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Notes.

Imperial Wireless.

It is a little difficult to say whether the report of the Imperial Wireless Telegraphy Committee is the more interesting from the technical or the commercial point of view. Its detailed criticism of the various possible methods of generating electromagnetic waves is well worth serious study, having in mind the scientific attainments of those who formed the Committee; but, at the same time, it is doubtful whether the somewhat didactic conclusions reached can, or will, be accepted without discussion. The Committee label themselves out-and-out champions of the valve system, though in passing they admit that the arc system is well established and proved for long range working. They point out, however, that arcs of greater power than 250 kw. still present elements of uncertainty, and that this power will be required if stations with a range of 4,000 miles are to be established. On the other hand, the thermionic valve, with all its undoubted advantages of reliability, cheapness and efficiency, has a present extreme range of somewhere about 2,000 miles. It is therefore argued that it would be preferable to reduce the length of the link in the Imperial Wireless Chain to that distance, so that the valve system may be used. In this way money will be saved and reliability gained. Perhaps, with our present knowledge of the present available systems, no other conclusion could have been arrived at; but we wish it did not look so much like a piece of special pleading. For it may well be argued that the advantages of the arc system also become correspondingly greater at shorter range, and it is interesting to note that the arc is to be used between Oxford and Cairo, on the first link of the chain.

A Praiseworthy Policy.

Nevertheless, there is a good deal to be said for first finding out what the apparatus available will do and fixing the position of the stations accordingly, rather than to draw lines on the map and make theoretical calculations of the power required to transmit the signals. The resulting diagram is doubtless, as the Committee point out, "gratifying and impressive"; but that is about all that can be said for it. To reduce the distance between the stations has the further advantage that it is accompanied by an enormous reduction in transmitting power, a great increase in speed, and a reduction of height of the transmitting aerial. The possibility of this country being obliged to use long wave lengths is a further argument in favour of this arrangement. The capital cost of the scheme suggested by the Committee would be £1,243,000, with an estimated revenue of £325,000, and though there would be a loss at first, it is considered that within 10 years the scheme would be a paying concern. Compared with the benefits accruing, this is a moderate sum in these days of grandiose expenditure.

Another Commission.

The procedure to be adopted for carrying out this work is not without interest. Of course it involves the creation of another Commission. This Commission would design the stations, the work of the erection being carried out by the Post Office and the corresponding overseas authorities, while the greater part of the equipment would be obtained from commercial concerns. When the work of erection is finished, the Commission would, presumably, disappear. In any scheme of this magnitude it is difficult to see how the creation of a virtual monopoly can be wholly avoided. But the proposals made by the Committee, considered from this point of view, strike us more favourably than those put forward by the Marconi Company. These we found necessary to condemn, and we are not surprised that our views are held by the Committee, who are of the opinion that, if fully carried out, that scheme would be prejudicial to the interests of free wireless research and independent development. This danger, however, also lurks in the Committee's own scheme, and we hope that every precaution will therefore be taken that progress on the technical side is not retarded in the slightest degree, for progress is essential to the well-being of wireless science.

The Future of Turbo-Alternator Design.

Some of the subjects dealt with in the articles which we publish in this week's Electrician are complementary to those discussed at the I.M.E.A. Convention last week. Others are supplementary. In the latter class may be placed the article by Mr. J. Shepherd on "Present Tendencies in Turbo-Alternator Design." This raises several points to which it is desirable close attention should be given if that most necessary increase in the efficiency of the methods employed in converting the energy in coal into electricity is to be achieved. In the Papers read at the Convention we heard a good deal about improvements in methods of steam raising, about the precautions necessary on the network to ensure continuity of supply, and even how to sell electricity as satisfactorily as possible, but for some reason that most important link in the chain, the generating plant, was neglected on this occasion. We must be careful, however, not to deduce from this that finality has been reached in this branch of electrical development. Indeed, the problems which are now coming up for solution are as important in their bearing on the future of electricity supply as any others.

Stresses and the Insulation Difficulty.

One of the principal reasons for this is the increasing size of the generating units now being installed. This increase carries with it an increase in the value of the mechanical and electrical stresses which are set up and the necessity for so modifying the design as to provide for satisfactory working under the new conditions. As far as the purely mechanical parts of the turbo-alternator are concerned this is comparatively easy. But when the stresses in both rotor and stator windings are considered it is at once realised that there is a serious disadvantage in having to depend on such mechanically unsatisfactory materials as those which we are obliged to use for insulating purposes. As Mr. Shepherd shows, the duties imposed on this material in a modern machine are very onerous. Indeed, it is continually being forced to carry out work for which it is entirely unsuited. Mr. Shepherd's solution for this state of things is to make the best of a bad job, and to support the insulation in the most solid manner possible by using the continuous winding slot. This, however, is only a compromise; and we hope that matters will not be allowed to rest there. The time is eminently ripe for investigation and research into the nature of insulating materials. In this way we shall at worst increase our knowledge on an important subject, while at best some new material or combination of materials may be disclosed with properties which would ensure its efficient performance under the most modern conditions. Considering the even greater difficulties that have been overcome in electrical design we do not share Mr. Shepherd's pessimism that huge mechanical forces will continue to be transmitted through mechanically weak insulation.

Water versus Air Cooling.

Mr. Shepherd's ideas on the equally important subject of the cooling of turbo-alternators will undoubtedly receive the compliment of being considered heterodox in certain quarters. But it must not be forgotten that what is heterodoxy to-day is as often as not orthodoxy to-morrow. The heat thrown out by the generating plant must be removed in some way or other, and the physical properties of water indicate it as being a very suitable medium for the purpose. On the other hand, its employment gives rise to certain obvious difficulties when used in close connection with high tension electrical plant, and we are therefore not surprised to find that a good deal of doubt is being expressed as to the feasibility of so employing it. Here again there is a wide field for research and experiment, especially as we hope shortly to be able to show that the whole question of wet air cooling has recently been receiving exhaustive study, and that the results obtained indicate that it is hardly so inefficient for this purpose as Mr. Shepherd would like us to believe.

Electric Heating in the City of London.

The open fire is doomed. It may die a lingering but it will be a certain death, for on the score of convenience and efficiency it has little to recommend it. There remain those two great rivals the anthracite stove and the gas heater, which seem to have so much in their favour that some electrical engineers are doubtful whether there will be any room left for electric heating. An article by Mr. A. F. Harrison, which we publish on another page of this issue, will go far to reassure them. No doubt the City of London with its thousands of offices is an exceptionally favourable field for such an enterprise, but even then it will be admitted that a heating load of 15,400 kw. and a sale of seven million units are not by any means unsatisfactory figures, and this, as Mr. Harrison points out, is a very small proportion of what the load might, and doubtless will be.

Heating Load Problems.

But it is just on this subject of future possibilities that Mr. Harrison allows pessimism to seize him. He contends that the heating load has a poor individual load factor, and that regarded by itself it has little to commend it beyond the fact that it provides a daylight load. This argument, however true it may be in the City of London, can hardly be of general application. In the City even in the winter time the hours of usage of any heating apparatus are comparatively few. But this does not apply in a residential district, where the heating apparatus is likely to be used more freely both night and day, and in summer as in winter. The use of a heating apparatus that can be carried from room to room and switched on and off when required should be equally advantageous both to the consumer and to the supply undertaking. Apart from this, we cannot but agree with Mr. Harrison that the development of a heating load is going to bring special problems with it. Such a load will mean an increased provision of mains, and consequently an increased capital expenditure. The whole question, therefore, demands careful consideration in order that the consumer, while encouraged to employ electric heating, is not so encouraged at a loss to the supply undertaking. On the subject of tariffs Mr. Harrison makes the suggestion that a distinction in price should be made between current supplied for cooking and that supplied for heating in favour of the former. Theoretically the idea has something to recommend it, but it is unlikely to appeal to those who wish to see our tariffs reduced to the simplest possible form.

Exploding a Fallacy.

In an article which we publish on another page of this issue Mr. David Brownlie returns to the charge on the subject of national fuel economy. This is a question which we feel is second to none at the present time, but it is unfortunate that he should handicap himself by basing his arguments on the well-known "super-station" fallacy. He points out that certain experts consider that the 80,000,000 tons now used every year in this country for power generation only would be reduced to 25,000,000 tons by the employment of super-stations. He rightly points out that this would mean the scrapping of a large amount of plant and that the principle is entirely wrong. We agree. But then as nobody is going to do it it does not really much matter. We suppose some fine day the "super-station" legend will be laid, but it will be about the time that it will be economically sound to design and build such undertakings.

The Efficient Fuel Utilisation.

When he comes to a discussion of the obsolete methods which are now widely used for the generation of steam Mr. Brownlie is on firmer ground. His investigations show that the average net efficiency of our present boiler plant does not much exceed 60 per cent. This could be raised to 75 per cent., an increase which would result in the saving of some 20,000,000 tons of coal per annum. He resuscitates his old objection to mechanical stokers, suggests the more efficient use of low-pressure steam, and points out other directions, such as condensation and friction losses where further economies can be effected, while the low temperature distillation process also receives a word of praise. But the real solution lies, as he very rightly points out, not in the adoption of this or that revolutionary scheme for the alteration of our existing methods, but in a steady improvement of those methods along existing lines governed above all by a determination to depose waste from that very important and entirely unnecessary position which it at present holds in the balance-sheets of our industrial undertakings. This work, arduous as it certainly will be and distasteful as it may be, must be undertaken sooner or later if our prosperity as a nation is not to suffer. As Dr. **Ferranti** aptly said, " No saving is too trivial to take into account if power is to be made really cheaply."

Payment for Experience.

The amateur philosopher will find much that is curious in the present position of both salaries and wages. On the one hand, wage earners are being paid sums which rest upon no basis of individual skill, but are simply the result of collective bargaining. It follows that economically they are often too high. On the other hand, the salaried official, who up till recently has disdained to combine, is often being remunerated at a rate far below the figure which represents his real value. This is perhaps most evident in Government and municipal departments where the brain worker has less opportunity of controlling his gains than in commercial life. Economically both situations are all wrong. Morally also they are all wrong. But of the two the underpayment of the brain worker is likely to do the country more harm, though while politics can intrude into these matters in the way they do at present it is difficult to see how the situation is to be altered without a good deal of trouble.

Southampton and Wrexham.

We may point our argument by reference to three cases affecting the salaries of the chief engineers of municipal electricity undertakings. The resignation of Mr. **Harry Ellis** has left a vacancy at Southampton, applications for which are being advertised at a salary of £1,000 per annum. With the present high cost of living, and having in mind existing conditions at Southampton, this is not over generous, but compared with pre-war salaries it does at least show an enlightened tendency. But though it is not enough it is a very great improvement on our next example. The resignation of Mr. **Pickvance** has caused a vacancy at Wrexham. It is being advertised at £450 per annum. This is nothing less than scandalous. The authorities in that town must be equally careless of the efficiency of their undertaking, and ignorant of the true value of professional experience. For while Wrexham is not a large undertaking, neither is it likely to develop into one under its present guidance. It would be difficult to find a better case for boycott. But unfortunately there will always be men who will accept these posts to their own loss and to their employers' discredit.

A Case of Shabby Treatment.

We also notice that the Town Council of Ipswich has refused, contrary to the recommendation of the Electricity Committee, to increase the salary of Mr. **Frank Ayton** from £850 to £1,200 a year, and that the proposal to pay Mr. **Ayton** £1,000 a year was also rejected, thus forming another disgraceful example of the working of local politics. For there can be no question of deserts in this matter. Even the Town Council must recognise that under Mr. **Ayton**'s control the Ipswich electricity undertaking has prospered exceedingly, and is continuing to do so. Further by his work on the Electric Vehicle Committee he has acted as an unofficial Development Agent for the town by giving it a name for enterprise and modernity, of which it seems hardly deserving. With such cases before us it is hardly to be wondered at that the municipal service is becoming to be regarded with distrust, and that more and more of its abler officials are being drawn away into commercial life where at least a man's remuneration depends to some extent upon his own effort and less on the obscure mental operations of some town councillor or on political wirepulling.

The Problem of the Systems.

The old diversity of opinion on the best system to use for electrical distribution has once again become vocal. For instance, a contemporary thinks that " direct current, except for battery charging and other special duties, has had its day," while in the discussion on Mr. **Gillin**'s I.M.E.A. Paper, Major H. **Bell** pointed out that on the American Edison Companies systems the use of direct current is still growing though the area in which it is supplied is restricted to that contiguous to the generating station. During the course of the same discussion Mr. S. E. **Fedden** said he had not yet decided whether to use single-,two-or three-phase for his heating load, while a manufacturer inquired rather fearfully the other day our opinion of the future of single-phase, as it was necessary to make a decision between the two policies of stopping and continuing to manufacture single-phase motors. We suppose that if electricity supply were being started *de novo* with our present knowledge (if such a state of affairs can be imagined) there is no doubt that three-phase generation with a frequency of 25 would be adopted as being the system most easily applicable to all conditions of load. But we are not so sure that there would be anything like the same agreement when the system of distribution came to be considered. There is such a lot to be said on both sides, and so many people to say it. Each system has its advantages and each its disadvantages, and when a cast-up is made the balance in favour of one side or the other is small. Future conditions may, of course, operate to change this state of things, but for the present we think there is little fear that steps will be taken to make any wholesale alterations in methods at present employed.

Apathy and the Electric Vehicle.

It is deplorable that Mr. **Ayton** should have to state, as he does on another page of this issue, that the one great drawback of the development of the electric vehicle in this country is lack of charging facilities. It is just one of those cases of which we unfortunately come across so many examples, where the absence of vision on some essential point results in a retardation of progress which affects the general welfare. Now, this is not a case of holding back because the capital expenditure necessary does not seem to be justified, nor does it rest on any opposition to the electric vehicle or disbelief in its future. It is simply the result of a sort of dull apathy which makes it distasteful to leave the rut if only temporarily, and is manifest not only in great things, but in such relatively unimportant matters as a failure to answer letters. It is the more difficult to understand this frame of mind where the advantages derivable from such a load are considered. There is no necessity for mains extensions and, as Mr. **Ayton** points out, the necessary supply can usually be arranged to be given at " off-peak " times, so that it really results in an improvement of load factor with no corresponding disadvantages. Any real excuse for failing to take advantage of this load has now disappeared.

Loans for necessary buildings can be obtained, and we, therefore, hope that a determined effort will shortly be made to develop this class of business. To do so will not only be to the advantage of the electricity supply undertakings, but mean sweeter streets and a corresponding improvement in the health of the public.

The Hiring of Electrical Apparatus.

In the course of his Presidential Address to the Incorporated Municipal Electrical Association Mr. Thomas Roles called attention to a disability of municipally owned electricity undertakings which the Electricity (Supply) Act has not removed. For while the Act allows such undertakings to hire out apparatus it forbids an extension of these powers to "hire-purchase" or to sale outright. The lack of the first of these powers places these undertakings under a serious disadvantage. The consumer when he first adopts electrical apparatus for domestic use is naturally uncertian as to its suitability and expense. He therefore hires the apparatus instead of buying it outright, but as time goes on and he becomes convinced of its value on both scores he is faced with the difficulty that he must either go on paying the hiring charges or start again and buy his equipment. This places a very real obstacle in the way of development of domestic electrical apparatus. To remove this disability is essential. Some working arrangement with contractors would seem to be the right policy, and we hope that both sides will come together with this end in view.

British Water Power Resources.

There are two main reasons for our neglect to utilise the water-power resources of this country. One is based on the partial fallacy that these resources are so small and scattered that they are not worth developing in the way that similar resources have been developed in nearly every other country. The other is that our coal fields have until recently supplied us with fuel so cheap that it has not been found necessary to explore other methods of power generation. There are, in addition, the minor reasons that as water powers are usually found in out-of-way places there is necessarily a heavy initial outlay before they can be hydro-electrically developed.

An Economical Necessity.

Coal is, however, no longer cheap; and, though our native coal fields are not yet within a measurable distance of being worked out, supply lags behind demand. This among other reasons is likely to keep prices up and makes it an economical necessity to discover whether some, at least, of our water-power cannot be employed as an alternative method of power generation. Not unconnected with this question is the desirability of establishing factories in more pleasant surroundings than those afforded by our large towns, both for financial reasons and for the not less important fact that the health of the worker is thereby improved.

Proper Conservation and Systematic Use.

The second interim report of the Water-power Resources Committee, of which Sir John Snell is chairman, deals with both these questions, the one directly, the other by implication. As will be remembered, the original terms of the Committee were recently enlarged to include a consideration of what steps should be taken to ensure that the water resources of the country were properly conserved and fully and systematically used for all purposes.

An Important Regulation.

Perhaps, the most important portion of the present report is that which refutes the generally accepted view that there is comparatively little water power in England and Wales suitable for development. As the Committee points out, far from this being the case, surveys showing that the water-power resources of the Hampshire Avon, the Chester Dee, North Wales and Mid-Wales, Dartmoor and Exmoor and the rivers in the West Riding of Yorkshire represent a total catchment area of about 12,000 sq. miles, with possible water-power resources in each case averaging approximately 10 continuous horse-power per square mile of such catchment area. Most of these possible sources of power have so far been left untouched, partly for the reasons we have outlined above, and also, we are afraid, because vested interests, of whose existence the recent outcry against the Dartmoor scheme was an indication, have prevented any attempt at development, on grounds quite other than those of inherent merit.

State Assistance a Necessity.

As the Committee point out, it is unlikely that such sources of water-power will be developed unless some State assistance is available, and it is therefore recommended that either the Board of Trade or the Electricity Commissioners should be charged with the duties of studying, supervising and promoting these developments, and should have powers and the necessary funds given them for the purpose of starting enterprises in such areas.

In addition the Committee recommend that there should be established by Act of Parliament a controlling Water Commission with certain statutory powers and duties. These would include the compilation of the water resources and water requirements of the country, the allocation of these resources in the general interests of the country, the adjustment of conflicting interests, the assistance of Government Departments, local authorities and water supply undertakings in the uses and control of water, the grouping of the watersheds of the country into suitable areas and the establishment of watershed boards, the consideration of the development of rivers as a whole, and the initiation of legislation for such development, the improvement of the laws of water utilisation and the appointment of an advisory committee of representatives of water undertakings. This is a formidable list of duties not all of which are of equal importance or urgency, but all of which are necessary if our water power resources are to be properly developed.

A Statutory Body.

It is further recommended that an inter-departmental Water Committee should be set up by statute, which body should comprise a representative of each water interest, and act as a connecting link between the departments interested in the various aspects of the water problem. It is also recommended that the Ministry of Health and other Government departments concerned with water interests should make orders authorising schemes which should take effect without confirmation by Parliament in the absence of opposition.

It will therefore be seen that the Committee have gone very closely into the subject with the evident determination of formulating a procedure which shall ensure the development of our water resources in the best possible way. But with the best possible intentions they have, we consider, a little over-reached themselves, the machinery recommended for carrying out the work being on the face of it so cumbrous and complicated as to be likely to prevent rather than to assist the object in view. There are, in fact, three distinct authorities—one the Board of Trade or the Electricity Commissioners—to do the work of development, a Water Commission with statutory powers relating especially to the allocation of powers and the adjustment of anomalies, a task of great difficulty in itself, but also with powers of development which seem to duplicate those it is proposed to confer on the Electricity Commissioners or the Board of Trade. And as if this were not enough, an inter-Departmental Committee is to be set up to consider various aspects of the problem, and the Ministry of Health are also to be given further powers. No true development of water power will, we fear, be obtained along these lines. The only result will be the multiplication of officials, the creation of swollen dossiers so beloved in Government offices, the passing of innumerable inter-departmental minutes, and an almost entire lack of useful work. Though the simile is, perhaps, not entirely appropriate, the number of cooks will result not only in the spoiling, but in an absence of broth.

A Tactical Error.

And while we wish to see the water-power resources of this country utilised to their fullest extent for electrical purposes, we feel that the introduction of the Electricity Commissioners into the question in the way suggested would be a mistake. Water-power and water facilities are required for many other domestic and industrial purposes than the generation of electricity, and the claims of these interests must be duly considered. We have no liking for reactionary vested interests, but we feel that the only subject is one that must be considered by some independent judicial body, so that all sides may be treated fairly. We hope some means will be found to bring about this simplification, so that the preliminary work connected with this development may be started at once and go forward without delay.

Modern Electrical Politics.

The main subject matter of the Presidential Address delivered by Mr. Thomas Roles before the Incorporated Municipal Electrical Association last week is highly controversial. It deals with the attitude which municipal electricity undertakings should take towards the Electricity (Supply) Bill now before Parliament, and for that reason is not likely to receive general acceptance. At the same time it lays down a policy with which we are in entire agreement, and which, as we have pointed out from time to time in The Electrician, is the only one which can safely be followed if there is to be that development of electricity supply which is necessary not only for the future good of the electrical industry, but for the future prosperity of the country.

The Demise of Parochialism.

For parochialism in electricity supply is dying. Nothing that is being done or that can be done will prevent that. Yet this salient fact is by no means universally recognised, for, as Mr. Roles points out, the new Bill is being viewed with indifference and even opposition by some municipalities. He does not add the reason which lies, we think, in that reluctance, so innate in every Englishman, to look upon his neighbour other than as his potential enemy, and to consider individualism a greater virtue than combination. There may be cases where this is so, but electricity supply conducted on modern lines is not one of them. These combination is essential, and no time or means must be lost to bring that fact home to all concerned.

The Form of the Opposition.

The opposition to the new Bill, which, of course, comprises the controversial clauses dropped from the present Act at the last minute in deference to certain interests, centres round two points. First, the setting up of District Electricity Boards with powers for the compulsory acquirement of existing generating stations and transmission lines, and, secondly, the so-called financial clauses which empower the Electricity Commissioners and unauthorised undertakers to give monetary assistance to Joint Electricity Authorities and District Electricity Boards. The financial opposition has been strengthened by the "super-station" fallacy, by a growing dislike of anything savouring of nationalisation, and by a fear that the market will be "flooded" with numerous wild-cat schemes. The first of these objections has lost all the real force it ever had, and is now chiefly employed for political purposes. The nationalisation bogey can similarly be laid if the present electricity undertakers themselves will form Joint Electricity Authorities and set to work to finance their own schemes without Government assistance. The only other way to obtain the increased electricity supply we require is, as Mr. Roles points out, to hand the task over to private enterprise, which, it may be added, is in many districts quite willing to do the work. Such a policy would, in our opinion, be a retrograde step for the reason that it removes from control a commodity the development of whose use is essential for the public welfare. Such public control will tame any "wild cat" proposal that is likely to be put forward.

The Benefits of Combination.

Combination in electricity supply would mean generation on a larger and more efficient scale, and consequently cheaper and more reliable supplies. This can best be brought about by the linking-up of existing generating stations, by the extension of those most suitable for that purpose, and, finally, by the erection of one or more large stations for the supply of a district rather than of a town. This policy can only lead to a greater gain of efficiency, but to carry it out there must be a broad outlook and a desire to sink local differences for the general good. It has been objected that municipalities cannot carry out this work as well as private enterprise. But it is not a case of one or the other, but of the two in partnership and if the right spirit exists, as we feel sure it generally does, this interesting experiment in new methods cannot but be otherwise than successful.

The second of the two causes of opposition is easier to understand and more difficult to remedy. It rests, as we have already said, on the Englishman's irradicable individuality. And is it just for this reason that the argument that compulsory powers are unnecessary will not hold water. The existence of compulsory powers does not mean that they will be used except in case of real need. But we feel all the same that they are necessary in order that schemes for combination in a particular area may not be indefinitely atrophied by the opposition of one small undertaking. This attitude of reaction is, we are glad to think, rare, but it is no good blinding ourselves to the fact that it does exist.

The Work of the I.M.E.A.

The attitude of the Incorporated Municipal Electrical Association to these matters is one of great importance to the electrical industry. At present municipal interests have a direct and predominating influence over the supply of electricity in many parts of the country, and for the very reason it is desirable in every way that it should be generally known what they individually feel with regard to the questions involved both in the application of the present Electricity (Supply) Act and of the new Bill. Mr. Roles tells us that the Bradford City Council have confirmed a resolution of the Electricity Committee laying down that the control of the generation and transmission of electricity should be placed in the hands of duly elected public representatives of the district in which the electricity generated and transmitted is to be used, and recommending that the necessary financial assistance should be given. This example should be quickly followed by those who desire to support the new electricity policy while those who oppose it should equally come out into the open, so that we may know how we stand. Though we do not presume to dictate what attitude they should take, there can be, we feel, no doubt that all progressive undertakings will see that in combination lies the only true solution of the problem.

Present Tendencies in Turbo-Alternator Design.

By J. SHEPHERD.

THE initial difficulties of the electrical and magnetic characteristics of turbo-alternator design have been successfully overcome but, as the sizes of single units and the systems to which they are connected increase in size, other difficulties are encountered, resulting from the magnitude of the mechanical forces set up.

The normal working forces on the stator bars resulting from the driving torque and the centrifugal forces on the rotor insulation are capable of close calculation, and by skilful design the stresses can be confined to desired limits. The highly impulsive stresses thrown upon the stator bars during short circuits are not capable of close calculation, but, as the result of experience, rough empirical figures of the mechanical stresses likely to be encountered have been arrived at, which much exceed the stresses of normal working.

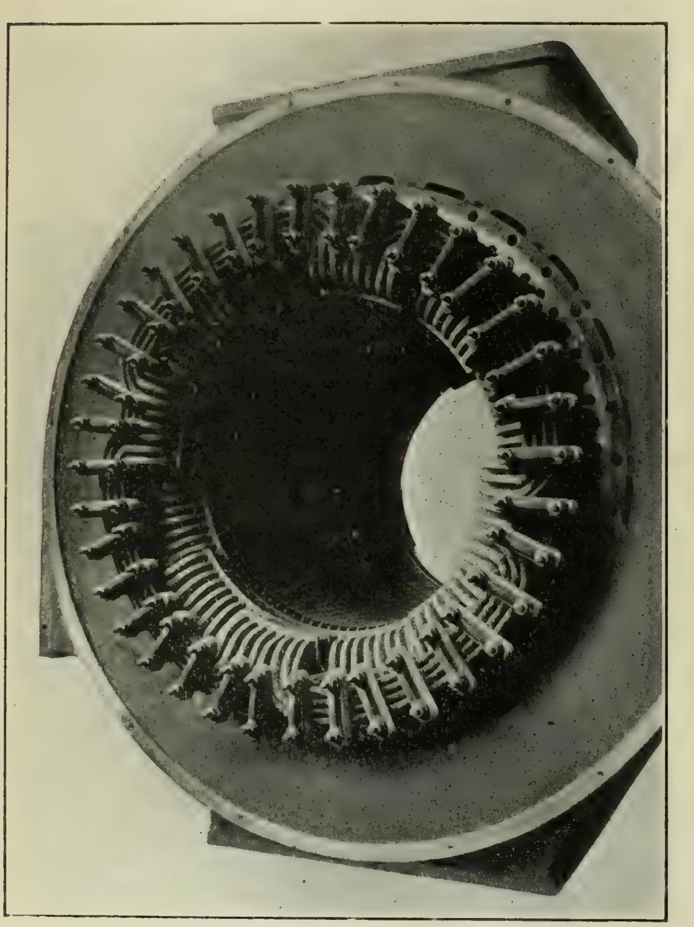

FIG. 1.—STANDARD ENGLISH STATOR CONSTRUCTION.

The weaknesses of turbo alternators disclosed during working conditions have generally been recognised, and, so far as possible with present designs, have been rectified by continuous elimination of weak mechanical features.

PRESENT STATOR CONSTRUCTION.

Stator construction has generally settled down to the two designs shown on Figs. 1 and 2. Fig. 1 illustrates the construction adopted by several English manufacturers, and consists of straight laminated stator bars with separate jointed end connections. The ends of the stator bars are supported by segments of hard fibre provided with slots forming continuations of the stator winding slots.

The design shown in Fig. 2 is that generally adopted by American, Continental and several English manufacturers, the laminated stator bar is continuous and bent to form the end connections, the joints being at the ends between the upper and lower layers of bars.

ROTOR DESIGN.

The rotor design has definitely settled down to the standard cylindrical pattern with radial slots, of which Fig. 3 is an example.

The electrical efficiencies of turbo alternators have reached a high figure, usually over 95 per cent. for machines exceeding 10,000 kw., and any improvement in the efficiency cannot be considerable. Some saving may be made in the direction of cooling, as the present high-speed blowers are inefficient.

SOME PRESENT-DAY REQUIREMENTS.

Certainly turbine plant, when running normally, gives a minimum of trouble and requires a minimum of attention. It may therefore be considered that present designs have reached the practical limit of perfection, but for the requirements of more robust construction and reliability. Engineers in charge of large electrical systems are desirous of purchasing machines which

(1) Shall not break down under all working conditions including shorts and surges ;
(2) Shall have a life exceeding the accepted maximum of 10-15 years ;
(3) Shall be independent of air-cooling difficulties and be fire-proof.

The first two requirements are, of course, closely correlated, as in the absence of breakdowns longer physical life should not be difficult to attain.

THE MECHANICAL DRAWBACKS OF INSULATION.

Whilst continual eliminations of weak mechanical features of both stator and rotor have been made, the electrical designer is always at a serious disadvantage through having to deal with so mechanically unsatisfactory a material as insulation.

On low-pressure machines fibrous insulation has been used for over 30 years, and machines nearly 30 years of age are still in use in certain cases where the working temperatures have been limited.

With the more recent mica insulation, cases are on record where medium pressure plant has been successfully used on the same machines for over 20 years with load factors of 40 per cent. and working at temperatures exceeding 300°F.

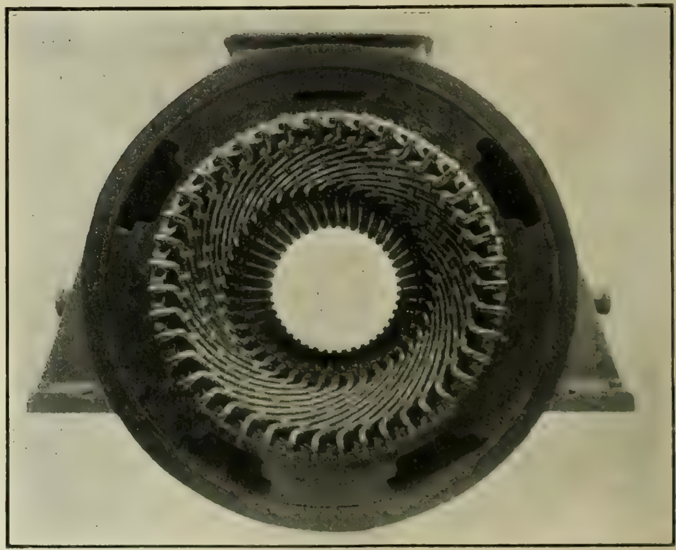

FIG. 2.—END VIEW OF STATOR OF HUDDERSFIELD CORPORATION TURBO-ALTERNATOR SHOWING LATEST AND STANDARD TYPE OF BASKET WINDING. 7,500 K.V.A. (6,000 kw. at 0·8 p.f.) three-phase 3,000 R.P.M. 6,600 volt, 50 cycle.

The one fundamental difference between the working conditions of these older machines and those of the more recent turbo generators is the absence of high mechanical stresses in the older machines and the mechanical overstressing of insulation in turbo generators, due especially to bending stresses. Whilst the mechanical study of insulation has not received much attention the effect of prolonged heating has been carefully studied both in this country and in America. The considered opinion of two of the most experienced American electrical engineers, Messrs. Steinmetz and Lamme on the effect of temperature and life is given by the curves in Fig. 4. They confine their review to a life of 10 years, but in the figure the curves have been exterpolated to a hypothetical life of 20 years. The curves must be considered only as indicating general results, as other factors are involved. At ordinary working temperatures insulation soon dries out and becomes brittle, and, when in this condition, impulsive stresses on a stator bar, inadequately supported, will bend a weak laminated bar and crack the insulation surrounding it. On a low-pressure system the insulation might still hold up until dirt, surface leakage or a transient high-pressure surge caused a breakdown to earth, and the life of the insulation has then terminated. Apart from mechanical stresses cracking the insulation, the temperatures and lives given on the curves may be considered quite conservative.

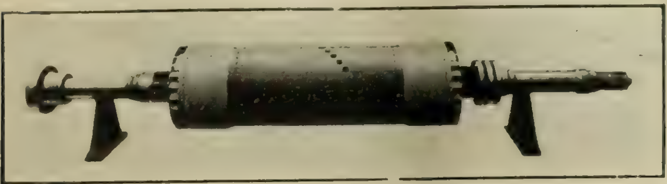

Fig. 3.—Latest Type Turbo-Alternator Rotor (Leg a12) for use with Stator (Leg a13).

Under compressive strains mica insulation has a very high resisting value and on rotor bars is frequently stressed to about 2 tons per square inch, the limiting factor in such cases may well be the resistance of the copper to the crushing stresses.

What Stator Insulation Has To Do.

The duties thrown upon the insulation around a laminated stator bar are very onerous, viz. :—

(1) To hold in position the component conductors of the laminated bar;
(2) To transmit the driving torque from the turbine;
(3) To withstand the impulsive bending stresses on short-circuit;
(4) To insulate the live conductors from working and transient electrical pressures;
(5) To transmit the heat from the copper to the cooling medium.

If solid stator bars were practicable the surrounding insulation would be relieved of the bending stresses on short circuit, the usual cause of failure. The obvious remedy of using more insulation is not practicable on account of the difficulty of free transmission of heat from the copper through the insulation.

The method universally adopted is to provide supports to the insulated bar, in the form of clamps and packing. If such supports were continuous, as in the form of a tight-fitting slot, the bar would be freed from bending stresses and all mechanical stresses would be imposed as compression against which the mica insulation is as strong as the copper. Under such conditions cracking of the insulation is improbable, and, if the insulation be not over-heated or punctured by electrical discharges, its life should certainly be as long as the examples cited, viz., 20 years and upwards. The continuous winding slot for conductors and their end connections has not been adopted with turbo generators as with air cooling the proposal is impracticable.

Limitation of Short Circuit Stresses.

The remedy has been sought in the other direction, viz., the limitation of the short circuit stresses by the insertion of high reactance in the machine circuits. In large systems of the future this remedy will probably be used very extensively in the form of external reactance coils between sections of 'bus-bars and on feeder sections, and of internal reactance on the alternators.

When all possible provision in the way of reactance has been made it must be remembered that electrical power units of the future will probably exceed 100,000 k.w., which means that driving torque of upwards of 50,000 H.P. must be transmitted by insulation alone. Whilst the resulting mechanical stresses will be considerable they will be quite dwarfed by the short circuit stresses when the combined uncontrolled power of a large station would be instantaneously thrown upon the stator insulation of the defective machine.

As we cannot dispense with insulation and know of nothing stronger than that now used, what is clearly desirable is to support it in the most solid manner possible, viz., by the continuous winding slot. When that has been done, finality has been reached, as the insulation in compression is as strong as the copper it surrounds.

The Dissipation of Heat.

Consequent upon the high speed of modern machines and their compact design are two important results from the operator's point of view. The amount of heat to dissipate per cubic inch of material is considerable and the proportion of inflammable insulation built into the machine much exceeds that used in the older slow-speed plant.

As the heat on air-cooled machines must be dissipated by air, a medium of light weight and low specific heat, the amount required is considerable, viz., about 100 cubic ft. per minute for every kilowatt of internal loss, for a unit of 20,000 kw., the amount of cooling air is about 90,000 cubic ft. per minute, requiring an air duct about 60 sq. ft. cross sectional area.

The collection and cleaning of such large quantities of air is troublesome and its correct distribution throughout the air ducts of the machine is not under the control of the user. Without cleaning or filtering the air, the air passages of machines would become choked and serious over-heating would occur. The hurricane blast of air inside the machine adds considerably to the fire risk, as a fire once started inside the windings is immediately swept throughout the machine.

Fire-Proof Insulation.

These risks are well known and many remedies have been proposed. The most obvious is that of using a fire-proof insulation. Whilst both mica and asbestos are non-inflammable, they cannot be used in the raw state and must be incorporated with compound or varnish, and, at present, no suitable non-inflammable insulation is known. The next solution is to limit the air supply either continuously, by using a closed air water-cooled circulating system, or, on the outbreak of fire, by electrically operated air dampers. Neither proposal has made much headway, but is evidence of the fire risk of modern machines.

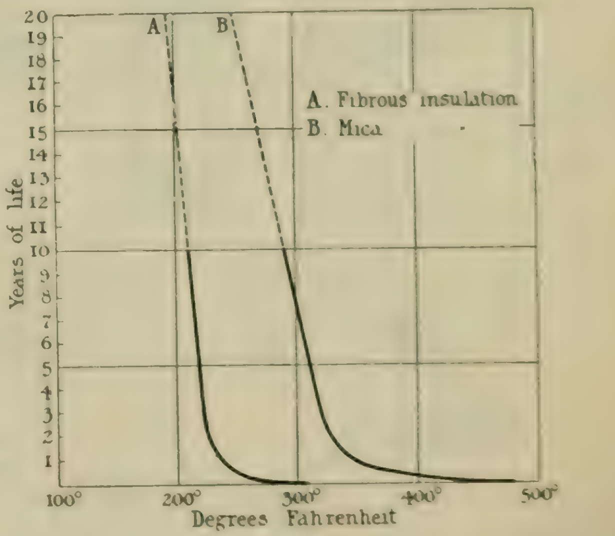

Fig. 4.

Water Cooling.

The proposal which holds favour at the moment is the closed air circulating system. The hot air discharged from the machine is passed through a water cooler on the condenser principle, the inside of the tubes having a supply of cold water for cooling the air. The proposal to cool by water is, of course, a very natural one, as the cooling capacity of water is so superior to air, its density being 800 times and its specific heat four times greater, the exact figures being—

$$\frac{\text{cooling capacity 1 cubic ft. water}}{\text{cooling capacity 1 cubic ft. air}} = 3{,}420.$$

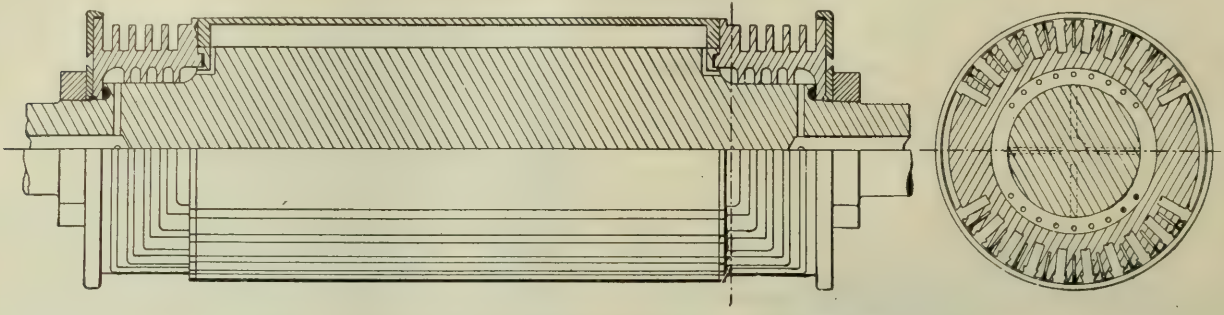

Fig. 5.—Water-cooled Rotor with Supports to End Winding Loops.

The application of water cooling to rotors has been put to practical use by Messrs. C. A. Parsons & Company (British Patent 16,986, 1914) and at the Carville extension all five machines of 10,000 kw. have water-cooled rotors. As an interesting coincidence, a similar patent application was lodged by Messrs. Siemens Brothers Dynamo Works, Ltd., for another water-cooled rotor on the same day, 17/7/14, as Messrs. Parsons. but does not appear to have been applied in practice. The application of external air coolers by water has been proposed by many designers, more particularly for enclosed air-tight motors.

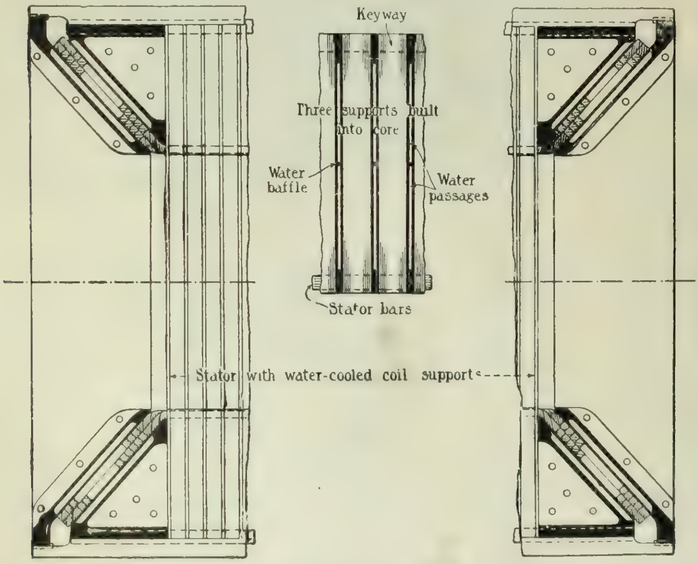
Keyway
Three supports built into core
Water baffle
Water passages
Stator bars
Stator with water-cooled coil supports

Fig. 6.—Stator with Continuous Supports to Windings and Core Teeth.

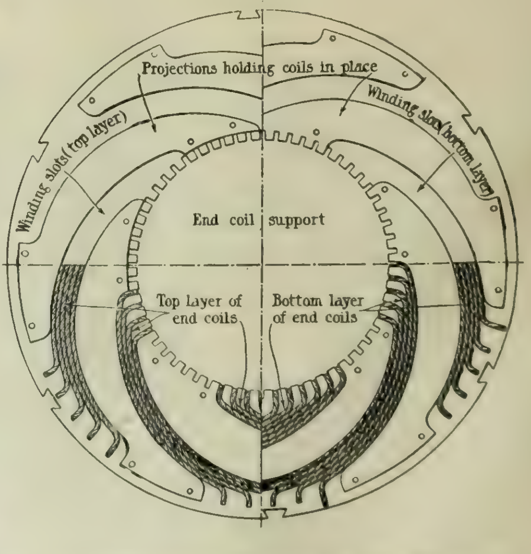
Projections holding coils in place
Winding slots (top layer)
Winding slots (bottom layer)
End coil support
Top layer of end coils
Bottom layer of end coils

Fig. 7.—Water-cooled Supports to End Windings.

It is generally considered by most turbo-alternator designers that the large machines of the future will, of necessity, be water-cooled. It, therefore, becomes of considerable interest to consider in what form the application of water cooling shall be made and whether it is not possible in its adoption to eliminate the weak features which exist in air-cooled machines.

The Continuous Winding Slot.

The most essential improvement is the development of the continuous winding slot to relieve the insulation of all bending stresses. The next essential feature is to abstract the internal heat in the most efficient manner possible.

Finally, the enclosing of the conductors with their insulation by the water coolers would practically render the machines fire-proof.

There are other subsidiary features, such as more solid stator cores, increased support to stator teeth and side support of rotor end winding loops, which should also be considered for amelioration.

It would appear logical that, whilst a change of method of cooling is proposed, advantage should be taken of all improvements possible in the machine itself. To apply water cooling by the use of external water coolers to machines of present construction is but the first step towards perfection. Whether the cooling water be applied to external water coolers or to coolers built directly in the machine, makes but little difference to the risk of water leakage. If external water coolers be used, the number of water joints at the tube plates must be very considerably increased and packed or expanded tube joints cannot be so sound as welded joints. Any water leakage outside the machine would at once be swept inside the windings by the blast of cooling air, whether the water cooler be close to the alternator or as remote as the station building would allow.

The application of water coolers inside the machine and in the form of coil and core supports is indicated in Figs. 5 to 8.

The idea common to all the devices is the continuation of the winding slots in which all the coils are tightly clamped and the close proximity of the cooling medium to the material to be cooled. Whilst the support of the coils and the effective cooling of both copper and core will, no doubt, be granted, the devices offer certain objections, viz. :—

(1) Risk of water leakage ;

(2) Increased surface of earthed metal in close proximity to the high tension windings ;

(3) Difficulty of wrapping micanite insulation on the curved end stator windings.

These objections are quite valid and will be considered in detail.

In the case of rotor cooling the water pressures encountered are those resulting from centrifugal stresses.

The Joint and Leakage Problems.

Messrs. Parsons have found no difficulty with expanded tube joints when subjected to these pressures ; fusion welded joints would reasonably appear to be more reliable still. The joints between the end coil supports and the rotor core could be made with heavy spigots and substantial packing, methods used in hydraulic practice for pressures of 3,000 lb. per square inch and upwards. The leakage problem, at first sight, might appear to be more serious in the construction of the stator cooling devices. The water pressures to be resisted, however, are more moderate, probably less than 100 lb. per square inch, and against such pressures reliable fusion welded joints are of easy construction. The best construction would be seamless joints throughout, this ideal can be closely approached by two methods. Arc welding is practically the deposition of volatilised metal on the weld and virtually is the growth of seamless metal.

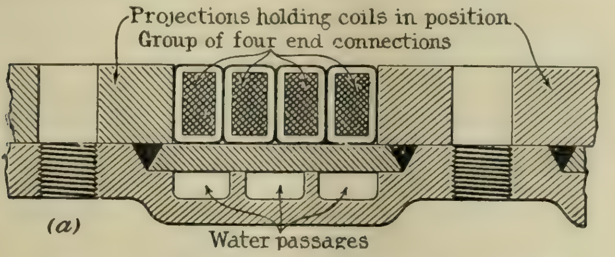
Projections holding coils in position
Group of four end connections
(a)
Water passages

Fig. 8.—Slot for Four End Winding Conductors.

A second method is that of electro-deposition of metal from an electrolyte in rapid motion. This method is one now in commercial use for the construction of seamless vessels. A combination of the two methods could be adopted to give joints as reliable as a solid rotor core. At present most generating stations contain fusion welding on either high pressure steam pipes or boilers subjected to more severe conditions than those proposed, and generally no trouble is encountered with them.

With the steady increase of steam pressures and superheats this class of steam joint will increase as soft packed joints between the various lengths of piping will be impracticable, welded and caulked joints must be substituted whether they are liked, or not. If welded joints are found practicable for these severe conditions their use for the internal alternator coolers should give rise to no misgivings. The additional precaution of a substantial seal of sound electro-deposited metal would render the joints thoroughly reliable.

Certainly a more substantial and more mechanical construction would be possible than that of any form of external air cooler now manufactured with expanded or packed tube joints.

The Haefley Wrap.

The most reliable form of stator-bar insulation at present known is the Haefley Wrap, built up of mica, paper wrapping and a binding gum. By tight mechanical wrapping whilst hot the whole mass is worked up into practically a seamless homogeneous mass. This insulation can be best worked upon straight solid conductors, it is also applied to straight laminated bars provided the component conductors can be firmly held together during the wrapping. The insulation can be further combined with a metallic wrapping beneath the external insulating layers with the object of the equalisation of electrical stress throughout the insulation and the better conduction of heat. Insulation of this character is hard and impervious with the elimination of air cells and is a very superior heat conductor. It is very strong under compression but very brittle under bending stresses ; for a continuous winding slot it is the ideal insulation.

Some Working Details.

By a modification of the wrapping tools with narrow steam-heated rollers and by applying the insulation in narrow strips, a continuous wrap can be worked on the straight bar and the continuing curved end connectors. The end joints between the two layers of conductors must be hand-insulated and, if desired, supplementary micanite insulation can be applied clamped on the conical faces of the coil supports, upon which insulation the insulated joints may lie. The conductors can be finally wedged in position when hot and pliable by passing steam through the cooling elements during winding. Whilst in this condition the whole-end turns could be impregnated with suitable compound giving a seal impervious to damp and dust and preventing surface creeping.

The Effect of Vibration on Life.

When consideration is given to long life of turbo-alternators the effect of vibration must be reckoned with. Generally its effects on the alternator are masked by other influences, but certain failures can be directly traced to vibration. If analogies are sought in other examples of engineering that of steel pulleys is a striking one. When such pulleys are fixed on shafting wholly rope- or belt-driven a life of 40 years and upwards is commonly experienced. If the shafting be driven by toothed gearing vibration is set up causing the steel rims of the pulleys to break away from the heads of the wrought-iron spokes rivetted into them, even when the pulleys are remote from the gearing causing the disturbance.

The life of the pulleys is then found to be reduced from 40 years to 20 years and even to 10 years with gearing having defective teeth ; this reduction of life has been clearly traced to vibration, other factors being eliminated. When dealing with alternators the alternating forces are generally of the same periodicity as the current, but the mutual attractions and repulsions of conductors of the same and different phases have a periodicity of double the frequency.

The failures on alternators which can be definitely traced to vibrating forces are the breaking of core teeth and of the spacing fingers maintaining the core air spaces. More recently another type of vibrating trouble has been found with large stator bars having laminated conductors. Owing to the spring of the separate conductors, the micanite wrap was not as tight as desirable, and the mutual current attraction between the conductors and their natural elastic spring set up destructive vibration within the wrap, which after a few months working gradually ground the mica to powder and cut through the wrap.

The rough analogue of the steel pulley is a forcible illustration of the destructive character of vibrating forces. The obvious remedy is that of more solid cores and better clamping of the conductors in place when the insulation is hot and pliable and thorough impregnation with heavy compound filling up all spaces between the conductors and between the completed bar and its insulation.

Troubles Increase with Size of Undertaking.

The troubles described have usually been experienced with electrical systems of some magnitude. An alternator working alone on an isolated system may give no trouble throughout its naturally short life ; the same machine when a unit of a large system may be subjected to the shocks of the entire station and fail the first time a short occurs. Generally the troubles described have been experienced with many different types of plant from 3,000 kw. to 12,000 kw. connected to systems of 30,000 kw. to 50,000 kw.

The size of the undertaking is the measure of the destructive forces to be resisted when the power gets out of control ; the mechanical stresses set up increase as the square of the current.

The scale of the undertakings in the past has begun to make us realise that a quiescent conductor when passing a heavy current possesses peculiar mechanical properties. The future electrical systems of this country will be measured by single units of 40,000 kw. to 50,000 kw., and power stations of 250,000 kw. and upwards. When a short in or near such stations occurs the destructive energy set up will be appalling, and machines constructed on present lines cannot be expected to meet such buffeting with impunity; their scale of design has been that of the present 30,000 kw. to 60,000 kw. period.

The internal heat to be dissipated from such machines will be of such a character that air cooling will prove quite inadequate, whilst the frequent air spaces which would be necessary would give a comparatively weak vibrating structure against vibratory forces of considerable magnitude. *With every improvement possible we come down to the bed-rock fact that the huge mechanical forces to be handled in future developments must be transmitted through mechanically weak insulation, in effect the weak insulated stator bars are the driving members of the alternator quite as much so as the coupling bolts.* However the problem of the construction of large machines of the future is examined one is driven to the inevitable conclusion of the continuous winding slot combined with water cooling.

Once the end in view is realised the initial difficulties of construction will be easily overcome; they are insignificant compared with those successfully surmounted during the past 10 years of electrical progress.

Recent Tendencies in Cable Manufacture.

By H. SAVAGE.

THE importance of the electrical transmission of power is evidenced by the enormous growth of electric supply undertakings, the widening of the areas of distribution, and the elimination of self-contained or isolated power plants.

The utilisation of natural forces, such as waterfalls, or the desirability of placing generating plant near a coal supply with a view to economy, necessitates some reliable means of conveying or transmitting power to the distant point of distribution or consumption.

A further demand for such means of transmission is called for by the interchange of supply among various generating or distributing stations by a process of linking them up. Present practice in electrical power distribution has been arrived at by a process of evolution beginning with the use of conductors for telegraphy.

Aerial Construction.

The simplest form of conductor is, undoubtedly, the bare wire supported in the air upon suitable non-conductors, and this form is one of the earliest adopted, its use in telegraph construction being common in all countries.

Aerial construction for power work has been generally adopted in America and the Colonies, and is common on the European Continent, but is exceptional in this country. It is interesting to note that while there has been recently a gradual increase in aerial conductors here, mainly in open country, in America it has been found necessary to resort to underground cables to a considerable extent in the neighbourhood of towns and cities.

Relative Merits and Demerits.

The two distinct methods are therefore gradually converging into a combination, and transmission engineers instead of being divided into two opposite camps, underground versus overhead, are recognising the relative merits and demerits of each system, according to the circumstances of each case with regard generally to electrical and financial considerations, but more especially to the nature of the route through which the transmission line must pass.

U.S. Tendency Towards use of Cables.

The Journal of the British Institution of Electrical Engineers and articles in the Technical Press show that lately more attention is being directed to aerial lines in Great Britain. It was formerly customary to turn to the American Press and the transactions of the American Institute of Electrical Engineers for information with regard to overhead work. The latter contained many excellent papers and discussions on both experimental and well-established practice, based on unique experience, but articles on underground cable work were conspicuous by their absence. During the last few years however, under pressure of the necessity of resorting to cables, considerable attention has been directed to underground work, and papers on the subject have appeared in the Journal. A perusal of these clearly shows that our American friends have experienced difficulties and encountered problems, which have been already met and largely overcome by British cable engineers at a much earlier stage.

It is, however, only fair to state that the problems have been attacked with characteristic American energy, aided by the resources which modern scientific knowledge and apparatus supply, and the stage between experiment and sound practice, at least in high pressure cable work, is probably a shorter one than in Europe where cables were gradually evolved from low to high pressure, and being used at an early date, scientific methods and apparatus for controlling manufacture and use were not so highly developed.

While claiming that British cable engineers or manufacturers have little, if anything, to learn from the "other side" it behoves the former to maintain that lead which circumstances of time have given them in the maintenance of a sound transmission system, and the latter, by a combination of experience with modern scientific research, to retain their high place in the world's markets.

Cables Require Most Attention in this Country.

While, as pointed out above, there is a tendency to conformity of practice in both continents, yet at the same time, owing to differences in geographical conditions and density of population, aerial lines are almost certain to preponderate in America, and underground cables in Great Britain. The ratio of the cost of underground cables to the total cost of a power system will, on the average, be greater in this country, and cables therefore merit a fuller measure of attention.

Aerial conductors have the great advantage of rapid construction, and what is more important, low cost. There are, however, many disadvantages connected with their use. Being exposed to the weather they are liable to damage, causing interruptions in supply and constituting a danger to the public.

Combination of Advantages.

With a view to combining the advantage of the aerial system with the safety of the underground many attempts have been made to use uncovered conductors under the surface. Copper strip supported on insulators in ducts or trenches have been extensively tried, but, with one or two isolated exceptions, have been abandoned

Persistent attempts have been made by inventors to produce a system of underground conductors as an alternative to continuously insulated and protected cables. In one, the conductors, plain or lightly insulated to prevent contact, were supported on solid insulators in cast iron troughs which were filled with oil. In another, plain conductors were simply embedded in bituminous compound in troughs. Although possessing theoretical advantages neither system has survived the tests of practical use and time. These facts illustrate our dependence upon, and emphasises the importance of, cables as a feature in the electric transmission of power.

The earliest type of cable was a conductor covered with some form of semi-flexible dielectric with, as in telegraphy, the earth as a return conductor. The use of a second cable for the return, the placing of two conductors in one sheath, and the provision of cables with three conductors for the three-wire system naturally followed, while the coming of two-phase and three-phase systems produced a variety of cables to meet the peculiar demands.

A Committee of the Cable Makers' Association in 1899 crystallised the somewhat varying practice of different makers by fixing standards for sections of copper conductors, thicknesses of dielectric, sheathings and armourings, and recognising vulcanised rubber, impregnated jute and paper as dielectrics, lead as a sheathing, and strips or tapes of steel, or a ring cf round steel wires, as armourings for power cables.

A review of the subsequent twenty years' practice shows how good a foundation was then laid, and enables a forecast to be made of future developments.

DIMENSIONS STANDARDISED.

The dimensions have been adopted, subject to slight modifications, by the British Engineering Standards' Association, and incorporated in numerous specifications, and no appreciable departure is likely to be made unless British engineers are prepared to accept a lower factor of safety, or margin of test pressure, than they have hitherto required, although Continental practice permits of a lower factor with consequently smaller and cheaper cables.

Copper is still without a serious rival as a conductor. Impregnated jute has practically dropped out as a dielectric, except for a few low-pressure cables. Vulcanised rubber has a considerable field for light and medium cables, and for service work, but only to a limited extent for high-pressure work, and there is a distinct tendency to eliminate it as far as possible for the higher pressures; a policy which cannot be condemned.

IMPREGNATED PAPER *v.* VULCANISED BITUMEN.

Impregnated paper has proved its value, being used, to an enormous extent, for all pressures and conditions, and it is the only really reliable and satisfactory dielectric for extra high pressures. There is no indication of its being supplanted, at least until the ideal dielectric for which the industry has been searching for years is discovered. The only serious competitor is vulcanised bitumen, which, being a speciality at the time of the C.M.A. Committee, referred to above, has emerged into an article of general manufacture and use. Its rise is mainly due to the extension of electricity in the mining industry. Being neutral to the peculiar moist conditions in mines, independent of a heavy sheath, semi-flexible, and not requiring the skilled care of a hydroscopic-dielectric, it found acceptance among colliery managers when electrical work was only a side issue. Further, owing to the changing conditions of the mines, seams are worked out and abandoned, and the permanence of a public transmission is not anticipated. Although also adopted for public services it has not yet been honoured by "standardisation" although that may shortly become desirable, if not imperative.

PAPER INSULATED CABLES IN MINES.

In the early days of electricity in mines, certain manufacturers urged the adoption of paper and lead cables without effect, but with the raising of the standard of construction and maintenance of colliery installations, consequent upon the operation of the Home Office Regulations, there is a tendency to put in the best obtainable, and it is probable that in the near future, above ground, shaft and main distribution cables will be paper insulated and lead sheathed, bitumen being used for the less important cables up to the road end boxes.

SHEATHING AND ARMOURING.

Lead is still the sheathing "par excellence" and the occasional failures due to corrosion or crystallisation only serve to illustrate the enormous extent to which the electrical industry is dependent upon it. Steel strip armouring is still satisfactory when longitudinal strength is not essential. Round wire armouring, an inheritance from the submarine cable, continues to justify its existence. The narrow shaped strip, or so-called segmental wires favoured on the Continent are seldom called for in this country.

Jute in various forms as a bedding for and a protection over the armouring remains. In submarine telegraph cable practice (upon which the use of jute is based) strips of woven canvas were gradually superseded by a serving of yarns. The recent tendency in underground cables is to discard the serving of yarn in favour of canvas tape. A thorough saturation of all external fibrous materials with preservative compounds is a distinctive feature of modern cables, especially since the practice of some large supply engineers is to lay cables direct in the ground without embedding them in troughs filled with compound.

GRADING LITTLE USED.

The steady rise in working pressures from 3,000 to 30,000 volts has not produced any drastic change in cable materials but has been met by a certain increase in thickness, greater care founded on experience, in manufacture, and a reduction in the ratio of test to working pressure, a policy not inconsistent with other branches of engineering work.

Grading of the dielectric to minimise the potential gradient of stress in the dielectric, although practised to a limited extent, has not yet fulfilled the anticipations of its authors. Although learned professors, with the aid of logarithms and an array of symbols demonstrated that a high pressure conductor could be insulated with films or thin laminae of dielectric, the hard fact remains that cables have to be constructed in workshops with commercial materials, and practice is only able to approximate to theory.

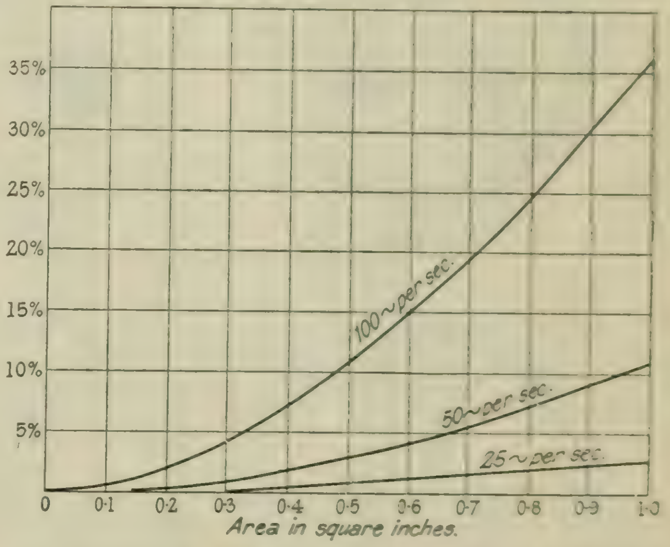

FIG. 1.—ORDINATES ARE PERCENTAGE INCREASE IN RESISTANCE TO ALTERNATE CURRENTS OVER RESISTANCE TO CONTINUOUS CURRENT.

DISAPPEARANCE OF "HOLLOW" CABLES.

It is worthy of note that there is a gradual disappearance of the large single core cables with hollow centres, which were prominent some years ago when single phase alternating current was in the ascendant, and which were designed to minimise the so-called "skin effect." This is due to two principal causes. The increase of working pressures permitted smaller conductors for the same power, although this was partly counter-balanced by the revision of the B.O.T. regulations, allowing more power to be transmitted over a single main feeder. The "skin effect" being much less with the smaller conductor, there was less need for the hollow centre. The second and chief cause is the lower frequency of alternation now used. With the early frequencies of 133 and 100 cycles per second the "skin effect" was appreciable, but with later frequency of 50 and the more recent 25 cycles, it is negligible. This makes for increased efficiency in the cable, with the further advantage of lower hysteresis and other losses. The diagram Fig. 1 shows the reduction of the ratio of alternating current to direct current resistance at the lower frequencies.

Protection.

Following the work of Mr. Leonard Andrews (Journal I.E.E. Vol. XXVII., p. 487, and Vol, XXXII., p. 901) considerable attention has been devoted to protective devices for cutting out or isolating faulty feeders without disturbing the network, especially with regard to three-phase supply, which is of primary importance.

One of the earlier methods (A) (Fig. 2) which has been in vogue several years was a small auxiliary or pilot cable in conjunction with the necessary relays, laid alongside the main cable, which does not call for special treatment. Later methods aim at incorporating the protective principle in the main cable itself, which is of special construction.

One method (B) consists in dividing each conductor (or phase) into two equally conducting portions (usually on the concentric system), the current passing through differential relays and over the two parts in parallel. This system, which is now fairly well known, has been used to a considerable extent, even up to 30,000 volts, and has been adopted in America.

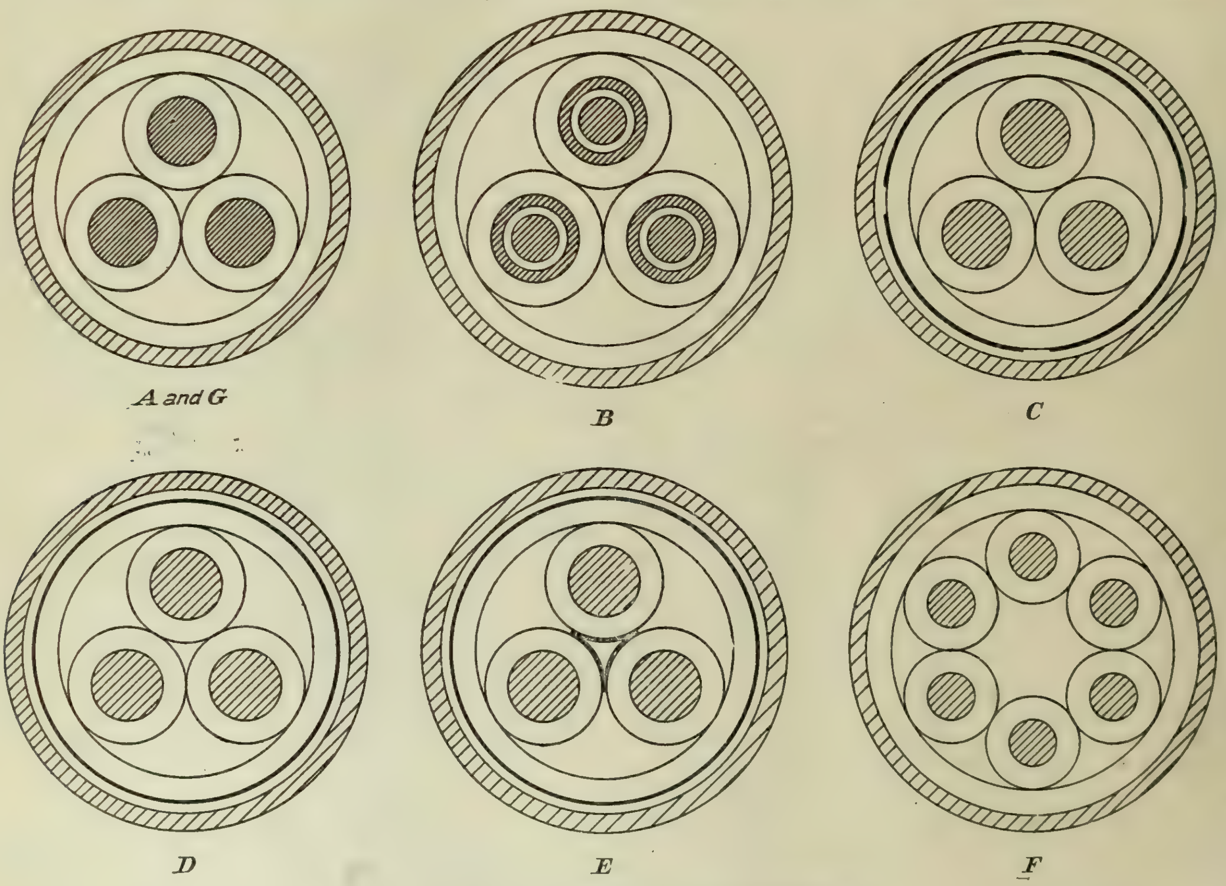

Fig. 2.—Sections of Cables for Protective Systems.

In another (C) two or more separately insulated copper strips are placed over the cable proper before the lead sheath is applied.

A system (D) in which the cable proper is surrounded by a copper sheath lightly insulated from the lead sheath, although designed primarily for detecting, by tests, any damage or defect in the lead, has been also associated with relays devices for protecting the network.

A later one (E) employs in addition to the sheath in (D) a triangular copper centre common to the three cores, which are thus partly surrounded by conducting screens

A still later one (F) is a modification of (B), and employs six ordinary cores arranged in the usual symmetrical fashion diagonally opposite cores forming the parallel paths for each of the three phases.

A recent method (G) is a return to (A) with a specialised form of auxiliary or pilot cable, but which still involves no modification of the main cable.

Others with small pilot wires in the main conductors are largely a return to old Continental practice, and call for little comment.

Time Test the Criterion.

It is almost impossible to decide upon the relative merits of the different schemes until each has stood the test of time and working conditions, especially as a judgment must be based not on the cables only, but upon the system of relays, switches, &c., of which the cable forms, however, an important part. The statements of inventors alone are insufficient, especially when supported by claims for incidental advantages, such as diminished dielectric stress, greater heat dissipating surface, &c., without recognition of the fact that these at least might be obtained otherwise. Broadly it may be stated that A and G use a main cable of standard construction. B presents some difficulties which have, however, been surmounted. C and D involves the introduction of conducting parts not necessary for the *transmission* of power, and F is hardly economical in the disposition of materials. Some of them disturb the normal distribution of potential between the conductors. Manufacturers are of opinion that the maximum of reliability can be best assured by simplicity of construction and a minimum number of separate elements.

Experience and a reference to electrical patents shows that the industry has passed through waves, or phases, of inventive activity in different directions, and it appears that recent years have provided a period of protective cable inventions. There are, however, already indications of a reversion to first principles, and it is probable that, in the near future, main cables will be designed simply to fulfil their normal function, viz., the transmision of power, and any protective or discriminating device will be entirely subsidiary and external to them.

The Storage Battery in Relation to Power Supply Schemes.

By A. S. BARNARD.

About 18 months ago Mr. E. C. McKinnon presented a valuable Paper to the Institution of Electrical Engineers on the subject of large batteries for power purposes.* That Paper, and the discussion that took place at the various centres of the Institution where it was read, show clearly that the electrical storage battery has by no means exhausted its field of usefulness, in spite of the general adoption of high-tension or extra-high-tension three-phase alternating-current generators, and steam turbines whose reliability and capacity for overloads were undreamt of in the early days of public supply. How far it will maintain its place in the scheme of things when the whole country is covered by a network of extra-high-tension alternating-current mains, fed by a limited number (whether it be 16 or 100) of super-generating stations, remains to be seen.

The Operation of Auxiliaries.

There is, however, one niche that it is pretty sure of being called upon to fill. The power station that depends upon its own current to drive its own auxiliaries, and even light its own boiler house and engine room, will sooner or later meet with the inevitable shut-down, and the consumers will be left wondering why it takes so long to resume supply. Of course, the linking-up with a common network of mains provides some safeguard against this contingency, but the security attained with a good storage battery at the generating station itself is far ahead of that given by a supply from another station received through the very switchboard where the trouble may have occurred. Such a battery is not necessarily of very great size—it is wonderful how few of the motor-driven station auxiliaries are absolutely essential to a start-up after a shut-down—but it is essential that it shall be absolutely reliable, and instantly available in emergency. As examples of the capacity considered necessary in such batteries in modern stations may be quoted :—

Bolton Corporation, Back o' th' Bank Station, 400 ampere-hours at the 1-hour rate.
L. & Y. Railway, Clifton Junction Power House, 250 ampere-hours at the 1-hour rate.
Birmingham Corporation, Nechells Power House, 600 ampere-hours at the 1-hour rate.

Details of Arrangement.

Where reliability is of such paramount importance, it is probably desirable that the battery should be in lead-lined wood boxes and not glass containers; although with the modern system of using wood separators, which will hold enough electrolyte to maintain continuity of circuit for a considerable time, the risk of a broken glass container is not so alarming as it was when a broken box meant a disconnection in the battery through the loss of the acid. With wood boxes, then, the cells should be arranged back to back and the plates connected by solid lead-burning to substantial channel bars. This, while it makes it a longer job to disconnect an entire cell, enables any single plate to be cut out for renewal and the new plate burned in again. Simple lead-burning, such as this, can nowadays be done by most battery room attendants, even without an elaborate hydrogen generator and bellows, by means of a hand "arc-burning" outfit. If, however, glass containers are used, it is desirable that the entire cell should be easy of removal, so that a broken box may be replaced by a new one without loss of time. In this case the plates are best burnt or cast up to separate bars, with lugs at each end of the bar, and lead-covered bolts and nuts to couple the lugs of adjacent cells. As, however, there is always a liability of the nuts working slack in time, and so causing heating and possibly fusion of the lugs, it is a wise precaution to tip-burn the lugs and so provide a low resistance path for the current in addition to the contact path provided by the bolts. This tip-burning can be quickly cut through with a hack-saw, and need not be renewed until after the battery is in service again.

Attention to such details as these in the design, and subsequent regular attention to the charging and discharging and the maintenance of the electrolyte, make the auxiliary, or as it is sometimes called "exciter," battery at a power house absolutely reliable and a standby of importance at one of the most vital spots in a power supply system.

The Battery in the Sub-Station.

This in itself would not seem to justify the extravagant hopes of those who have devoted time and money to the perfecting of storage batteries. Even in the early days of small direct-current stations the battery played a more important part than that of standby to the exciter 'bus-bars; and now in the immeasurably greater field of power distribution, it is being called upon to do very similar work to that which it has done in the past. The only difference lies in the point at which its help is applied. So long as the power house was a "central" station, it was both convenient and economical to place the battery there. Now that the word "central," if it applies at all, refers only to the relation of the generating station to its sub-stations, it is in the sub-stations that the larger batteries can be of most use, and it is there that they are more commonly placed.

In a sub-station in a continuous-current network the storage battery is a valuable standby, as well as an efficient peak-load controller. The charging current can be distributed over a considerable number of hours, although the discharge is available at a high rate representing for a short time a reserve of kilowatt capacity far in excess of the carrying capacity of the feeder from the generating station.

Recent troubles through shortage of coal supplies, dirty and unsuitable coal, insufficient generating plant, and even labour disputes, have shown that supply stations cannot yet afford to despise the help of storage batteries in emergencies, which are much more nearly normal conditions now than they were before the war.

The Birmingham Scheme.

Of the many large schemes now in hand in this country of which any particulars have as yet been made public, that of the Birmingham Corporation provides one of the best examples of the use of storage batteries. In Birmingham they have now either in use or in course of erection two sub-station batteries each of 6,000 amperes capacity for one hour; three of 2,000 amperes for one hour; and some five or six of 500 to 600 ampere-hours. These capacities may bear a very small ratio to the total output of the plant, but the same is true of the "peak" units with which they are called upon to deal—those peak units which have forced so many central stations during the past two winters to call upon their customers to restrict their demands at certain hours.

So long as the electrical supply business is a local affair, where the aggrieved would-be consumer can grumble at his own Town Council and borough officials, or even enter into their difficulties and sympathise with them, this question of keeping demands off the peak can be dealt with reasonably. When, however, the local generating station becomes a distributing station only, very little sympathy will be wasted on the department which fails to supply shop windows or cinemas—not to mention factories with electricity at whatever hour of the day or night those particular consumers desire.

Batteries a Necessity in Future Development.

With the highly concentrated direct-current supply networks already in existence in so many of our chief cities, it seems probable that, as is being done in Birmingham, large storage batteries will have to be put down in the heart of the demand, to act primarily perhaps as a standby against brief interruptions of supply, but secondarily as a peak load reserve of power for extraordinary occasions when a few additional kilowatts would make the difference between restricting supplies and carrying through.

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* See The Electrician, Vol. LXXX., p. 892.

REDUCTION OF LABOUR COSTS.

There is another aspect of the battery question which deserves attention. During the past few years costs and prices have risen enormously, but there are few cost curves which show as sharp a rise, and as little indication of a downward turn to come, as does that representing the cost of labour. Any small station, therefore, that could by means of a battery reduce its boiler house staff (if no other) from three shifts to two, would do well to look closely into the question of whether it would not pay to do so. Later on, when such a station becomes the fore-ordained tributary to a super-station, the battery will not represent wasted money, even though the onus of keeping the mains alive on light loads be shifted to other shoulders.

THE BATTERY AS STANDBY.

As the large power supply schemes get under way, one after another of the relatively small direct-current generating stations which abound throughout the country will be faced with the problem of shutting down its comparatively inefficient plant and taking its supply in bulk from the super-station high-pressure mains. In such a case there will be those who will advocate the retention of the old plant as a standby in case of failure of the supply. No matter, they will argue, if the plant *is* inefficient and out of date, since it will only be used occasionally, in emergency, and the units it will be called upon to generate will be very few. Surely in a case of this sort it is worth consideration whether better results could not be obtained both financially and from the point of view of reliability by devoting the old engine room to the new rotary converters (or, shall we say, rectifiers ?), and the old boiler house to a modern storage battery, which, instead of calling for apologies for its inefficiency, can actually increase the efficiency of the system by improving the load factor.

As regards usefulness in emergency, of course the storage battery has everything in its favour. The old boilers, unless they are to be kept continually under steam, would probably be useless until long after the supply had been resumed. Financially, too, the battery should be the better proposition. Certainly the municipality which adopts this scheme should be able to secure its bulk supply on better terms than one which simply throws its peak loads into the common melting pot with others, without taking the trouble to round off the corners.

THE PRIVATE CONSUMER.

What applies to the small town supply system applies also to the large private consumer. There are many private plants of considerable capacity, electrolytic works, coal mines, rolling mills and others, using continuous current, and which would be far more desirable customers for the super-stations if their load curves were leveller. Of course, there are other means than storage batteries, well known to engineers, for achieving this end, and the deciding factor will generally be the financial test. The power-limiting and indicating device adopted on the Chicago, Milwaukee and St. Paul Railway in America appears to be a comparatively inexpensive arrangement, well suited to the work of controlling the load factor at the sub-stations. In practice, it is stated, by restraining the peaks, the load factor is brought up from about 40 per cent. to approximately 60 per cent. It is questionable, however, if such a system is applicable to a public supply for miscellaneous industrial purposes (including lighting), depending as it does on the automatic lowering of the trolley (or distributor) voltage at the sub-station threatened by a peak or overload. At any rate, it is not so positive a remedy as the calling out of power held in reserve after being accumulated during times of light load.

THE BATTERY IN RAILWAY WORK.

On the British suburban railways so far electrified, the use of continuous current at 600 volts, or thereabouts, and storage batteries in the sub-stations, seems to be fairly standard practice. Thus, the London & North Western Railway has some 10 or 11 sub-stations equipped with batteries of 1,500 to 1,600 ampere-hour capacity, controlled by Entz Reversible Boosters ; and the Central London and Great Western Joint Railway from Ealing to Shepherd's Bush has one only a little smaller.

Judging from the enthusiastic report of the French mission to America on railway electrification in favour of the high tension continuous-current system employed on the C. M. & St. P. Railway, it seems possible that British main-line electrification may also employ continuous current. In that case, as the Lancashire & Yorkshire Railway (amongst others) has already shown, the storage battery can still be utilised not only as a peak-controller, but also as a very real standby in emergency. The difficulties of insulation at 3,000 volts (the pressure employed on the C. M. & St. P. Railway) can be overcome, just as the circuit breaking and commutator difficulties have been overcome. Already the L. & Y. Railway is using 1,200-volt batteries at its Victoria and Radcliffe substations on the Manchester and Bury system, and with proper attention to details, and to the protection of the attendants, there is no insuperable difficulty in giving equally safe and reliable batteries at the higher standard voltage.

Mr. McKinnon, in his Paper mentioned above, referred to the 1,200-volt batteries of the Stockholm-Saltsjobaden Railway, and pointed out that there the dry Swedish climate tends to simplify the question of insulation. No such explanation is forthcoming in the case of the Manchester batteries, and if the 1,200-volt batteries give no trouble here it is reasonable to suppose that the " humid atmosphere " bogey is overrated.

THE BATTERY LOCOMOTIVE.

Railway electrification will tend to the general adoption of storage batteries in another direction. The battery locomotive has of late years become a sound and practicable machine, and in any general system of electrification it is certain to be employed for many purposes, such as shunting at termini and in goods yards. On the small branch lines, also where the infrequent service will not warrant the cost of electrical overhead and permanent way equipment, the battery locomotive will be able to deal with the service, and draw its charge from the main system, to the benefit of the latter's load factor. Such locomotives are already in use on several of the British railways, including the North Staffordshire, the Lancashire and Yorkshire, and the Midland, and in other countries—notably Germany—their use is now very general. Of course, the work of a shunting locomotive is arduous, but storage batteries, whether of the nickel-iron-alkaline or lead-acid type, are now available which can and do successfully cope with the demands made upon them ; and the storage battery will as surely displace the coal-fired shunting loco as it is even now displacing the horse-drawn goods lorry, and the man-power platform truck.

ADVANCES IN DESIGN.

Equally, in the matter of stationary batteries, accumulator manufacturers of this country have shown that they can produce reliable batteries of very large capacity suitable for either " peak load " or " stand-by " use. There are at least three fairly distinct types of plate from which to choose, and the details of box construction, plate suspension, connecting lugs, insulation, and so forth, have shown a marked advance in recent years. The use of wood separators, for example, has now become standard practice in large stationary batteries, and one has only to look at the record of the British Submarine Service in recent years to realise that accumulator manufacture in Britain has kept abreast of the times. There seems no reason to suppose, therefore, that if larger schemes call for larger capacities, or higher voltages, whether for power supply systems or railway electrification, the accumulator manufacturers will be able to meet all reasonable requirements.

Recent Electric Vehicle Progress.

By F. AYTON.

THE economy, reliability and other well-known advantages of the electric commercial vehicle are to-day beyond question. They have been proved to the hilt by the experience of many large users, and the Motor Press, till recently indissolubly wedded to petrol and steam, are now constrained to admit the superiority of the electric in the sphere which is peculiarly its own, *i.e.*, delivery and other service in urban and suburban areas. Indeed, some of these journals have become quite enthusiastic and paint in glowing tints the great future which is opening out for electric road transport.

Electric Vehicles and the Eight-Hour Day.

As Major Whittington, the manager of Messrs. Maple & Company's transport department, has recently pointed out, the advent of the eight-hour day has so restricted the utility of horse haulage that the latter is no longer a paying proposition. Motor transport is certain, in consequence, to become universal. The soaring cost of fuel for the internal-combustion engine, not to speak of the extremely heavy cost of keeping in repair vehicles fitted with this type of motor, is all the while giving a greater and yet greater advantage to the simple, clean, reliable and economical "electric." Steam vehicles may for a while continue to be used in urban districts for heavy loads, but a great increase in their number in such service would seem out of the question since the awakening of the public to the injurious effects upon health of air pollution in our towns and cities will undoubtedly bring about, in course of time, legislative restrictions upon the use of any power-propelled vehicle which gives off smoke or noxious gases. The petrol vehicle cannot be exculpated in this matter of air pollution as the state of the atmosphere in the main thoroughfares of the metropolis on any windless day will bear witness. The entire replacement of the horse by the adoption of petrol or steam haulage on a large scale is, from the public health point of view, unthinkable. Fortunately, in these matters, the economic factor is the determining one in the choice of the method to be employed, and in the replacement of horse haulage in urban service there can be not the slightest doubt that the electric is the destined universal substitute.

Lack of Charging Facilities the Drawback.

Why then, it may be asked, if the advantages of the electric vehicle are so great and manifest, are there not more in service? The answer is the lack of charging facilities and the difficulty of obtaining vehicles due to the present limited output of those firms which are building them. The latter obstacle is in gradual process of removal, but in regard to charging facilities it must regretfully be admitted that electric supply undertakers have, with some exceptions, been somewhat wanting in enterprise. London, than which there is no finer or more promising field for the employment of the electric vehicle, is, with some exceptions, sadly lacking in public charging garages, and speaking generally, for here again there are some notable exceptions, it is the electric supply companies which have shown the least inclination to cater for this class of business. It is difficult to understand the frame of mind which will concentrate upon pushing the cooking and heating business, which inevitably, sooner or later, makes costly extensions to plant and mains necessary, while neglecting entirely the cultivation of the electric vehicle business. The latter can be built up without necessitating any additional plant or mains, for properly handled, the vehicle charging load can be confined to off-peak night hours with a highly beneficial effect upon the load-factor of the supply system and consequently upon the cost of production.

Ample Charging Facilities a Necessity.

The electric vehicle will not be employed to the maximum extent possible until charging facilities upon an ample scale are available in every locality. Unless it is to a big prospective user who will be likely to employ such a number of vehicles as will make it pay to install a special charging plant it is of little avail for an electric supply undertaking to preach "electric vehicles" in its district unless it can say, "You buy the vehicle and we will care for it and charge it." It is rarely, however, that a possible large user can be prevailed upon to put down his own charging plant—usually he desires to make a trial of one vehicle at the outset. There is no difficulty in persuading him to make that trial if the electric supply authority is in a position to take care of the vehicle each night and to hand it over to the driver each morning ready charged for the day's work.

L.G.B. Opposition Removed.

Up to now there has been some excuse for any failure on the part of individual municipal electric supply authorities to provide garaging and charging facilities because unless they could pay for the cost of buildings for this purpose out of revenue the money needed could not be obtained, the erstwhile Local Government Board being unwilling to sanction loans for such work. Fortunately, things have changed, and with the appointment of the Electricity Commissioners wider and more enlightened views are prevailing in matters concerned with the development in this country of things electrical. The Commissioners have made it clear that they are anxious to encourage to the fullest possible extent the use of the electric vehicle, and to this end they are prepared favourably to consider applications for borrowing powers for the erection and equipment by electric supply undertakers of electric vehicle charging garages, where not only the vehicles belonging to the local authority but those belonging to outside customers may be charged and housed. The Ipswich Corporation is the first local authority to be granted borrowing powers under this head, and there is in course of construction alongside the power station, to supplement the existing temporary accommodation secured by screening off a portion of the tramway body-building and wood-working shop, a garage 80 ft. by 60 ft., which will accommodate about 24 large commercial vehicles. It is to be hoped that with the sweeping away of what was, until recently, a serious difficulty in the way of providing charging facilities and housing for electric vehicles, many municipal electric supply authorities will, without undue delay, take steps to give "electric vehicle service" and so tap a new and very remunerative class of business.

Electric Vehicle Construction.

It is significant that the construction of commercial electric vehicles in this country has been taken up by some of the best known and most experienced firms of mechanical engineers. The first in the field was the firm of Ransomes, Sims & Jefferies, of Ipswich, who have laid out a special factory for the purpose. Then came Messrs. Richard Garrett & Sons, of Leiston. The General Vehicle Company have recently allied themselves with an old established engineering firm, whose well-equipped works are near Birmingham, where Messrs. Edison Accumulators have also established a factory for building "electrics." Other firms also building this class of automobile are Electromobile (Leeds), Ltd., and Newton Bros. (Derby), Ltd., the latest to enter the business being Messrs. Clayton & Shuttleworth, of Lincoln. An enormous demand is springing up for that small and handy transport machine known as the electric industrial truck. The majority of the above-named firms are building these vehicles, in addition to the road type of vehicle, while such firms as British Electric Vehicles, Ltd., of Southport, The Indiarubber, Gutta Percha & Telegraph Works Co., of London, and the Roadcraft Engineering Co., of Liverpool, are specialising in their construction.

The vehicles turned out by the leading British makers are unquestionably superior in many respects, and certainly in no detail inferior to the best examples that have been sent over here by American firms. There is, therefore, no excuse now for purchasing foreign-built commercial electric vehicles. The 2-ton model appears to be the smallest at present supplied by British makers, but there is undoubtedly a demand for vehicles of half a ton and of 1-ton carrying capacity, and it is known that at least one British firm has designs under way for such vehicles. It is possible that a small vehicle of the three-wheel type, capable of carrying about 5 cwt., would find a ready sale among fishmongers, butchers, grocers and other tradesmen, provided, of course, that charging and garaging facilities were available. Three-wheel electrics were being imported into this country from Germany in 1913-14, and were sold under the name of the "Torpedo" electric cars. They were, however, of somewhat crude design, not too well made and, moreover, were fitted with a flat plate type of German lead-acid battery which did not apparently have a very long life.

When speaking of three-wheelers, one may mention as significant the fact that the firm that for some years specialised in building the three-wheeled petrol engined delivery vehicles, of which so many are to be seen on the London streets, has lately added a fourth wheel to their design for these little cars. It may be, therefore, that a four-wheel light delivery car is practically as cheap to manufacture as the three-wheel type; it is unquestionable that from the point of view of tyre repair and changing as well as of stability, the latter has important advantages over the former.

Advantages of the Two-Motor Design.

In regard to the design of the ordinary commercial electric vehicle, it is safe to predict that the two-motor arrangement will come more and more into vogue in view of the important advantage which it has of eliminating the differential, a piece of mechanism which is most expensive to construct and upon which the effects of wear and tear are somewhat severely felt. Another advantage of the two-motor arrangement is that it makes possible the series parallel method of control with the accompanying greater economy in the consumption of electrical energy during the process of acceleration.

Roller Chain Drive the Best.

It would seem to be established that the most satisfactory and efficient drive to the road wheels is by roller chain, at any rate for the heavier class of vehicle. It is rumoured that at least one of the large firms building petrol commercial vehicles is seriously contemplating a return to this method of "last stage" transmission in place of the live axle with worm or bevel gear drive. The roller chain has the advantage, along with its sprocket wheels, of being readily renewed, while being easily adaptable to different requirements as to gear reduction ratio. If chains are properly fitted and periodically removed for cleaning and soaking in an oil bath, a comparatively high transmission efficiency is maintained. At one time it was considered a desirable thing to provide oil and dust-tight chain cases. Those who have had vehicles fitted with chain cases have sooner or later come to the conclusion, as the result of experience, that they are best dispensed with. Not only do the sides of the case act as sounding boards, magnifying any small noise that, as the result of wear, may come from the chain, but the case sooner or later gets knocked out of shape when it fouls the chain, and, ceasing to be dust-tight, forms a pocket for the lodgment of dirt.

The use of a single chain as the reducing and transmission gear between the road wheel and the motor would necessitate a comparatively slow speed motor which would be heavy and would not have so good an overall efficiency as a smaller and lighter machine running at a comparatively high speed. Thus, in most commercial types of electric vehicle there is a double reduction between the motor and the road wheel, the first transmission from the motor being in the form of either spur gearing or a silent toothed chain, the gear or chain running in an oil-tight case.

Recent Passenger Car Designs.

In the case of the passenger car, the two-motor arrangement is not so easy to apply and the modern vehicles, which, as yet, are mostly built in America, follow conventional petrol car practice, being provided with a single motor driving through a cardan shaft and single reduction bevel or worm gear on to a live axle of either the full or part floating type, the nose of the motor being spring-supported from the chassis frame. Two interesting departures from this general type are being developed in the United States, but it remains to be seen whether in practice they will bring to realisation all the advantages which their designers claim for them. The cars referred to are those known as the "Dey" and the "Steinmetz."

In these two types an effort is made to reduce the weight of the motor, and at the same time to raise the overall efficiency, by a radical departure from the usual design of motor. Both designs also render possible the elimination of the differential. The departure referred to consists in arranging that what is usually the stationary part of an electric motor, namely, the field magnet frame, shall also revolve, but in an opposite direction to that in which the armature rotates. Thus, while the relative speed between the armature conductors and the magnetic field may be doubled, the mechanical ratio of speed reduction between the motor and the driving wheels is not increased. This principle is not new, but the details embodied in the "Dey" and "Steinmetz" motors are at once novel and ingenious. One element of the motor drives the road wheel on one side of the car, while the other rotating element drives the other road wheel, a reduction gear intervening in each case. The motor and reduction gears are incorporated in the rear axle housing in the "Dey" design, the total weight of the rear axle, including motor, being given as only 100 lb. for a two-seater car.

The Steinmetz Car.

In the Steinmetz system the motor and the reduction gears are connected at right angles to the back axle, but fixed directly to the housing of the latter. The chief novelty lies in the ingenious use of a single accumulator cell connected in parallel with the series field winding of the motor. The resistance of the field winding is made such that with normal load on the motor the drop in pressure across the field winding is equal to the voltage of the accumulator cell, and under these conditions no current flows into the latter. If, as when starting or ascending a gradient, the current exceeds the normal, the greater pressure drops across the terminals of the series winding will cause a charging current to flow into the field cell. On the other hand, with a load on the motor below the normal, as when running with a lightly loaded car, or on a very good smooth and level road surface, or down a slight gradient, the current through the motor, and, therefore through the field winding, will be so small that there will be a drop of pressure across the latter less than the voltage of the field cell. Under these conditions the field cell will discharge through the field winding, increasing the strength of the field. The result claimed for this arrangement is that no matter how the load upon the motor may fluctuate, the field strength will vary only within relatively narrow limits, the minimum field excitation being, of course, that due to the discharge of the field cell alone. The motor is also arranged that when going down hill, it acts as a generator when the speed exceeds a certain limit and charges the battery. A flatter, and, from the point of view of commercial vehicle needs, a more satisfactory motor characteristic curve is obtained by this method, as compared with that of the ordinary series motor which also shows the regenerative action. Dr. Steinmetz, who is well known throughout the world as the consulting electrical engineer to the General Electric Company of America, summarises the advantages thus :—

1. The speed is well maintained on heavy up grades and with heavy loads.
2. More rapid acceleration.
3. On the level and on slight down grades the maximum speed is limited, in consequence of which a driver cannot race the car.
4. The usual friction brake is not needed except to hold the car at rest, all the ordinary braking being done by the regenerative action of the motor.
5. Less waste of electrical energy in the series field winding with large currents, thus increasing the mileage per charge.

It may be mentioned that the use of the motor or motors for electric braking on electric vehicles is not new, one of the best known of British makes having from the first made it a feature of their designs.

The Battery Question.

Much controversy has in the last few years raged round the battery question where electric vehicles are concerned, the claims made by those interested in the "nickel-iron-alkali" and the "lead-acid" types often causing difficulty to a purchaser in deciding which to adopt. The writer, being in a position to take an impartial view in these matters, and being in touch with many users of both types, has information additional to that obtained in his own experience of the running of a number of large vehicles at Ipswich, which enables him to say, without hesitation, that where reasonable care is bestowed upon the charging and maintenance of the batteries, and the district is only moderately hilly, either type of battery will prove equally satisfactory in service results and maintenance costs. Where there is the possibility of the battery being left uncharged for long periods, or where there will be general lack of care in seeing that it is fully charged each time, then the advantages undoubtedly lie with the first-named type. But it must be remembered that even that type is not immune from serious damage through mishandling, the most serious danger being that of allowing the temperature of any cell to rise above the limit of 115°F. when charging. In this respect the "nickel-iron-alkali" battery differs little from the "lead-acid" type.

In hilly districts experience shows that better results are obtained, in regard to average vehicle speed, by the use of the lead-acid type, owing to its lower internal resistance.

The de Martis Battery.

From time to time statements have appeared concerning a new type of "lead-acid" battery designed by an Italian engineer, Horace de Martis, and during the past 12 months a factory at Bologna has been working upon its production. The cell is of the "lead-acid" type, but it is claimed that by the use of a special paste which combines extreme hardness and closeness of texture with great porosity the formation of lead sulphate is prevented. Sulphation is a chemical reaction which in the ordinary lead-acid cell is fundamental to its functioning, while having its disadvantages when careful attention is not given to the charging operation. It is said of the de Martis cell that it may be charged at a higher rate than other cells; that it can take a full charge, after complete discharge, under ordinary working conditions in from two to three hours, while 60 per cent. of the capacity may be replenished in from 20 to 30 minutes. According to those interested in the sale of the battery in this country, tests made on a de Martis cell at the Carnegie Institute at Pittsburgh covered the full charging in two hours on 22 occasions without injury to the cell. Other advantages claimed include, as compared with the ordinary types of lead-acid battery: Higher capacity for same weight, slightly higher voltage on discharge, and increased watt-hour efficiency. Such a battery would undoubtedly prove of great advantage in the development of the electric vehicle business and one can but hope that independent tests, carried out by some recognised and impartial authority in this country, may show results which go to support the rather wonderful claims made by the inventor. It is understood that a factory for the manufacture of the de Martis battery will be in operation in this country in the near future.

The Assistance of Undertakings Essential.

But however much we may wish for further improvements in batteries, and doubtless they will come, it cannot be gainsaid that the results obtained with electric vehicles fitted with the two best-known existing batteries are such, in the matters of economy, reliability, simplicity and cleanliness, as to mark out a very big future for that class of automobile. The need of the moment is that electric supply undertakers should recognise how much it is to their interest to assist in promoting the use of the electric vehicle by hearty propaganda effort, but more especially by the provision of proper charging facilities. It is also desirable that manufacturers should seriously consider the question of standardising upon a definite number of cells not only for road vehicles, but also for industrial trucks, and that, taking the long view, for the battery exchange system will come, they should see whether it is not possible to standardise two or three sizes and designs of battery boxes to serve this end.

The Selection of Oil Circuit Breakers.

By W. A. COATES.

Until a few years ago there was rarely need to take special care in selecting oil circuit breakers, especially those for sub-station work. Plants were of limited generating capacity, so that even a short length of the small feeders then used sufficed to keep the possible short-circuits within values easy to handle.

Conditions have changed. Many generating stations are interlinked with their neighbours, and individual plants are of very large capacity. The area of feeders used is also correspondingly increased. Under these conditions, considerable care must be exercised in the selection of main station switches, and the older types of sub-station switch, which had breaking capacities of about 10,000/30,000 k.v.a., are no longer capable of universal application.

That this is the case is generally recognised, and much attention has been given to the matter both by power station engineers and by switchgear builders. Unfortunately, we still lack definite information on many points affecting the breaking capacity of oil switches, and also in regard to the precise determination of the value of short circuit at any point on a system.

Breaking Capacity.

Concerning breaking capacity, the leading makers of oil switches have all had opportunities of testing their apparatus under service conditions, and for the smaller switches at any rate, can state their operating limits with reasonable certainty. Chances for testing large oil switches rarely occur, and it is probable that only those firms who build generating plant as well as switchgear have been able to carry out extensive tests with more than, say, 5,000/10,000 k.v.a. of generating plant.

The British Engineering Standards Association will be issuing shortly their first specification for oil switches, and in this, breaking capacity is defined in the following terms:—

> The breaking (interrupting or rupturing) capacity is the maximum kilovolt-amperes which the circuit breaker can break under prescribed conditions, at stated intervals, a specified number of times.
>
> The value of the maximum kilovolt-amperes is the product of the rated working pressure in kilovolts, and the *actual current at the time of separation of the contacts*, multiplied by 1, 1·73 or 2 for single-phase, three-phase, or two-phase systems respectively.
>
> R.M.S. values of current and pressure shall be taken.

The words in italics will be noted. When a generator is short-circuited the current instantly attains a peak value, from which it dies down to a lower sustained short-circuit value. All oil switches have a certain inherent time delay in opening, due to the inertia of moving parts, and even in this short time the short-circuit current appreciably diminishes. Thus, in the case shown in Fig. 1, if the oil switch does not open till point *A* is reached the short-circuit will have fallen to half its peak value. The time interval *A* is usually about 0·2 sec. on a modern "instantaneous" oil switch. One maker who set out deliberately to reduce this time succeeded in making his switch contacts part in a trifle under 1/10 sec.

Most makers now state their breaking capacity figures in the manner required by the definition quoted above. The American method of rating is on similar lines, but capacities are stated in terms of amperes at the time of separation of the contacts, without bringing the system voltage into account.

Peak Value the Wrong Rating Basis.

Occasionally it will be found that a switch rating has been based on the result of actual tests, but that the peak value of current has been used. This is clearly wrong, since the work which the oil switch has to do depends on the intensity and duration of the arc at the instant of rupture. Unfortunately the figure derived in this way from peak values may easily be double that which would be given by the standard method, and the purchaser is apt to be misled when comparing the guarantees of competitive makers.

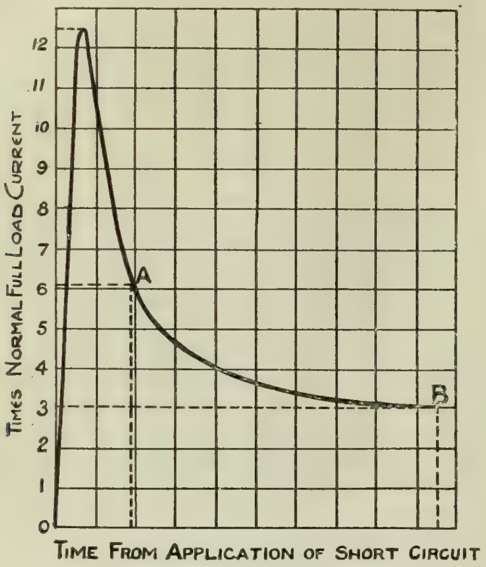

Fig. 1.

From Fig. 1 it is clear that if the switch operation can be delayed from *A* to *B* the value of current which must be broken will be considerably reduced. The value of current and the shape of this die-away curve depend on the generator reactance, the type of machine and designs adopted by the builder, and also on the field excitation at the instant the short-circuit occurred.

In the absence of specific information it is customary to assume that the machine has reactance of 10 per cent., and that when using an instantaneous oil switch the value of short-circuit current has died down to six times normal full load by the time the contacts part. Further, if a time delay of not less than 1½ sec. be introduced the short-circuit current will have reached a sustained value of three times normal full load.

Effect of External Reactance.

The addition of external resistance or reactance in series with the generators serves to reduce the severity of a short-circuit. The instantaneous peak value of the current is proportional to the total reactance in the system, including that of the generator. The sustained short-circuit current will not be reduced to the same extent, and the precise shape of the die-away curve is difficult to determine.

In order, at least, to put on a uniform basis the means for determining the value of short-circuit current to be expected under given conditions the two leading manufacturing concerns in America held a conference some time ago. This resulted in a Paper read before the American Institute of Electrical Engineers (" Trans." A.I.E.E., 1918, Part 1, p. 123, " Rating and Selection of Oil Circuit Breakers," by E. M. Hewlett, J. N. Mahoney and G. A. Burnham).

In this Paper it was proposed that the values in the following table be adopted, until such time as further investigation may show reason for a change.

The percentage reactance used in this table is based on the total kilovolt-amperes of all synchronous machines, and includes both the internal reactance of the machines and the reactance in external circuits reduced to the basis of total machine capacity.*

British Switchgear Practice and American Experience.

The figures which have been used by at least one of the large switchgear manufacturers in this country conform quite closely to those given in this table. British switchgear practice in the past has frequently benefited by American experience on their larger power systems; our standard specification will agree in many respects with that of the American I.E.E., and it appears desirable that we should consider carefully whether this table of current values also can be adopted for general use in this country.

The calculation of possible short-circuit values becomes a very complex matter on systems having linked-up networks. Certain power authorities in America have built up electrical models of their networks on which they can obtain directly the value of maximum short-circuit current at any point. Such devices are naturally expensive and can only be a paying proposition on a large, complicated and rapidly growing system.

Table I.—Short-Circuit Current Factors.

Reactance.	8 %	10 %	12 %	15 %	20 %	30 %	40 %	50 %	60 %	75 %	100 %	125 %	150 %
Elapsed time in seconds from start of short circuit.	Current Factors expressed as number of times full-load current.												
0·05	13·91	11·16	9·59	7·68	6·04	4·03	3·01	2·40	2·00	1·58	1·17	0·92	0·77
0·08	11·78	9·54	8·25	6·66	5·27	3·59	2·74	2·21	1·86	1·50	1·13	0·90	0·76
0·10	10·94	8·89	7·68	6·23	4·97	3·41	2·63	2·13	1·81	1·46	1·11	0·89	0·76
0·15	9·16	7·54	6·57	5·40	4·38	3·08	2·42	2·00	1·71	1·41	1·09	0·89	0·76
0·20	8·24	6·80	5·97	4·95	4·06	2·92	2·30	1·92	1·66	1·38	1·08	0·88	0·76
0·25	7·55	6·28	5·54	4·63	3·82	2·79	2·23	1·87	1·63	1·36	1·07	0·88	0·76
0·30	7·03	5·88	5·19	4·39	3·67	2·70	2·18	1·84	1·60	1·34	1·06	0·88	0·76
0·40	6·27	5·30	4·74	4·03	3·40	2·57	2·10	1·79	1·57	1·32	1·06	0·87	0·76
0·50	5·74	4·91	4·40	3·80	3·23	2·48	2·04	1·75	1·54	1·31	1·05	0·87	0·76
0·70	4·99	4·34	3·93	3·45	2·98	2·34	1·96	1·70	1·51	1·29	1·04	0·87	0·76
1·00	4·25	3·77	3·47	3·11	2·73	2·21	1·88	1·65	1·48	1·27	1·04	0·87	0·76
1·50	3·63	3·31	3·08	2·82	2·53	2·10	1·81	1·61	1·45	1·25	1·03	0·87	0·76
2·00	3·20	2·98	2·82	2·63	2·39	2·03	1·77	1·58	1·43	1·24	1·02	0·87	0·76

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* Thus in calculating the short circuit current on the far side of a 2,000-k.v.a. 5 per cent. reactance transformer served by 1-5,000 k.v.a. generator 10 per cent. reactance and 1-4,000 k.v.a. generator 12 per cent. reactance, we figure as follows :—

$$\left.\begin{array}{l}\text{1-5,000 k.v.a. generator } 10\% \\ \text{1-4,000 k.v.a. generator } 12\%\end{array}\right\}\text{equivalent to 9,000 k.v.a. at } 10{\cdot}8\%$$

1-2,000 k.v.a. transformer 5% equivalent to 9,000 k.v.a. at 22·5%

33·3%

Total reactance based on 9,000 k.v.a. .... 33·3 per cent.

A GRAPHICAL METHOD.

The problem of devising a graphical method of determining short-circuit currents under all conditions of system and network has yet to be solved. As a partial attempt the chart in Fig. 2 was prepared to facilitate the selection of switches connected through single feeders with the generating station. It will serve to emphasise the need for careful selection when working on power systems of any size. In calculating this chart it was assumed that all generators were connected to a single 'bus-bar without section reactances, and that the system voltage is that of the generators, *i.e.*, there are no transformers in the circuit. It was based on the use of instantaneous automatic oil switches, the contacts of which part in 0·2 sec.

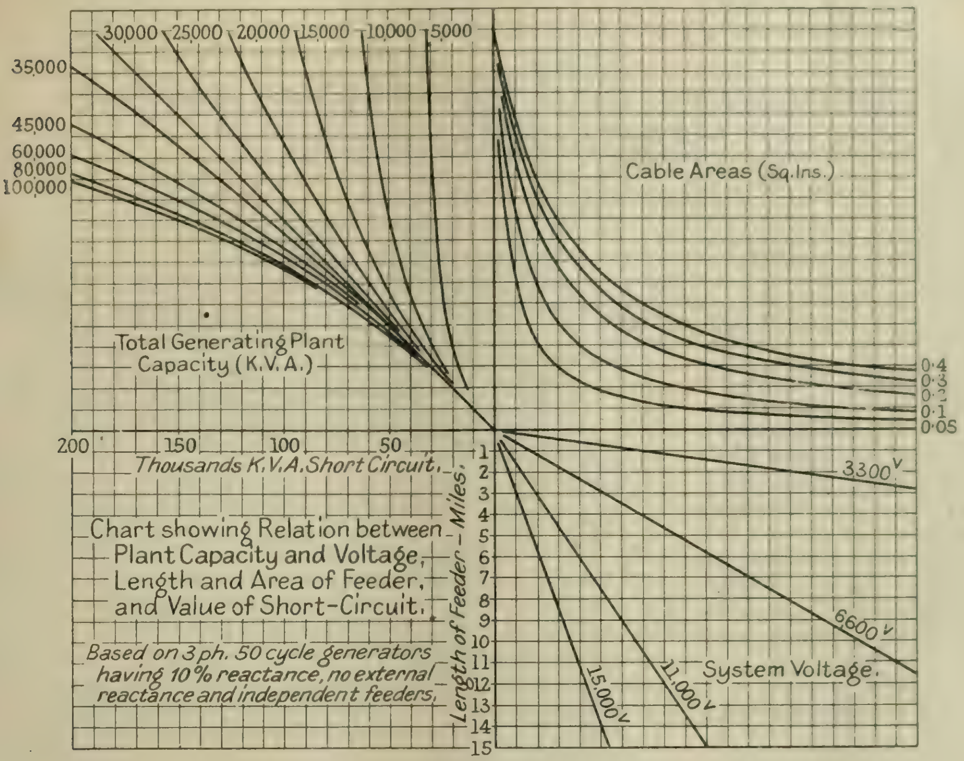

FIG. 2.

The method of use is simple. Taking the length of feeder to the point at which the switch is to be located, the distance in miles is read off on the lower vertical scale. From here carry horizontally to the right to the system voltage line, thence vertically to the appropriate cable area curve, horizontally to the left to the radial representing the total plant capacity, and down to the horizontal scale of kilovolt-ampere breaking capacity necessary. The process is, of course, reversible, and the results given are very close approximations on the assumptions mentioned.

THE PEAK VALUE BASIS.

The engineers responsible for certain large power systems prefer, in the case of switches controlling important circuits, to base their requirements on the peak value of current, neglecting the time delay in operating the oil circuit breaker. The argument in favour of so doing is that if a fault takes an appreciable time to develop, the switch mechanism may be actuated while the fault current is still on the increase, and the peak value may actually coincide with the instant at which the contacts separate. A further reason sometimes advanced for being conservative in the matter of rating is that a circuit breaker having tripped may be reclosed on the short circuit. In this case the automatic device should operate before the contacts are closed right home, and the arc would persist longer than usual during the time necessary to reverse the direction in which the switch contacts are moving.

The possibility of such occurrences can hardly be questioned. In fact, the standard test for oil circuit breakers in the specification shortly to be issued, contemplates a more severe duty resulting from closing on a short circuit. Commercial considerations, however, will generally preclude making provision for such conditions which would only happen very rarely.

ADVANCES IN OIL SWITCH DESIGN.

It is interesting to note that the art of oil switch design has progressed considerably in the last few years, so that it is now possible to obtain switches of breaking capacity three or four times as great as could formerly be done in the same space.

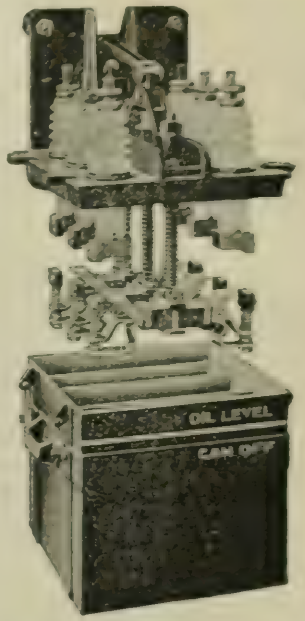

FIG. 3.

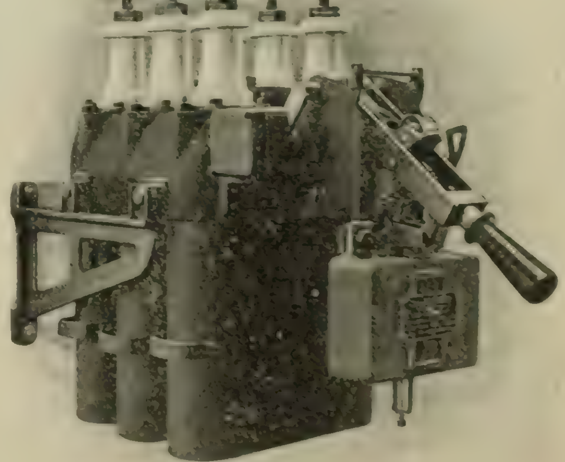

FIG. 4.

In Figs. 3 and 4 are shown an early design and a modern oil circuit breaker which will illustrate this point. The improvement in operation has been obtained by a variety of changes. The depth of oil above the arcing contacts is considerably increased, and a large air chamber with vent pipe is now placed above the tanks. The switch arm is accelerated by means of powerful springs, and in this manner the time during which an arc can persist is reduced.

Perhaps the most notable feature, however, is the great increase in tank strength. In earlier switches the tanks were designed primarily to hold the oil, and bulged or burst tanks were frequent. In the best modern switches the tanks are built of welded steel plates, usually of elliptical shape and with dished bottoms, the flat sides being reinforced. On the largest switches for central station use, the tanks are circular with hemispherical bottoms, the whole thing being pressed out of a single plate. Such tanks are designed for working pressure of anything between 40 lb. and 400 lb. per square inch.

National Fuel Economy and the Government Super-Power Station Scheme.

By **DAVID BROWNLIE, B.Sc.Hons.Lond., F.C.S., A.I.Mech.E.**

As is well known to every engineer, one of the most important national problems that confronts us to-day is that of fuel economy. In the first place, in considering a problem of this magnitude, one of the great difficulties is the lack of sufficient data and a proper engineering census of Great Britain is long overdue.

According to the recent Interim Report on electric power supply in Great Britain of the Reconstruction Committee (Coal Conservation Sub-committee), Ministry of Reconstruction (Cd. 9084, 1918), the total mechanical energy required in Great Britain is about 10,000,000 H.P.-hours, including everything except railways, although there seems to be some difference of opinion as to the accuracy of these figures.

Also, from the same report, taking 1913 as an average year, the total amount of coal raised in Great Britain is about 287,000,000 tons, of which about 189 000,000 tons is consumed in the country. This consumption is divided as follows :—

1. Railways	15,000,000 tons.
2. Coasting steamers	2,500,000 tons.
3. Factories	60,000,000 tons.
4. Mines	20,500,000 tons.
5. Iron and steel industrie	31,000,000 tons.
6. Other metals and minerals	1,250,000 tons.
7. Brickworks, potteries, glass works and chemical works	5,750,000 tons.
8. Gasworks	18,000,000 tons.
9. Domestic	35,000,000 tons.
Total	189,000,000 tons.

Super-Power Stations No Remedy.

The Government remedy for the present wastage of fuel is the super-power station scheme—that is, the establishment of a great central system of electrical generation and distribution. Sixteen vast super-power stations are to be erected in various parts of the country, and many of the large existing power stations are to be purchased by the State, whilst scores of smaller stations are to be scrapped, together, apparently, with millions of pounds worth of steam plant. The country is to be covered with a network of wires and wholesale electric driving, including railways, adopted in place of existing steam engines.

According to the supporters of this scheme, the 80,000,000 tons of coal now used per annum for power generation only, including railways, would be reduced to 25,000,000 tons only—that is to say, the saving would be no less than 55,000,000 tons annually. The reasons for this somewhat startling conclusion are no means clear, and are strongly disputed by some of the most prominent experts in the country ; but, assuming that the figures are true, the scheme is essentially that of scrapping a vast portion of the present power plant of the country, and relying almost entirely on electricity generated by steam plant burning raw coal.

Modernisation of Existing Plant.

I am of the opinion that this principle is at the present time entirely wrong, and that the proper method is entirely the opposite—namely, first of all to bring up to date and make full use of the existing plant, and to take advantage of other sources of power available. A consideration of the various methods that can be adopted to carry out this latter plan constitutes the most effective criticism of the Government scheme

Present Figures of Coal Consumption.

In the first place, much the largest amount of coal consumed in Great Britain is used for one operation only, that of steam raising. The figures for the national coal consumption, given in Cd. 9084, can be expressed in another way.

Deducting the amount used for railways, coasting steamers, gas-works and domestic purposes, we have left 118,500,000 tons. According to the above report, about 80,000,000 tons are used for power production only, inclusive of railways. Deducting 15,000,000 tons for the latter, leaves us with 65,000,000 tons used for power. Also further, according to this report, 90 per cent. of the coal used for power is used in steam boilers, so that we arrive at the figure of 58,500,000 tons used per annum for steam generation for power only ; but in addition to power there is an enormous amount of steam used for heating and general technical processes.

Thus, in industries like dyeing, bleaching, calico-printing, tanning, hat manufacture, brewing, the chemical trades, &c., much more steam is used in this way than for power production. Also in very many other industries a considerable quantity of steam is used, even although the amount may be less than that used for power. It is not possible to find out what is the exact amount of coal used for the production of steam for purposes other than power, because of the lack of a proper engineering census of the country. I am of the opinion, however, that, roughly speaking, the total amount of coal used for generation in the British Isles is between 75,000,000 and 100,000,000 tons per annum (being 60–70,000,000 tons for power and 15–30,000,000 tons for purposes other than power), that is, 40 to 52 per cent. of the total.

Obsolete Methods.

Our present methods of steam generation are entirely out of date. The firm with whom I am associated have been engaged continuously during the last 10 years in carrying out complete scientific investigations into the working of steam boiler plants, with a view to bringing them up to date.

We have made such complete investigations, including a week's test in each case, of nearly 500 boiler plants, with an annual coal bill of nearly 5,000,000 tons, in about 50 different industries, and the average nett working efficiency is only about 60 to 62 per cent.

I recently published* average figures for 250 steam boiler plants, representing 1,000 boilers, with an annual coal bill of 2,100,000 tons in 27 different industries as given on page 21.

I also published† the separate figures for the exact performance of 100 colliery steam boiler plants, and the average nett working efficiency was only 55 per cent., the colliery industry being notoriously the most inefficient from the point of view of steam generation.

In addition to testing nearly 500 plants, we have made an inspection of about another 2,000 plants, and we find these latter to be all working on the same general lines.

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* *See* " Engineering," July 12, 19, 1918, " Coal Saving by the Scientific Control of Steam Boiler Plants."

† *See* " Engineering," July 25 and August 1, 1919 (" Exact Data on the Running of Steam Boiler Plants : No. 2, The Performance of Colliery Boiler Plants ").

Average of 250 Typical Boiler Plants.

(A). WORKING DAY'S TEST :—	
Type of boiler	"Lancashire."
Number of boilers	Four.
Grate area	152·6 sq. ft.
Duration of test	9·43 hours.
Amount of fuel used	30,131·72 lb.
Analysis of fuel used :—	
British Thermal units	11,822.
Ash	11·5 per cent.
Fuel burnt per boiler per hour	798·8 lb.
Fuel burnt per square foot of grate area per hour	20·9 lb.
Water evaporated	197,776 lb.
Water evaporated per boiler per hour	5,234 lb.
Water evaporated per square foot of grate area per hour	137·4 lb.
Water evaporated per lb. of fuel	6·56 lb.
Equivalent evaporation from and at 212°F. per lb. of fuel	7·46 lb.
Equivalent evaporation from and at 212°F. per 1,000,000 British Thermal units	631·0 lb.
Temperature of feed-water before economisers	116°F.
Temperature of feed-water after economisers	193°F.
Percentage of fuel bill saved by economisers	7·1 per cent.
Draught in side flue	0·40 in. W.G.
Draught in main flue at exit of economisers of chimney base	0·80 in. W.G.
Temperature of flue gases before economisers	598°F.
Temperature of flue gases after economisers	478°F.
Percentage of CO_2 in flue gases from side flue of boilers by means of combustion recorder	7·6 per cent.
Steam pressure :—	
Pounds per square inch (gauge)	89.
Pounds per square inch (absolute)	104.
Temperature of saturation of steam	330·5°F.
Temperature of superheated steam	346·5°F.
Steam or power used as auxiliary to the production of steam	2·4 per cent.
THERMAL EFFICIENCY :—	
A. Nett working efficiency complete, after deducting 2·4 per cent. steam or power used as auxiliary to the production of steam	60·09 per cent.
B. Boilers only	56·71 per cent.
C. Economisers only	4·35 per cent.
D. Superheaters only	0·51 per cent.
B. LONG CHECK TEST (one week of seven days) :—	
Duration	167·5 hours.
Amount of fuel used	128·25 tons.
Water evaporated	184,435 gallons.
Water evaporated per lb. of fuel	6·42 lb.

AVERAGE NETT WORKING EFFICIENCY.

Until further data is available, I think, therefore, it can be taken as correct that the nett working efficiency of the steam boiler plant of Great Britain is only about 60 per cent.

Now, it is quite possible under average conditions to run a boiler plant on 75 per cent. efficiency by adopting proper methods of control in working the plant, and by bringing it up to date as regards equipment and lay-out. This is not an exaggerated figure, but a reasonable one for average conditions, and which we have obtained regularly as the result of many reorganisations carried out by us. If, therefore, it be agreed that the boiler plants of Great Britain only average 60 per cent. nett working efficiency, and by adopting scientific methods of control the efficiency can be brought up to 75 per cent., this represents a saving of 20 per cent. of the coal bill. On 75 to 100,000,000 tons this is equal to a national saving of no less than 15 to 20,000,000 tons of coal per annum. In my opinion this figure is well on the conservative side, and the saving to be obtained in this direction is enormous.

POPULAR MISCONCEPTIONS.

In connection with this question of steam generation, there are some very remarkable popular misconceptions which have not a shred of evidence in support of them. For example, most people, even skilled engineers, imagine that a water-tube boiler plant is more efficient than a cylindrical boiler plant, that coke firing is bad for boilers, that high CO_2 in flue gas necessarily means high efficiency, and that mechanical stoking, even on cylindrical boilers, is more efficient than hand firing. I am afraid that another popular misconception is that the boiler plants of electric generating stations are more efficient than the average for all the industries of the country.

This is certainly not the case, and I believe that 10 per cent. of the coal bill of the electricity stations of Great Britain could be saved by adopting modern scientific methods of steam generation. Many boiler plants of electricity stations are in a really disgraceful condition in this respect. I have been in at least a couple of dozen large electricity stations where the boiler plants are not even fitted with such elementary apparatus as water meters and CO_2 recorders, and nothing whatever is known about the performance of the boiler plant from one year to another. In scores of stations the water meters in use are never tested for accuracy, and the records are taken in a purely mechanical fashion without making the slightest use of them.

SCIENTIFIC CONTROL NECESSARY.

As regards CO_2 recorders, it is really an exception to go into a station and find an instrument in correct running order. It is impossible to get fuel economy in steam generation unless the most ruthless methods of costing and general scientific methods of control are adopted, and such methods are sadly lacking in the average power station to-day.

Again, power stations generally apparently believe the popular fallacy that mechanical firing is better for cylindrical boilers than hand firing. Thus, Mr. David Wilson states that there are still 865 cylindrical boilers in power stations of which 566 are mechanically fired.

MECHANICAL STOKING A FALLACY.

I read recently before the Institution of Mechanical Engineers in London a Paper on "Exact Data on the Performance of Mechanical Stokers as Applied to 'Lancashire' or other Narrow-flued Boilers,"* giving the complete figures for the performance of 80 typical "Lancashire" boiler plants mechanically fired. The average nett working efficiency of these typical plants was only 59 per cent., as against about 62 per cent. for 350 hand-fired plants, so that on "Lancashire" and other cylindrical boilers the idea that mechanical stoking is giving better results than hand firing is a complete fallacy.

In connection with economical steam generation, there is also the question of burning inferior coal thrown away at the colliery on the tips at the pit-head. A large proportion of this coal could be burnt on the colliery steam boiler plant, as is being done already by a few collieries, and it is probably a conservative estimate to take the total saving in this direction in the whole country as equal to 3,000,000 tons of ordinary good coal per annum.

ADOPTION OF THE "PASS-OUT" SYSTEM.

Another vital point entirely overlooked in the Government scheme is the enormous saving to be obtained by adopting the "pass-out" system in connection with low-pressure steam required for purposes other than power generation. As already stated, 15–30,000,000 tons of coal are used per annum for steam generation for this purpose, and the steam produced is not required at more than about 40 lb. gauge pressure on the average. The proper scientific method is to generate steam at high pressure, say 160-200 lb., and pass it through a "pass-out" turbine or engine, emerging at, say, 40 lb., ready for the process work. The turbine of engine in this manner generates electricity by the mere drop in the steam pressure, and entirely prevents all the latent heat of steam loss in the condenser, the saving being very great. For example, taking the present annual consumption of coal for low pressure at, say, 40 lb. gauge pressure, as 22,500,000 tons, at 160 lb. pressure the same steam would be produced at 40 lb. from the engine or turbine, whilst at the same time the power generated would be about, say, 1,400,000 H.P. Taking the figure of, say, 2 lb. of coal required to produce 1 H.P., under average good conditions this would correspond to an annual saving of, say, 6,250,000 tons of coal.

OTHER ECONOMIES.

Secondly, very considerable economies could be made in other directions on existing plant in connection with the utilisation of steam. For example, at least 7½ per cent. of the coal consumption—that is, 5,600,000 to 7,500,000 tons—could probably be saved by avoiding condensation losses in steam-pipe circuits, &c., by adopting up-to-date methods of lagging and partial superheating.

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* See THE ELECTRICIAN, Vol. LXXXIV., p. 338.

Another item is friction losses in shafting and drives, and in many factories 10 to 20 per cent. of the coal used is thrown away for this one reason alone. In all the industries of the country at least another 2–3,000,000 tons of coal could be saved in this direction. Also, as most engineers are aware, many of the present steam engines in use are out of date, taking anything from 17–30 lb. of steam per indicated horse-power, and substantial economies could be effected by replacing them with more modern engines, giving figures of, say, 11–12 lb. of steam per indicated horse-power.

Utilisation of Water-power.

A very important point is that of the proper utilisation of the water-power of the country. The recent investigation of the Board of Trade Committee on Water Power has shown that 1,500,000 h.p. can be obtained in this way. It must be remembered that this power would be generated continuously day and night, and not just during the ordinary working hours of a factory. If, therefore, this power is stored in accumulators it would be equivalent to, say, 3,000,000 h.p., which, taking indicated horse-power as equal to 2 lb. of coal, would correspond to a saving of, say, 20,000,000 tons of coal per annum.

A further valuable field for national fuel economy is the proper utilisation of blast-furnace gas, as pointed out by Mr. S. H. Fowles in his recent Paper, "The Production of Power from Blast-furnace Gas," read on March 11th before the Institution of Electrical Engineers.* Mr. Fowles states that most of the blast-furnace gas produced is either thrown away or used in a most crude and wasteful manner. He points out that if this gas is thoroughly cleaned in an efficient manner and used for power generation in gas engines, the blast furnaces of Great Britain would produce about 1,000,000 h.p., equal to the output of about 300 electricity stations.

Low Temperature Distillation.

Another valuable field is that of the low-temperature distillation of coal with the production of valuable petrol and oil products, together with gas and "coalite" on the lines advocated by Messrs. The Low Temperature Carbonisation Company, Ltd. It is difficult to give figures in a short article, but there is no question that enormous savings can be effected in this direction. For example, if only 50,000,000 tons of coal per annum were subjected to this process, one of the products alone would be 150,000,000 gallons of benzole per annum. This would effect a revolution in the cost of motor transit, and the "coalite" could be used to better advantage than coal, not only for household purposes, but for steam generation as well. The gas would of course be available for gas engines to be used for electric power generation.

Methods of Reorganisation.

The best scheme for national fuel economy is surely to work along all these different lines to a common subject. By taking in hand where the conditions are favourable our already existing steam boiler and power plant and reorganising our out-of-date methods of steam generation, by substituting a due proportion of good quality coal burnt at collieries by refuse coal, by adopting "pass-out" methods for steam in those works, by reducing the condensation losses in steam-pipe circuits and friction losses in power drives, and replacing many antiquated and worn out steam engines, the saving obtained would be about 35,000,000 tons of coal per annum. By also following up with the utilisation of water-power and blast-furnace gas, together with the low-temperature distillation of coal where the conditions are favourable, the total saving would be enormous, and probably something like 55,000,000 tons per annum, the same figure given for the Government super-power station scheme.

All these various methods of economy are, however, obvious, and are not in the nature of a leap in the dark, and they have also the great advantage that they can be carried out gradually and at a moderate cost without disorganising the industry of the country.

Real Economy Not Popular.

The trouble seems to be, however, that real economy is not popular, and such methods are too essentially sound in principle, whilst at the same time they do not lend themselves to notoriety, nor do they involve the squandering of untold millions of money.

Even if the Government principle of wholesale scrapping of plant and machinery might be correct, the scheme as presented is open to the most severe criticism. For example, no mention is made of the almost stupendous annual figure that will be swallowed up for depreciation and interest on the capital expended. This, together with the difficulty of obtaining the staggering amount of new plant required, are two of the most vital points in discussing any such national scheme.

A consideration of one single industry only, that of coal mining, is a case in point, and is characteristic of more or less every industry. The Government report states that 70 per cent. of the coal consumed on colliery boiler plants could be saved. At the present time the collieries of the country consume 6·7 per cent. of the coal they raise—that is, say, 18,500,000 tons per annum on the 289,000,000 tons raised. The typical colliery power plant can be stated to be a "Lancashire" boiler plant with steam non-condensing winding engines, in which the exhaust steam is partially used by being blown into the boiler feed water, and most of the subsidiary power, such as air compressing, haulage, screening, &c., also supplied by steam-driven engines. In some cases, however, the wasteful exhaust steam from the winding engines is economically used in mixed-pressure turbines for electric power generation or air compressing.

Wholesale Scrapping.

If the Government super-power station scheme is adopted, and collieries are electric driven, this involves the scrapping of millions of pounds worth of plant and machinery, including about 6,000 winding engines, say 12–14,000 "Lancashire" boilers, together with untold thousands of steam engines of various sizes and miles of pipes and accessories. If this was carried out, it is open to the very gravest doubt that the saving would be 70 per cent. of the coal bill—that is, 13,000,000 tons per annum. On the other hand, if the existing colliery boiler plants were reorganised and brought up from an average of 55 per cent. nett working efficiency to, say, 70 per cent., the saving would be, say, 4,000,000 tons per annum. Further, if a due proportion of colliery refuse coal was burnt, as already stated, a further saving of, say, 3,000,000 tons would result. By reorganising the existing steam generation plants alone the figure would be therefore 7,000,000 tons. Further, a very large saving could be effected by reorganising the existing colliery steam utilisation plant, and a modern system of steam pipe lagging with partial superheat would alone save, say, 1,500,000 tons per annum. Most collieries are wasting the exhaust steam from the winding engines, which could be economically used in mixed-pressure turbines. Taking all these and other facts into consideration, I do not think it is an exaggeration to say that 10,000,000 tons of coal could be saved per annum on colliery steam boiler plants—that is to say, 55 per cent. of the coal bill. The results are certain and obvious, and such as are already being carried out by some collieries. Compared with the super-power station scheme, the cost of new plant and machinery would be infinitely less, most of the existing plant would continue to be used, and the change would be gradual.

Chaos and Muddle.

Many further arguments, other than purely engineering and scientific, can easily be advanced against the scheme, such as, for example, the usual chaos and muddle on painfully familiar lines, which would almost certainly result from the Government control of power production. It is very curious that the scheme seems to be essentially German in its whole conception, as shown by its lack of imagination and glorification of bureaucracy. Also by the method adopted of presenting a mass of figures in a pompous manner, with a great show of thoroughness, whilst in reality the most vital matters are entirely left out of consideration. In fact, the whole principle is entirely alien to British institutions and ideas, and can be summed up in a few words as centralisation gone mad.

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* *See* The Electrician, Vol. LXXXIV. p. 349.

Centrifugal Boiler Feed Pumps.

By J. WHITE.

OWING to the great development in the design of centrifugal pumps which has taken place within comparatively recent years, the time has come when even the most conservative amongst us and the most bigoted champion of the reciprocating pump has, at any rate, to acknowledge the possibilities of the centrifugal type. Actually at the present time, these pumps have as large, and probably even a larger, field of service than the reciprocating pump. The old troubles of low efficiency and inability to work against high pressures are now overcome and a delivery pressure of 1,000 lb. per square inch at the present time presents no great difficulty. It will be obvious, therefore, that the higher boiler pressure of to-day easily come within the range of a centrifugal pump—in fact, it has become standard practice, both in this country and abroad, to equip power stations in which large quantities of water have to be handled, with boiler feed pumps of this type, direct driven by steam turbines or electric motors. The advantages of a centrifugal pump are numerous and can be tabulated under the following heads :—

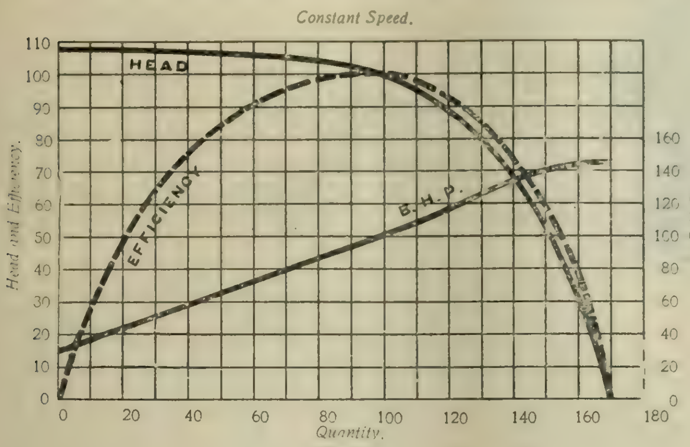


FIG. 1.

1. *Low initial cost.*
2. *Low running cost.*
3. *Small space occupied.*
4. *Light in weight and requiring no expensive foundations.*—The whole motion of a motor-driven set is rotary and without the vibrations of a reciprocating pump. Often, as a matter of fact, centrifugal pumps and motors are run on a test bed without the bedplate being bolted down at all.
5. *Flexibility.*—An examination of the characteristic curve shown in Fig. 1 will indicate that the quantity of water delivered can easily be regulated by the delivery valve, and that this can be done economically as there is no loss due to water having to be by-passed back to the suction. This property is very valuable in the case of a centrifugal boiler feed pump, as it enables the pump to adjust itself to the demand as the boiler feed valves are regulated. For this reason it is specially suitable for a battery of boilers where the load may vary very considerably.
6. *Smooth running.*—The flow of water from a centrifugal pump is continuous instead of intermittent, and consequently there is no fear of shocks in the pipe system. A particular advantage of this is that economiser pipes are not unduly stressed. As an actual example of the usefulness of centrifugal pumps the following case may be cited. A boiler plant was working at a pressure of 200 lb. per square inch. The economisers had got into such a state that they were no longer safe at this pressure. New economisers were out of the question for several reasons and it was therefore decided to put in two centrifugal pumps, each to deliver against a pressure of 100 lb. per square inch. These pumps were arranged to work in series and thus give the full 200 lb. pressure required, but the water from the first pump of the series was passed through the economisers before entering the suction of the second pump. In this way the economiser pipes were only subjected to a pressure of 100 lb. per square inch and could thus be retained in service.
7. *Suitability for direct coupling to a Steam Turbine or High-speed Motor.*—The high speed at which centrifugal pumps can be satisfactorily run renders direct drive an ideal arrangement and dispenses with the noise, expense and inefficiency of gearing.

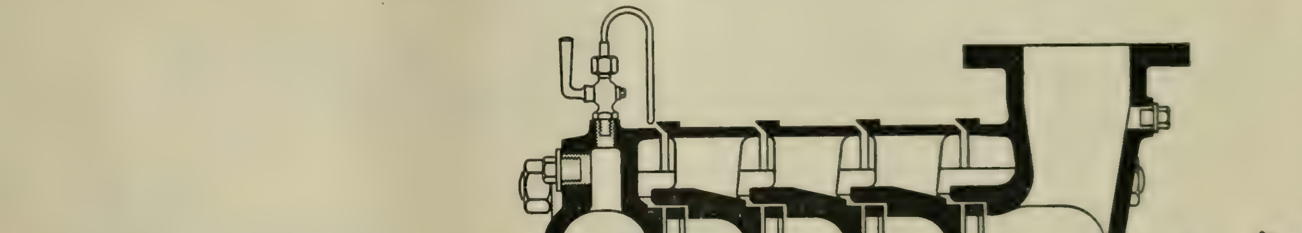


FIG. 2.—SECTION THROUGH FOUR-STAGE ELECTRICALLY DRIVEN PUMP.

The Question of the Drive.

The question of whether centrifugal boiler feed pumps should be driven by steam turbines or electric motors is one which must be settled after all the local conditions have been taken into account. Up-to-date practice in the case of large power stations seems to be to install motor-driven pumps for general use and turbine-driven sets as standby units. Naturally, the turbines required for driving the feed pumps are comparatively small and their steam consumption is high. For this reason, if they have to exhaust into the atmosphere or even into the main condensing system, turbine-driven pumps are not an economical proposition from a steam consumption point of view, and, where they are put to work under these conditions, it is for some such reason as small space available or lack of the necessary electric supply.

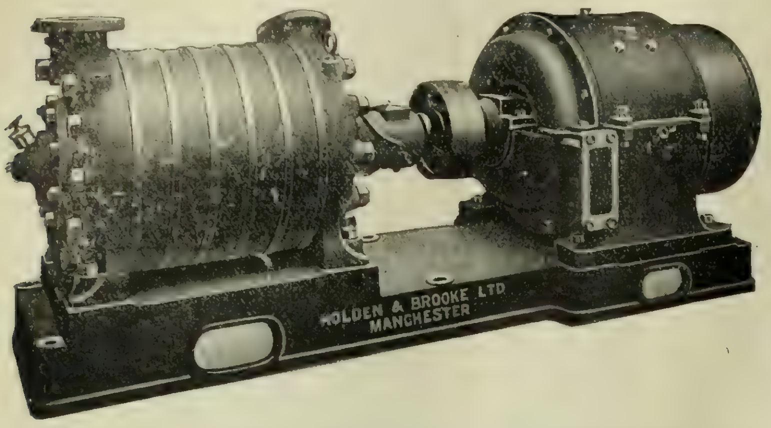


Fig. 3.—Shows a Six-Stage Pump Coupled to a Direct-Current Motor and Capable of Delivering 22,500 galls. per hour against a pressure of 250 lb. per square inch when running at a speed of 1,400 revs. per min.

To obtain the maximum efficiency from a turbine-driven set the exhaust steam is utilised for feed-water heating. Fortunately, owing to the fact that no oil is mixed with the steam used in the turbine it can usually be led directly into the feed water in the hot well through an ejector heater. It may be mentioned, in passing, that without the use of some form of ejector heater serious disturbances would be set up in the hot well tank at a comparatively low temperature, in fact, the use of an ejector heater does not altogether ensure the tank against disturbances when the temperature approaches boiling point. In a large power station where a number of other auxiliaries are electrically driven, centrifugal feed pumps also electrically driven are the best proposition except in the case of a standby set, where, as mentioned above, the turbine driven pump is often used.

Relative Performances.

To compare the relative performance of a steam turbine drive and an electric motor drive it will be interesting to consider the case of a power station in which it is desired to have the feed pump units each capable of delivering 20,000 gallons of water per hour against a pressure of 325 lb. per square inch.

A steam turbine driven pump for the above duty would most probably be of the single impeller type running at a speed of about 6,000 revs. per min., and would have a steam consumption of about 4,000 lb. per hour when running under full load. From these figures it will be seen that this unit would deliver 50 lb. of water into the boilers per lb. of steam used.

An electrically-driven pump for the above duty would be of the multi-stage type, and would most probably run at a speed of 1,450 revs. per min. The pump would have an efficiency of approximately 68 per cent. and the motor an efficiency of 91 per cent., giving a combined efficiency of 62 per cent. As the current for the motor would be most probably taken from the main bus-bars of the station, it can be assumed that the steam consumption in producing this supply would be in the order of 12 lb. per kilowatt-hour. Taking these figures, it will be found that this electrically-driven unit would deliver a little more than 180 lb. of water per lb. of steam used.

We, therefore, have the following results :—

Steam turbine unit delivers 50 lb. of water per lb. of steam.

Electrically-driven unit delivers 180 lb. per lb. of steam.

Of course, it must be borne in mind that there are other factors to be taken into account in considering the question of drive; for example, the increased capital charge in the case of the electrically-driven unit. The above figures, however, have been given solely for a comparison of the amount of steam used in each case.

The Electric Drive and the Multi-Stage Pump.

In the case of motor-driven sets the speed is most often 1,450 revs. per min., and, in order to obtain the required pressure, it is necessary to build up multi-stage pumps. A section through a four-stage pump is shown in Fig. 2. Such a pump is, in effect, a number of single impeller pumps arranged to work in series, so as to obtain a cumulative effect. One stage takes the water as delivered to it from the previous stage and adds its portion of the total head to the water. Thus, if a six-stage pump gives a total head of 300 lb. per square inch, each stage adds 50 lb. pressure to the water as it passes through it. The multiple stages are so arranged and fitted together that they form a complete pumping unit when assembled. See Figs. 3 and 4.

A typical characteristic curve is shown in Fig. 1. Naturally it will vary slightly for different makes and designs, but the general idea is the same for all. It will be seen from the curves in Fig. 5 that the conditions imposed upon a motor in starting up a centrifugal pump are quite light, as the power required is practically nil at very low speeds, gradually increasing as the speed increases and reaching a maximum of a quarter to a third of the full load when the pump is running at its normal speed with delivery valve closed, *i.e.*, delivering no water.

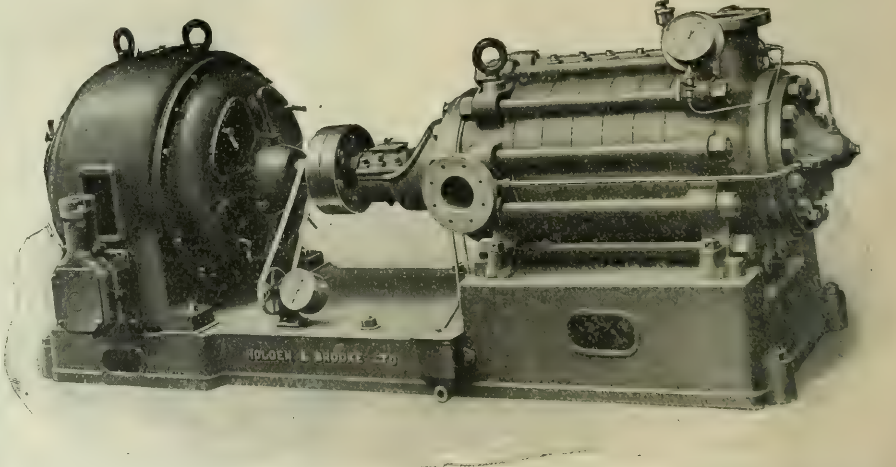
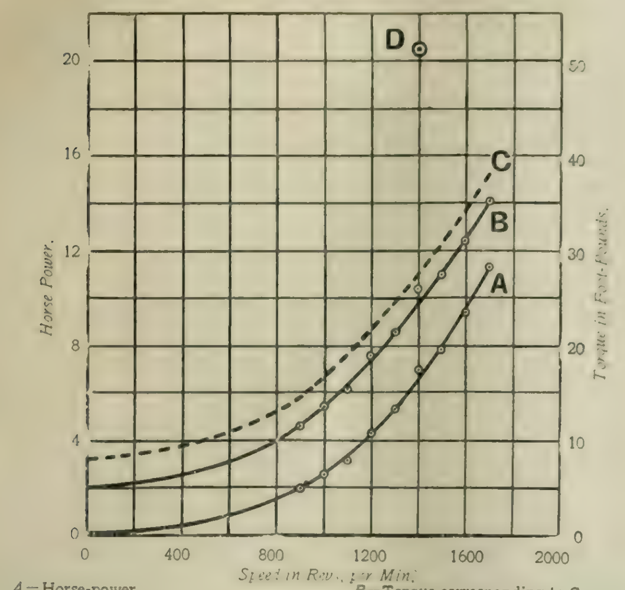


Fig. 4.—Shows an Eight-Stage Pump Coupled to an Alternating Current Motor and Capable of Delivering 20,000 galls. per hour against a pressure of 340 lb. per square inch when running at a speed of 1,440 revs. per min.

The behaviour of a centrifugal pump is so very different from that of a reciprocating pump that a few remarks upon the running characteristics of the former will not be out of place. The curves for a pump running at a constant speed are given in Fig. 1 and show the variation of head, quantity, power and efficiency, all expressed as a percentage of the normal conditions. For example, it will be seen that the quantity will be increased to 130 per cent. and the efficiency decreased to 85 per cent. of the normal when the head falls to 80 per cent. of its normal value. As a result, the power will be increased to 125 per cent. of the normal. This shows that a *slight decrease in head means an increase in power required if the speed is kept constant.* For this reason, in the case of pumps driven by electric motors running at a constant speed, the latter should be capable of taking continuously a load at least 20 per cent. above the normal so as to meet, without being overloaded, any slight variation in head which may occur. It is also evident that the total head against which a centrifugal pump has to work should be correctly estimated, allowance being made for all losses due to friction and shock in the system of pipes. An interesting point shown by the curves is the condition when the pump is not delivering any water. It is obtained in this case by increasing the head on the pump to about 8 per cent. above the normal, and therefore it is clear that the *delivery valve* of a pump of this type *may be closed without fear of the pressure rising to any dangerous degree*, such as happens in the case of a reciprocating pump, and therefore it is unnecessary to fit any by-pass arrangement. It also follows *that a centrifugal pump may be used to deliver into a closed pipe system*, from which water may be taken at intervals, while the pump runs continuously. These curves also show that the quantity at constant speed may be regulated easily by slightly increasing the head. Thus, by operating the delivery valve, the quantity can be regulated to any desired amount and this may be done to a large extent without much loss in efficiency, as a glance at the curve will show.



A = Horse-power. *B* = Torque corresponding to Curve *A*.
C = Total torque including accelerating torque. *D* = Full load horse-power.

Fig. 5.

It may be mentioned in conclusion that modern practice tends more and more towards the installation of centrifugal pumps in place of the reciprocating type in all cases where large quantities of feed water have to be dealt with.

The writer wishes to acknowledge his indebtedness to Messrs. Holden & Brooke, Ltd., Manchester, for the loan of the illustration blocks.

Electric Heating in the City of London.

By A. F. HARRISON.

The City district with its many thousands of offices was naturally the first to make practical use of electricity for heating purposes. The domestic staff of an office block consists usually of a few charwomen who depart as soon as the fires have been lighted, and thereafter the office occupant is left to attend to his wants for himself. When he arrives the fire may be out or the room full of smoke, but business will not wait and the discomfort has to be endured. In larger rooms desks and partitions create cold draughts and shield clerks from the fire, and the room does not get thoroughly warmed until the day is half spent. It is hardly necessary to point out that the electric radiator can successfully solve all these difficulties, whereas a gas stove, like a coal fire, must remain where it can have a flue connection.

An Increasing Demand.

At first consumers were very reluctant to face the expense of installing special circuits for heating purposes, but gradually as the convenience of electric heating came to be recognised this reluctance subsided, and the demand year by year rose to a respectable total. In the early days too, when only lamp radiators were available, and inexperience led to their being in positions well calculated to render them useless, a certain prejudice was engendered, which it took some years to overcome, but the lamp radiator to-day is the same as it ever was, and may be found in common use, a tribute to the fact that its earlier unpopularity was the result of mis-handling.

A few figures illustrating how the demand has grown may be of interest. In 1903 the aggregate capacity of radiators connected to the City of London Electric Lighting Company's mains was 600 kw. By 1908 it had increased to 2,000 kw. In 1914, it was 5,000 kw., and at the present time it is 11,400 kw. During the last six years therefore the progress has doubled notwithstanding the restrictions caused by the war, and it may be said that the addition made during the past winter has been double that recorded in any previous year, and would have been considerably more than double had there been no delay in the delivery of plant and meters required for the accommodation of the demand.

The Effect on the Day Load.

This growing use of electric heating means at the present time an addition of at least 10,000 kw. to the normal load on the Bankside Station on a frosty morning. On Easter Tuesday of the present year an unexpected fog coincided with an equally unexpected frost, and between 9 and 10 in the morning the load reached a peak of 23,000 kw. The station had been standing practically idle since the previous Thursday, and the fact that this demand was met without causing a single complaint is considered no mean performance.

The consumption of electricity for heating has, of course, increased with the load connected. No separate record is available for the year 1903, but in 1908 it reached one million units, in 1914 two million units, and in 1919 five million units. During the period of the war, and particularly during the period of control, it fell away considerably, and the average consumption per radiator connected has not yet quite returned to the pre-war level, showing that the habit of economical use inculcated by control has not yet altogether passed away.

Future Potentialities.

The statistics given above relate solely to the City of London Electric Lighting Company, and it is necessary to add corresponding figures relating to the Charing Cross Electricity Supply Company, whose City undertaking covers the same area. That Company at the present time has radiators with an aggregate capacity of 4,000 kw. connected to its City mains, and for the year 1919 sold two million units for heating purposes in the City. We thus get a total district connection of 15,400 kw. and a sale of seven million units for the year 1919. But though in itself the load is a large one it is actually negligible compared with the demand that lies ahead. A stranger might wander for many days through City offices, and though he would certainly notice the universal use of electric light he would be in no wise struck by the use of electric heating. And yet already the maximum heating demand is not far short of that for lighting. Roughly, it may be computed that 10,000 radiators (allowing an average of 1,500 watts per radiator) are in use within the one square mile, but the total possible demand must be fully thirty times that number.

THE DISADVANTAGES OF A HEATING LOAD.

It is hardly necessary to point out that the individual load factor is very poor, that diversity is almost non-existent, and that regarded by itself the heating load has little to commend it to the supply company. All that can be said is that it is confined to a certain season of the year, and during that period occupies during daylight hours plant which is required each evening to meet the lighting peak. There is reason to believe that some of the heating demand runs off in the afternoon as offices get thoroughly warmed up, and to the extent that this occurs the heating supply is valuable.

Up to the present supply undertakings have not had to deal with heating upon a large scale. It has been regarded as an adjunct to the main purposes for which electricity is used, and much has been assumed in regard to its value and profit earning possibilities. Whether, at the reduced price usually charged, it is or is not a paying business for Electric Supply Undertakings is a question which is likely before long to call for a definite decision.

THE COAL FIRE FETISH.

The open coal fire, admittedly wasteful, and now become an appallingly expensive luxury, is looked upon with suspicion, and people are beginning to realise that other and cleaner methods, though possibly more expensive in themselves, achieve such economy in cleanliness and absence of labour that their adoption means an actual reduction of expenditure to the user. These other methods will therefore be used much more freely in future, and their adoption will be hastened by the difficulties in retail coal supply brought about by the scarcity and cost of transport and labour. For many years past more gas has been sold for heating than for any other purpose, but it is clear that only a fraction of the possible field of business has yet been touched.

Now there is a great probability that this demand on the part of the public for a less troublesome heating agent than coal will gradually turn from gas to electricity for the reason that electricity is yet cleaner and more automatic in action. It is admitted that coal for home consumption is already being provided at less than cost price, and must inevitably become still dearer as the quantity exported is reduced. Gas and electricity undertakings of course will be called upon to pay more for the fuel. Doubtless they will in such case both become dearer themselves, but the effect of dearer coal will be greater in the case of gas and the relative position will thus be more favourable to electricity.

LESSONS FROM THE LATEST INCREASES.

The acceleration in the rate of progress in the City district during the past year, to which reference has already been made, may be cited as some proof that this movement is already on foot. For it is not confined to the City of London only. Every electricity supply undertaking has the same tale to tell, the only difference being that the City district has already accumulated a comparatively large heating business. Drawing conclusions from the parallel of the gas industry we may apparently anticipate in the not far distant future a heating demand exceeding that for all other purposes combined, and it is open to question whether the loss of load factor which will inevitably ensue will be sufficiently compensated by the increased sale.

The answer to this question probably depends upon the average provision in mains required per radiator connected, or in other words upon density. The difficulty will be the capital cost of distribution. In suburban or country districts this may easily prove prohibitive and compel a tariff designed for the purpose of discouraging the consumer from using electric heating. In town areas density may be attained, the mains difficulty will not be so great, but there is the danger that popularity may cause trouble at the generating station where the unanimity of demand in cold weather may prove disconcerting. While the radiator remains an instrument by which the consumer can inflict an uncomfortable demand upon his supply station without incurring a compensating addition to his quarterly consumption these difficulties will certainly be encountered. It cannot be said that either of them has yet become acute, but if the present acceleration in heating demand becomes an established enthusiasm on the part of electricity consumers they will very quickly become apparent.

HEATING LOAD AND LOAD FACTOR.

So far as the City district is concerned, the heating load has probably a higher value than elsewhere. Every room is occupied throughout the day, and each radiator connected is certain to be a source of steady revenue, though as pointed out it is the product of a poor load factor. But the load factor on the whole output within the district is already very poor (about 16 per cent. only) with little or no prospect of improvement, and the addition of a large heating load cannot have such a destroying eeffct as it may have in an industrial area. A reduction from 16 to, say, 12 per cent. would cover a very large addition in heating, and would not make much difference to the cost of production. Elsewhere the drop might be from 25 or 30 to 15 per cent. with uncomfortable, if not disastrous, results.

THE PRICE QUESTION.

The existence of a considerable heating load in the City has compelled more careful attention to the price charged for heating supplies. In spite of the policy pursued by other supply authorities the price per unit in the City has never been allowed to fall below 1½d. per unit, and as the demand and consumption is greater than elsewhere it would not appear to have proved excessive.

Every electricity supply undertaking will shortly have to undertake the revision of its tariff in the light of post-war experience, and the heating rate will require careful consideration in each case since it may soon become the most important of all. It appears desirable to arrive at some method of distinguishing between heating and cooking supplies, since the latter is obviously of greater value, possessing clearly the possibility of diversity in demand coupled with consumption throughout the year. The domestic service difficulty is having the effect of concentrating cooking operations in the period preceding the mid-day meal, a tendency which deserves to to be fostered by the manipulation of the tariff adopted since it will enhance the value of the cooking load to the generating station.

THE INHERENT INIQUITY OF THE HEATING LOAD.

Failing the invention of some method of heat or thermal storage, which will entirely alter the chief characteristic of the heating load, every effort must be made to overcome its inherent iniquity, bad load factor, by seizing upon and carefully encouraging every use of electricity likely to promote diversity of demand. Cooking, water heating, vacuum cleaing, ironing and many other somewhat neglected applications all come within this category. Comparative conditions are altering in favour of electricity, and the consumer is being forced to take less account of immediate cost and more account of ulterior advantages. No amount of theoretical or mathematical argument in favour of gas can alter these, and as electrical apparatus loses that air of mystery, which is simply the result of ignorance and must inevitably disappear, the demand for heating will eclipse all others.

Some Paradoxes of Supply.

By H. E. GOODY.

One of these days, I suppose, the business of electricity supply will lose its many fascinating inequalities, and become, like gas, a thing of almost blatent unmysteriousness—an affair for tradesmen rather than for those artisitic spirits who have framed the curiously elaborate systems of selling current which are a perpetual paradox to the logically-minded consumer. Of course, I am well aware that there exist the most excellent reasons for the majority of these apparent absurdities, but for the moment I am taking the view of the ordinary consumer. He does not understand the reasons underlying the financial complexities of electrical supply, and it seems to me that a great many householders would rather pay a little more if they might be saved the mental effort involved in trying to comprehend some of the present methods of charging.

Sometimes, as in the case of the "rateable value" and "maximum demand" systems, the system itself is complicated; in other cases, the basis of charge is pretty clear, but there exists an element of unfairness, which irritates the man who has to pay the bill.

Differentiation between Lighting and Heating Rates.

The most obvious example of this is the common differentiation between lighting and heating rates. It is evident to the most unintelligent user that exactly the same current is used for both purposes. Why then should he be charged, perhaps, five times as much for the one as for the other, especially when they coincide in point of time? There is only one justification for different charges, and that is when they are applied to different parts of the day. The man in the street understands that distinction; he is used to paying one price for an entertainment or exhibition in the afternoon, and another price in the evening. He could easily be made to appreciate the economic necessity of charging more for current during the period of the peak load.

Presumably, the lower heating and cooking rate was invented because it was assumed that such a load would inevitably be a day load. As a matter of fact, it generally is not. (Of course, I am dealing with domestic consumers.) The majority of heating and cooking devices in use take the form of radiators, kettles, hotplates, &c., and it may safely be estimated that from 60 to 80 per cent. of the current consumed by them is consumed during the lighting period. The object of the supply engineer, in arranging a differential rate, should be to encourage a domestic day load, a thing the present system certainly does not accomplish.

Day and Night Rates.

There is just one way of achieving this, and it is such a simple way that I will not insult readers of The Electrician by suggesting that it is new. Hundreds of engineers have doubtless thought of it, and for some good reason have decided that it was impracticable. However, having gone so far, this naïve plan must be outlined. Here it is: Charge the low rate during the daytime and the high rate at night. Two meters would be required, as at present, but only one system of wiring. Between the two meters would be fixed a special form of time-switch, either electrically operated or electrically rewound. This time-switch would have to be re-set by the meter reader every quarter to accord approximately with the varying incidence of the lighting load. During the summer quarter, for example, the switch might be set so that the high-rate meter was in circuit between the hours of 7.30 or 8 p.m. and, say, 4 o'clock in the morning. For the remainder of the 24 hours the low-rate meter would be in circuit.

Such a scheme would mean that all current used during the period of daylight would be charged at a 1d. or 2d. a unit, and all current, for whatever purpose, used after dark, at the ordinary lighting rate. This would have three advantages; it would tend to flatten out the peak of the domestic load; it would save money in the wiring of new premises, because there would be no need of a special power circuit; and, finally, such a method of charging would be essentially fairer and more comprehensible to the consumer, although it should not involve any decrease in the central station revenue. I daresay that there is not at present a sufficiently reliable time-switch for the purpose, and that is no doubt the reason why the scheme has not been so far adopted. Obviously, unless the time-switch can be left to itself for at least a quarter, the whole scheme falls to the ground.

Discrepancy in Flat Rate Charges.

Another supply paradox which exercises the minds of many consumers is the tremendous and apparently unreasonable discrepancy which exists between the flat rate charges in different neighbourhoods. In London, for example, the rates vary from about 4d. to 8d. A ½d. or a 1d. difference might be reasonable, but variations of 100 per cent. are really too great, and simply lead the ordinary business man to suspect the competence of those who calculate the works costs on which such rates are based. Perhaps, in the delightful fashion of the French waiter who was in the habit of including the date in the totals of his customers' bills, the supply rates have to bear the cost of irrelevant items such as district maternity homes and summer outings for the local guardians. Often, too, the rates are high where one would expect them to be low, and low where, as in certain scattered residential districts like Barnes, they might excusably be high. In East Ham, where there should be a great number of consumers and a considerable power load, the lighting rate is 7½d. per unit. In Barnes, with relatively few consumers, a very small power load and no trams, the lighting rate was, until recently 5d.; it is probably 5½d. now.

The unfortunate consumer who moves from one district to another has to face, not only the probability that all his lamps and other appliances will be useless in the new house, but also the terrifying possibility that his current may cost him twice as much as before. Of course, there is not a standardised price (still less a standardised quality) in the case of gas, but, within the area of greater London, one is pretty safe in assuming that no price variation will be more than a small percentage.

The Value of Control.

As to the question of different voltages and systems of supply, well, I suppose every station engineer will defend his own choice of plant and his inalienable right to inflict upon his consumers any voltage which he may consider desirable. I am not a central station man, and I do not pretend to be able to lay down the law as to the relative merits of direct current and alternating current, 100 volts and 200 volts; but I will not hesitate to say that it would be better for the progress of the industry and for the public if we had the most inefficient system of supply conceivable, providing that it was standardised throughout the country. Everybody is engaged just now in cursing Government control. It is a pity that there was not more control in the early days of the electrical industry. If there had been it might by now have become a real business, instead of being either a charity or a hobby.

I possess an electric hairdryer which I value exceedingly, not only on account of its usefulness, but also because it took me nearly six months to get it. My present tenancy expires in a few months, and I have to find a neighbourhood to suit, not my family, *but my hairdryer!* I cannot do without it, and life is too short to contemplate having it rewound or exchanged. What a ridiculous commentary on 40 years of electrical progress! What a damning, though slightly funny, indictment of the policy of allowing supply undertakings to choose their own systems.

The Prepayment Meter.

Let us pass from this personal tragedy to the persistent problem of the prepayment meter. The prepayment meter is good; but there seems to be no adequate reason why the user of one should have to pay more for his current than the man who has an ordinary meter and does not settle his account until the final demand note arrives. It may be urged that slot meters involve an extra expense for collection. Do they? I rather fancy the boot is on the other foot. Certainly the slot meter costs more to buy than the ordinary meter, but it is very doubtful whether the cost of postage, the delays in settlement, and the cash discounts which are occasionally allowed, do not involve a relatively higher cost for the collection of the ordinary quarterly accounts. In addition, one has to remember that the collector, in the case of the majority of domestic consumers, not only has to send an account by post, but also has to call personally for the money.

In any case, supposing that the cost of the slot meter collection is proved to be the higher, it is manifestly unfair that the best customer should have to pay most for the privilege of prepayment. If an extra ½d. a unit is charged for slot meters, the man who uses 20 units a year pays 10d. for the accommodation, whereas he who uses 100 units pays 4s. 2d. This is obviously unjust, and can only be remedied by expunging the extra charge, and putting the obliging prepayer on the same footing as the most dilatory quarterly consumer. The latter, of course, pays a meter rent. This rent, or a slightly higher one, could easily be collected in advance, once a year or once a quarter, from the slot meter user.

In conclusion, it is interesting to observe how the different supply companies severally regard the question of the arrangement of main fuses. I know of one block of flats in a London suburb in which the only main fuse is a 50-ampere fuse controlling the whole block There are neither consumers' nor company's main fuses in the flat only circuit fuses. A short circuit beyond the circuit fuses would plunge the flats in darkness; and on at least one occasion a fault in a lampholder blew, not only the 10-ampere circuit fuse, but also the 50-ampere fuse in the basement. Incidentally, this latter fuse was made up of a number of strands of 5-ampere tin fuse wire, and the idea that its capacity was 50 amperes was a vain imagining of the supply company's inspector.

The Development of Electrical Sales.

By "ELECTRON."

Being Three Open Letters to Those Concerned in the Future Development of the Electrical Industry.

Letter No. 1

To *K. Watts, Esq.,*
Engineer and Manager,
The Blankshire Electricity Supply Corporation,
High Tension, Blankshire

My dear Watts: Have you realised that the day has gone by when it was a glorious achievement to reduce the lubricating costs by a figure residing in the fourth decimal place? That was the time when you used to revel in the title of "Chief Engineer" and your main efforts were devoted to solving the problems of generation and distribution. But since then your title has had the magic word "Manager" tacked on to it. That new title implies that you are not only responsible for the economical supply of electricity, but that you have to take your share in selling "juice" and developing a public demand for it.

You've now got to realise that the average man in the street cares nothing for your beloved terms and symbols. Amperes, volts, kilowatt-hours mean nothing to him. To interest him your appeal must be plain and easily understood.

The user of electric motors buys them and the electricity that propels them as something which drives his machinery. The lighting consumer buys illumination. The cooking and heating consumer buys heat. The user of electric fans buys either ventilation or a cooling breeze

None of these people are interested directly in electricity as electricity. They only regard your magic "juice" as a service which enables them to satisfy their need for power, heat or light.

To create a further demand for any of these forms of service it is necessary for you to produce in your prospective consumers' minds visions of the service which electricity can give in the home, office, shop or factory. How are *you* tackling this important problem?

Women probably form the majority of visitors to your showroom. And though they are a delightful sex, they have their idiosyncracies. It is more important to them that there is no dust on their dining table than that your salary is £10,000 a year, more or less. Is your showroom kept clean and dusted, so as to drive home the advantage of cleanliness? Do you periodically change your window and showroom display, and make one particular appeal at a time? For example, a 14-day demonstration of vacuum cleaners, irons or kettles is a good idea. Or is your showroom more like a museum with a ceiling crowded up with fittings so that none of them can be seen effectively?

It is a far quicker and more effective method to drive one particular message home at a time by means of a specialised display than to endeavour to make a general appeal for all classes of domestic apparatus all the time!

Many women, and more men, are shy of asking questions. If you are married you may not think so, but it's true. Therefore employ neatly written display cards, stating the price of the apparatus and the cost per hour to run in pence or shillings. Don't use the word unit.

A display rack or table with propaganda literature upon it should be placed both in the showroom and in the cashier's office. And some form of advertising matter should be handed out with all receipts.

Good leaflets and enclosure cards, &c., can be obtained quite reasonably through the Electrical Development Association, which, of course, you are enthusiastically supporting. Much of the manufacturer's literature is too technical and therefore confusing and harmful to the average consumer.

What is the position regarding your staff? Have you aroused their enthusiasm in developing the sale of "juice"? Your meter inspectors come into daily contact with your customers and quite often their opinion is asked. The laudable efforts of your Sales Department representatives can be easily nullified by faint-hearted answers or adverse replies from the staff of the meter department. A conference with your meter men accompanied with demonstrations of the apparatus will go far towards obviating this difficulty. Don't discourage flirtation with the cook.

Don't forget you are in reality selling "service" (not the mains type), a really great service, and it is necessary for you to shape your policy accordingly. The secret of successful business-building is not only to sell to the customer, but to keep him sold, *i.e.*, happy with his purchase. The greatest cause of annoyance to the consumer, particularly the householder, is the cost of small repairs. Men's time and overhead charges have naturally to be paid for, but it would save many pin-pricks and promote business generally if the price charged for "juice" included the service of replacing fuses and making minor repairs, and the necessary increased cost per unit would not be high.

Again, when you have sold an iron, a cooker, or a heater to Mrs. Jones, don't heave a sigh of satisfaction and forget it. After a reasonable time arrange for a representative to call and see if the article is giving satisfaction.

If your monthly meter records indicate abnormal consumption on any premises a representative should be sent to ascertain the cause. Not because the meter may be wrong, but to safeguard against the ultimate kick which is likely to occur when the consumer gets the quarter's bill.

Finally, remember there are others concerned in your progress besides your consumers and your staff. There is the contractor. Are you neglecting him? Bear in mind even if you have a contracting department he can help, and if you haven't he is a necessity in finding outlets for your "juice."

Has it occurred to you that a quarterly round-table conference would do much to arouse enthusiasm and to promote goodwill between the contractors and your undertaking? By dividing the area geographically on mutually agreed lines and then acquainting the contractors concerned of new mains extensions you would help both them and yourself. Cursing the poor contractor may relieve your feelings, but it does not help him or you to develop your respective spheres in the industry.

Yours to an Ampere,
"Electron."

Letter No. 2.

To *A. B. Cleats, Esq.,*
Electrical Engineer and Contractor,
7, The Parade, Unitville.

My dear Cleats: There is an old American saying that you have either got to get on or get out. There is quite a nice little profit to be made on the sale of accessories such as kettles, irons, heaters, lamp-shades, &c. Why leave it all to the drapers? Have you noticed how the big stores are advertising these lines? They find the public want them but does not know the electrical contractor also sells them. What is more, so long as your window represents an antique dealer's collection of lamp-holders, ceiling roses, wire, &c., they never will realise it.

Wake up, man, and obtain your share of that prosperity for the industry which is undoubtedly coming through the public interest in the service electricity offers. Make an appeal to the public through the medium of your shop and its window, and keep both in such shape that an impression of tidiness and cleanliness is conveyed—cleanliness and labour-saving are the two great advantages of electricity!

Be more up-to-date in your methods—the public is daily becoming more used to receiving typewritten letters, and the scrawled estimate on a soiled sheet of paper is a relic of the past.

In estimating for electrical installations remember you are the man who should know, and it is up to you to see that the customer gets an installation which will not only serve for the present, but which can be easily extended at a later date when occasion arises. State definitely what you are quoting for and give reasons for including two-way switches, wall plugs, and extra size main feeds, and a spare way or two on the "dis" board. This will not only protect you against the firm that employs a policy of "Cut and Skimp," but also tends to bring you the future business for apparatus and extensions. Every wall plug installed offers an opportunity for the future sale of apparatus, be it a lamp standard or kettle, &c.

Don't let your interest evaporate with the payment of your bill. At a later date write or call to find out if the job is giving satisfaction. Keep a card index of your customers, so that when you have a new stock of apparatus or accessories you can write and tell them about it.

The supply authority and yourselves depend upon the public for progress. It won't help you to grouse to your customers about the supply authority. That only tends to bring electricity into disrepute and harms all parties.

Cultivate the goodwill of your staff and encourage them by adequate remuneration to bring you information concerning removals, new buildings, &c., and to take an interest in the progress of your business generally. Demonstrate various new accessories and apparatus to the staff. The wireman has many an opportunity of suggesting the use of domestic appliances when on customers' premises for the purpose of repairs and extensions.

You must endeavour to make good use of manufacturers' show-cards, and general advertising literature similar to that supplied by the Electrical Development Association. Showcards under your counter represent waste. In your window they will help to develop trade.

It is unfair to expect the other party to do all the spade-work. The eventual development of the Electrical Industry depends upon the active co-operative efforts of all concerned. You must, therefore, do your share, not only in perfecting your methods of business but also in educating the public up to the service that electricity offers.

Yours to a Switch,

"ELECTRON."

P.S.—There is much that applies equally well to you in my letter to Mr. Watts, of the Blankshire Electricity Supply Company, a copy of which is enclosed.

LETTER No. 3.

To *Messrs. Assembled Stampings, Ltd.,*
Punchdale Works, Westingham.

Gentlemen: Are you doing all you can to help the supply authority and contractor to dispose of the electrical merchandise that you manufacture? Or are you merely distributing your goods via the wholesaler to the trade retailer and leaving it at that?

In many industries manufacturers have found that it pays them to devote considerable attention to ways of helping the retailer to a quick sale of their goods. Not only is a careful study made of the conditions in which the goods will be used, but the goods are packed in an attractive way, adequate literature and advertising matter for window displays is provided and freely distributed.

In the electrical industry we daily come across lighting fittings which are neither artistic nor efficient from the point of view of good lighting or ease of wiring. Cooking apparatus is made in which the question of easy access for cleaning seems to have been completely overlooked, and some forms of radiators cause considerable waste of time when faulty elements have to be replaced. Many serviceable electrical accessories such as kettles, irons, &c., are purchased for presents, yet in how many cases is an attractively designed box or carton provided? It is just the little additional touch that means so much, and yet gets overlooked. But who likes to give away a present wrapped up in an awkward brown paper parcel?

It is a mistake to suppose that advertising literature in the form of leaflets should be written in the style of an excerpt from your catalogue. The man in the street does not understand what 3 kw. stands for, therefore why quote a 3-kw. heater at say price £3? Better call it a heater size No. 3, suitable under average conditions for heating a room of 2,000 cubic ft. capacity. Also the general descriptive matter in the leaflet should be written in a style calculated to promote a desire to purchase a heater, rather than to assume that the desire exists and all that is required are details regarding the various patterns you manufacture.

Your future progress depends upon increasing the demand for electrical energy and is therefore bound up with the activity of the supply authorities and the electrical contractors. It is, therefore, to your interest to endeavour by suitable specialised manufacturing methods to produce apparatus at as low a price as possible and to help the supply people and contractors to stimulate the public demand for electricity.

The publicity efforts put forward by the lamp manufacturers are certainly to be commended and, of course, their efforts have and will benefit the whole industry. It is doubtful, however, whether, granting they are willing, one section of the industry can afford to maintain continuously an advertising campaign of adequate size, and it is certainly unfair that all the expense of a campaign which benefits all should fall upon one section of the industry. Also, if various large sections were to start similar campaigns nothing short of chaos might result.

The more logical method seems to be to entrust this work to the Electrical Development Association, and thus to arrange for centralised control and for each section of the industry to carry a fair share of the cost.

It is not only press advertising that is required, but in addition the E.D.A. should set up a Bureau of Electrical Information, from which the public can obtain detailed information concerning new processes, equipment and development generally; such information to be collected from all parties, supply authorities, contractors, manufacturers and electricity consumers.

This information would be extremely valuable in connection with preparing new designs and arriving at standard types, and would also indicate the lines along which future demands were likely to arise.

Mutual co-operative effort between all parties will not only help the industry as a whole to progress, but will also reveal the difficulties with which each section has to deal. The manufacturer will learn through the supply authority and contractor where apparatus fails in the eyes of the public, and vice versa the contractor and supply engineer will learn of previously unthought-of difficulties and limitations in manufacturing under present-day conditions.

This distribution of information might even be taken further by arranging a National Electrical Conference Week in conjunction with an Electrical Exhibition at Olympia or other suitable place. Such a conference, and the exhibition for that matter, might be arranged by a committee composed of representatives of the various organisations who look after the interests of various sections of the industry, *e.g.*, the B.E.A.M.A., I.M.E.A., C.M.A., I.E.E., &c. To aid in creating still wider interest, various sections of the conference could be thrown open to interested parties, *i.e.*, the lighting section could issue invitations to builders and architects.

The latter part of this letter has digressed on to topics not solely concerned with the manufacturer, but generally speaking the manufacturers have learned the lesson of the value of co-operative and combined efforts more thoroughly than other sections of the industry, and therefore they form a suitable starting platform from which to build up the further co-operative effort of the whole industry, which is sorely needed at the present time.

Electricity is undoubtedly a great agent, but in these days the sale of such a product (which incidentally produces a sale for all electrical apparatus and material) can only be developed by active effort. The quality of the product is not in itself sufficient to ensure the rapid progress which can be had if only the industry reaches out for it. The idea that a good wine needs no bush is as dead as the gas mantle.

Yours to a Press,

"ELECTRON."

A Large Pulverised Coal Plant.

A brief reference to the pulverised coal installation which is to be erected at the new Milwaukee Generating Station appeared in our issue for May 21; we are now able to give further information regarding this plant.

We are informed that the Milwaukee Electric Railway and Light Company, of which Mr. John Anderson, a Scotsman, is chief engineer, after more than two years continued use of pulverised coal under five of their boilers in their Oneida-street plant have decided on using this form of fuel in their new Lakeside Power Plant, which they now have under construction. In the present station a comparatively small amount of fuel is used daily, only five out of a total number of the ten 468 H.P. water tube boilers having been equipped for burning pulverised coal, or an installation of less than 2,500 developed horse power operating alongside of a duplicate installation equipped with stokers. It naturally follows that if the efficiency obtained with pulverised coal and the economy of the operation compares favourably in a plant of this size, the results to be realised in a larger plant will be still more favourable. For it is well recognised that the cost of preparation of coal is reduced as the quantity handled increases.

The new Lakeside power plant of the Milwaukee Electric Railway and Light Company will contain an installation of eight 1,306 h.p. Edgemoor water tube boilers fired with pulverised coal, the furnaces being arranged to operate continuously at 250 per cent. rating. The first unit will be of 40,000 kw. capacity. Later there are to be two additional units of 80,000 kw. added, making the ultimate size of the plant 200,000 kw. The contract for the drying, pulverising and transportation equipment has been placed with the Fuller Engineering Company of Allentown. The drying equipment will consist of Fuller indirect pulverised coal fired rotary dryers with induced draft and complete dust collecting equipment. There will be eight Fuller pulverisers and complete Fuller-Kinyon pulverised material pumping system for delivering the pulverised coal from the pulverising plant to the bins above the boilers. This installation is now under construction, and the first four boilers are expected to be put into operation by December 1, 1920. This will be the largest installation of power-house boilers fired with pulverised coal in existence, and no doubt it will attract attention from engineers throughout the world who are interested in fuel economy, and the complete combustion of coal of any quality.

Incorporated Municipal Electrical Association.

Monday, June 21st.

During the late afternoon and early evening members, delegates and visitors, including a number of ladies, began to arrive at Ilkley, to register their names at the King's Hall, to find their rooms at the various hotels, to renew old friendships and generally to settle down to serious work. Unfortunately the housing difficulty has led to a crowding of the hotels in this beautiful residential spot, and has as a result prevented the accommodation of those attending in one hotel This, to a certain extent, cannot help detracting from the social amenities of the Convention, while at the same time it has meant an enormous amount of work on the part of Mr. Thomas Roles and those making the arrangements. However, every one settled down without a hitch, the only untoward incident being that one party had rooms booked for them at two hotels, which, at any rate, was better than having no room at all. In the evening an informal reception was held at the King's Hall, at which dancing took place. This formed an excellent send off to the work of the week, while the many informal gatherings in the various hotels were equally successful.

Tuesday, June 22nd.

The Convention was lucky in the fine weather which attended their journey from Ilkley this morning. A special train conveyed our party to Bradford, where they were joined by those staying in that town and other districts. The meeting is being held in the Queen's Hall, "The Windsor," Moseley-street, Bradford, which in normal times is used as a cinema, and provides therefore many facilities which are not always present in some halls with which we are acquainted. A feature of interest was the flowery background before which the Convention sat, while the acoustic properties were an obstacle to the more inexperienced speakers. Among the gathering we were glad to see Dr. de Ferranti, Mr. C. H. Wordingham, Ald. Fred Smith, and many others.

Here punctually at ten o'clock the Convention was welcomed by the LORD MAYOR OF BRADFORD (Ald. Wm. Wade, J.P.), who called attention to the satisfactory position of electricity supply in the city, and expressed the opinion that it had come to stay, and that its employment was likely to go on increasing. After having briefly thanked the Lord Mayor for his welcome, the PRESIDENT (Mr. Thomas Roles, city electrical engineer and manager, Bradford) then delivered his address. We give an abstract of this below.

Mr. Thomas Roles' Presidential Address.*

The electricity supply industry can claim to have adapted itself to meet the new conditions consequent upon the peace as well as it rose to the great emergency occasioned by the commencement of a terrible and unexpected war. On the Incorporated Municipal Electrical Association has fallen the task of rendering assistance to its many members in enabling them to meet the difficulties which have been almost daily experienced, and the Association's Council has had a very strenuous year of labour.

THE ELECTRICITY SUPPLY ACT.

The year must for ever remain memorable, as during its course the Electricity (Supply) Bill received the attention of both Houses of Parliament, and the Electricity (Supply) Act, 1919, came into operation. This Association may congratulate itself that many of the provisions of the Act give powers which the Association has itself for years laboured to secure, and a number of such powers have been obtained directly as the outcome of the efforts of the Association's Council.

The removal of the disability as to subscribing to Associations has already been of distinct advantage to this Association, and it is to be hoped that no municipal electricity supply undertaking will fail to avail itself of the advantages which membership of the Association affords.

THE HIRING OF APPARATUS.

Powers to provide apparatus on the hire-purchase system and to sell outright are very necessary in the interests of municipal undertakings. Such powers could be utilised for the benefit of consumers of electricity, electricity supply undertakings, electrical manufacturers and electrical contractors, and it is to be hoped that the relations between the Electrical Contractors' Association and this Association may become such that some agreement may be reached under which a successful attempt may be made by municipal electricity supply undertakings to secure powers for hire-purchase and sale.

THE NEW ELECTRICITY BILL.

It is a matter for regret that the Government found it necessary to withdraw certain clauses from the original Bill. This regret is not shared by a large number, who are of the opinion that the Act as it now stands is sufficiently comprehensive for all practical purposes, and that its provisions should be given a trial prior to any further legislation on electricity supply matters being promoted.

THE FINANCIAL CLAUSES.

From the point of view of the electricity supply industry, the financial clauses in the new Bill may be said to be the most important, as the financing of joint electricity authorities is impracticable until some such provisions are made.

UNREASONABLE OPPOSITION

With regard to that part of the Bill which concerns the setting up of District Electricity Boards and the compulsory acquisition of generating stations and main transmission lines, although in many cases such powers may not prove necessary, yet it is essential that the Commissioners should be provided with them, as otherwise it is difficult to see how they are to enforce the carrying out of a desirable scheme in face of unreasonable opposition from one or more electricity undertakings in the district to which such scheme is to apply. As things are at present, one unreasonable electricity supply authority might hold up a scheme which would be of benefit to a very large area. There is no reason why the Commissioners should not be furnished with the powers necessary to enable them to enforce the carrying out of proposals which they deem to be in the public interest, and it will be generally conceded that provision should be made under which generating stations and main transmission lines may, under certain circumstances, be compulsorily acquired. The provision of an adequate supply of electricity at the cheapest possible prices is an absolute necessity to the welfare of this country and its inhabitants, and no interest, either municipal or private, should be allowed to stand in the way of such an adequate and cheap supply being furnished, though, as President of this Association and chief officer of a municipal electricity supply undertaking, it is my duty to ensure that, as far as possible, municipal interests are conserved and furthered.

THE COMPOSITION OF THE OPPOSITION.

On general principles the Bill before Parliament should, therefore, command the support of local authorities. Of the noble lords who first opposed last year's Bill, one is a director of certain electricity supply companies, and the other was recently the President of the British Commercial Gas Association. The former, while not opposing the Bill as a whole, objected to that portion which related to the formation of District Electricity Boards; the latter objected to the Bill *in toto*. Having, then, in view the sources from which opposition to the measure emanated, local authorities would not be wrong in coming to the conclusion that last year's Bill, including the clauses which were deleted, was one which on the whole might be regarded as in no way inimical to their interests. It follows that municipalities should look with favour on the Bill at present before Parliament; but up to the present there seem to be few signs that this Bill is receiving any great amount of support from local authorities. It is high time that municipalities and the associations representing them came to some decision with regard to this matter, and defined a policy which their representatives and officials are to pursue on their behalf.

THE ASSOCIATION AND CONTROL OF ELECTRICITY SUPPLY.

It has been accepted by this Association that, in the interests of the country, the generation and main transmission of electrical energy should be placed under public control, and additional powers on the lines of the provisions of this year's Electricity (Supply) Bill must now be obtained. In view of the indifference and, apparently in some cases, open opposition of municipalities to the Bill, in fairness to municipal representatives and to officials who are responsible for the control and management of municipal electricity supply undertakings, and to the Council of this Association, the time has now arrived when each municipality should give some definite indication of its opinions, as has already been done at Bradford, where the opinion is that the control of electricity supply should be in the hands of duly elected public representatives.

OBJECTIONS TO JOINT ELECTRICITY AUTHORITIES.

One objection to the formation of joint electricity authorities and district electricity boards is that, in view of the heavy financial liabilities which municipalities are having to incur in connection with housing and other matters, they cannot be expected to incur further responsibilities by financing electricity supply schemes. It is advisable to consider the probable result should this attitude be generally taken up. The very great demand for electricity which is now being made must be met, and the Government have rightly determined that it shall be met. If the principle of public control is to be given effect to, this must be done either by schemes financed by the Government or by municipal bodies individually or in association. It appears quite clear that, under present circumstances, the Government is not in a position to finance such schemes, and, were they able to do so, Government control of the generation and main transmission of electricity would not be in the interests of the community. No objection has been raised by municipalities to their representatives taking a share of the responsibility for the control of electricity supply in the districts in which such municipalities are situated, provided that the financial risks are borne by the Government. It is not to be expected, however, that the Government, if it were prepared to take such financial risks, would entertain the idea of placing the control in other hands than their own. Such being the case, it must follow that if the Government will not, or cannot, supply electricity under a national scheme, and municipalities object to carry out the work by reason of the financial risks involved, the only alternative will be to hand over the task of the development of electricity supply to private enterprise.

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* Abstract.

THE SUPER-STATION BOGEY.

No grounds for serious apprehension with regard to the financial position exist. Such apprehension has arisen as a result of the flood of loose talk which has followed the issuing of the report of the Coal Conservation Sub-committee and the introduction of the Electricity (Supply) Bills. The general impression seems to be that it is the Government's intention to erect and equip 16 electricity generating stations of tremendous size in various parts of the country; that on these super-stations being put into operation all existing generating stations are to be scrapped; and that from these super-stations thousands of miles of mains are to be laid, quite irrespective of whether the revenue obtained from the electrical energy supplied through them will be sufficient to meet the capital outlay involved, and the working expenses incurred. But it is made clear by the Electricity (Supply) Act, 1919, that such schemes as are undertaken are to be carried out only with the sanction of the Electricity Commissioners. The Engineering Commissioners who have been appointed are fully acquainted with the principles underlying the supply of electricity under conditions satisfactory from a financial point of view, and they would hardly urge any joint electricity authority, district electricity board or individual electricity supply authority to embark on any rash scheme or sanction the carrying out of an unsound scheme put forward by any such authority. Moreover, one of the Commissioners has been specially appointed to give attention to the financial side of electricity supply, and it may be expected he will veto any scheme the financial aspects of which are unsatisfactory.

THE UNDERLYING PRINCIPLE.

The principle underlying the legislation which has been enacted and which is proposed is as follows: The great increase in electricity supply can be given by existing authorities acting for the most part individually. If, however, such authorities will co-operate, so that electricity may be generated on a larger scale, cheaper supplies should be available.

The situation would probably be best dealt with in the following manner: Immediate demands will for the time being entail the extension of many existing generation stations. Generating stations in reasonably close proximity to each other should be linked up by main transmission cables, and the most efficient stations of those so linked would naturally be called upon to meet the greater part of the demand, the least efficient stations being operated for as short periods as possible. As far as practicable, extensions should only be allowed in the most efficient stations. When the demand renders it necessary a capital station should be erected and equipped for the provision of the supply required in the district. This capital station should be run at a high load factor. The most efficient of the previously existing generating stations would be run at moderate load factors, and the smaller and less efficient stations would only be utilised at peak load periods or be entirely dispensed with. On these lines an efficient system of generating electricity would be gradually evolved, which should tend to cheap production and reliability of supply, and at the same time the capital already sunk in the industry would for the most part continue to be utilised to full advantage.

As far as one is able to judge from decisions which the Electricity Commissioners have from time to time been reported to have made, it is on these lines they are proceeding.

THE POWER COMPANIES' ACTION.

It is safe to say that the financial results of municipal enterprise in connection with the electricity supply industry in the past, taken on the whole, have been such as to be a source of satisfaction both to the municipalities and to their consumers, and as joint working should undoubtedly tend to economy, it seems to me that there is no reasonable cause for apprehending that less satisfactory results will attend joint, rather than individual, action on the part of municipalities, provided that development is carried forward on sound lines. It is somewhat remarkable that power companies seem to be expressing no fear of taking the financial risks involved in supplying electricity over large areas; on the other hand, they appear eager to accept such risks, and in many cases would be prepared to relieve municipalities of the financial responsibility regarding which some are so apprehensive.

It is for Municipal Authorities to decide upon the line of action they intend to pursue, both with regard to the new Bill and the formation of Joint Electricity Authorities. Their decisions should be come to without delay, as, if public control of the supply of electricity is desired, there is unlikely to be a better time than now for obtaining it.

DEVELOPMENT OF THE ASSOCIATION.

The work of the Association could be greatly facilitated if its permanent staff was added to and proper office accommodation provided. For 15 years the Association had the advantage of the services of such an efficient and energetic honorary secretary as Mr. H. Faraday Proctor, and no praise can be too great for the manner in which he and the secretary have applied themselves to their tasks; but the work, entailing technical knowledge and intimate acquaintance with details of the management of electricity supply undertakings, which has now to be executed, is far greater than can reasonably be expected to be dealt with by an honorary secretary, and the appointment of a salaried secretary having technical and managerial qualifications should be no longer delayed. In addition, the Association should be provided with suitable office accommodation. Now that official sanction for subscribing to such an association as this has been obtained, there is no reason why it should in the future rely to the extent it has done in the past on voluntary effort.

At no time was there a greater necessity for such an association to assist and further the efforts of municipal electricity supply undertakings than now and during the next few years. Arrangements must, therefore, be made which will ensure the work being so developed that it shall prove of even greater utility to its members in the future than it is to-day.

INCREASED COMMITTEE WORK.

Still greater co-operation between the individual undertakings and the Association is necessary, and more of its members should take part in its work, and so relieve to as great an extent as possible the present heavy duties of the Council. Much more business must in future be carried out in committee if important matters are to receive the detailed attention they deserve, and the only way in which this can be accomplished is by increasing the number of committees and of the members serving on them.

It is a matter for disappointment that more local centres have not been established. The principle which led to the formation of joint committees, such as that now existing with the B.E.A.M.A., should be still further extended, with the object of smoothing out difficulties which from time to time arise, and giving consideration to questions of mutual interest.

BRITISH ENGINEERING STANDARDS COMMITTEE.

It is also important that the representation of our Association on the panels of the British Engineering Standards Committee should be made as strong as possible, and, as it is quite out of the question to limit our representation on these panels to members of the Council, it is to be hoped that ordinary members will volunteer to take their share of this work, which is of the greatest importance to electricity supply undertakings. It is manifest that unless the views of users of machinery and apparatus are strongly put forward, the tendency will be for standard designs to approximate more to what is regarded as an ideal from the point of view of manufacturers rather than of users.

POLITICAL INFLUENCE.

The necessity of the electrical industry as a whole obtaining far greater political influence than it is able to exert to-day is paramount. Progress in this direction can only be obtained by intense and continuous propaganda work, and the British Electrical Development Association has during the past year been formed for the purpose of carrying out this work, and to carry out work of this nature ample funds must be available. It is to be hoped that the undertakings, municipal and otherwise, connected with this industry, will not prove backward in providing that moral and financial support which is necessary if the desired success is to be ensured.

At the conclusion of the address a vote of thanks to the President was proposed by Councillor H. R. BARGE (Poplar), and carried with acclamation.

A Paper on "The Design of Distributing Networks" was then read by Mr. C. A. GILLIN, mains engineer, Bradford Corporation Electricity Department. We give an abstract of this below.

The Design of Distributing Networks.*

By C. A. GILLIN.

(Bradford Electricity Department.)

The Paper aims at presenting a general survey of the subject, and is divided into three sections dealing respectively with (1) the design of distributing networks, (2) the best means of meeting future demands for electrical energy, and (3) the design and standardisation of substations and static transformer chambers.

DESIGN OF DISTRIBUTING NETWORKS.

By "distributing networks" is meant all cables connected with a general electricity supply system, whether classed as feeders, distributors, services, &c., except trunk lines or extended busbars carrying energy from a station to a distributing centre, or from one such centre to another. As the demand increases stations become eventually distributing centres. The objects to be aimed at in design are (1) economical service and distribution, (2) continuity, (3) satisfactory operation and (4) minimum expenditure on repairs.

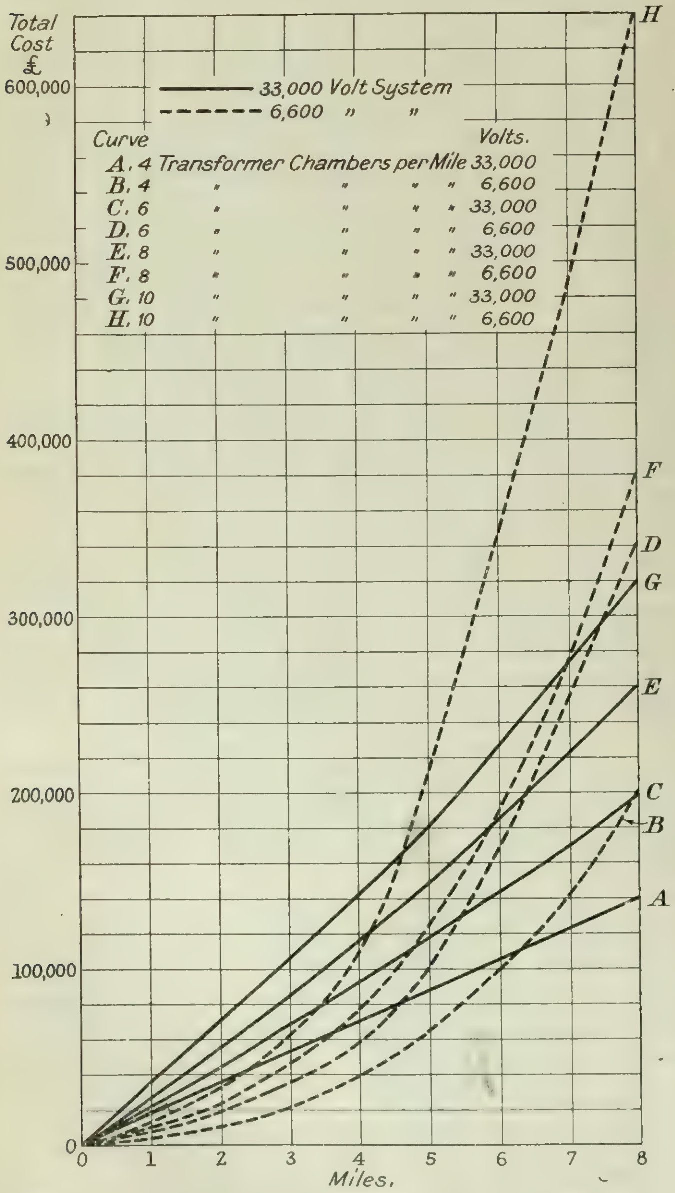

FIG. 1.—TOTAL COST OF DISTRIBUTION AT 6,600 AND 33,000 VOLTS.

(a) *Extra High-Tension Distribution.*—The first question is selection of a suitable voltage. The economical pressure should be at least 30,000 volts. For distances of 1 mile up to 5 miles radius the most economical value is 600 volts, up to about 8 miles 10,000 volts. (See Fig. 1.) In preparing these curves no duplicate cables are allowed, for all cables are split conductor type; transformers and buildings are not included as their influence is negligible; the average capacity of transformer chambers is 250k.v.a.; three switchgear cubicles in each chamber; total permissible pressure drop on cables 7½ per cent. When a generating station may be ultimately used both for the economical generation of large supplies of energy and as a distributing centre for its immediate district, the voltage for the latter purpose should be 6,000-10,000 volts; but for transmission of heavy loads, even for relatively short distances, 30,000 volts is the economic minimum. This is illustrated in Fig. 2, where the total permissible pressure drop (including transformers) is 10 per cent.; figures include only capital outlay, not transmission losses; transformers are only included for 30,000 volts curves; copper is taken at £125 a ton, lead at £40 a ton; cables unarmoured, taped and laid direct under average roadway conditions.

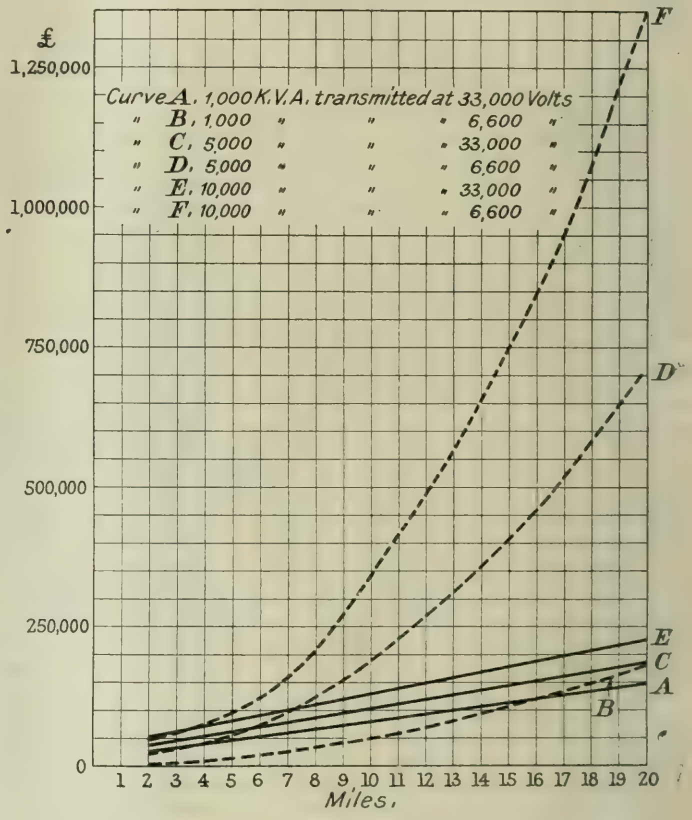

FIG. 2.—COST OF TRANSMISSION AT 6,600 AND 33,000 VOLTS.

In deciding the lay-out it is often necessary to compromise between good finance and good engineering. A reserve fund is essential with a view to establishing new distributing centres with transmission lines at 30,000 volts, other districts being meanwhile cross-connected until augmented by this means. In early days cables were too small. It is economical to load them up to their safe carrying capacity, and in the original Paper curves are presented showing the extent to which cables may be safely loaded.

Electrical protection should be studied at an early stage. For complex supply areas the Merz-Price, the split conductor and the Hunter-Beard compensated pilot seem the only tried systems of protection suitable. Split conductors appear best up to 20,000 volts. Beyond this the compensated pilot may have advantages. The author finds that the costs of the duplicate radial system and the split conductor system for a typical district 16 square miles in area are approximately the same.

(b) *Medium Pressure Alternating Current and Continuous-current Distribution.*—Medium pressure supply areas are now always divided into "feeder areas," connected with neighbouring districts through a number of fuse pillars. The tendency will be gradually to narrow down continuous-current areas by encroachment of alternating-current mains; such changes should be anticipated so as to render changer-over to alternating-current a simple matter. Continuous-current feeders should not be of large size except where necessary to compensate for voltage drop, and the radius of a feeder should be extended or reduced according to its load. For feeders two sizes, viz., 5 sq. in. and 1·0 sq. in sectional area, with a smaller neutral for continuous current districts, should be sufficient. Pilot wires should be protected by a light fuse at the feeding point as well as at the station. For distributors sizes from 0·3-0·05 sq. in., in four stages, should be adopted, a smaller neutral being also used on continuous-current networks. The same sizes would be used for services.

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* Abstract.

(c) *Cables and Methods of Laying.*—Paper insulated lead sheathed cables are now generally adopted. For multiphase alternating-current supply multicore cables are essential, and for continuous-current systems desirable, being cheaper, reliable and more convenient and adaptable than single core, though single core cables have the advantage of burning clear and reinsulating themselves, without taking sufficient current to blow feeder pillar fuses, and so maintaining continuity of supply.

The chief alternatives, as regards laying, are (*a*) solid systems, (*b*) conduit systems, (*c*) buried direct in ground and (*d*) overhead. (*a*) have had their day, being subject to access of moisture, slow dissipation of heat and faults due to traffic vibration. (*b*) are good but must be used with discrimination, *e.g.*, where excavations are frequent. The rate of heat dissipation for cables in ducts is low. Faults may cause cables to weld firmly to iron pipes. Stoneware and fibre ducts are rivals, and both may be buried in concrete, but fibre has an advantage in economy of space. Well designed manholes are essential. Lead covered cables are best when the ground is suitable, *i.e.*, free from ashes and organic matter. The cable should be protected by layers of compound. The retention of armour is debateable, and the use of a copper sheath of doubtful utility.

Spacing of cables is important. Further information is desirable in view of the use of pressures of 30,000 volts. The early publication of the I.E.E. Committee's researches on "The Heating of Buried Cables" would be welcome. Overhead lines have a few advantages, but their cost is not greatly less than that of buried cables and maintenance expenses after a few year's are many times those of underground cables.

(*d*) *Jointing, Bonding and Earthing.*—Properly made a joint should have as good a factor of safety as a cable, and a "married" joint will usually answer up to 10,000 volts. Above this pressure porcelain spreaders may be needed. Inefficient bonding of the armour has been responsible for many cable interruptions. The earthing of the neutrals and star-points of low-tension systems is compulsory and should also be common practice in electrical high-tension systems. Earthing of the neutral in three-phase 4-wire alternating-current distribution deserves discussion, especially as regards cases in which low-tension networks of adjacent districts have to be paralleled.

(*e*) *Accessories.*—Faulty manufacture of accessories has caused much trouble. Occasionally only one or two samples of a batch of articles going through the shops are tested, and faulty material may thus escape detection. In future central testing departments may be established under recognised authorities; this could be arranged by the Electricity Commissioners. Feeder and section fuse pillars should be carefully selected, and all fittings should be interchangeable. Disconnecting boxes should be safe, easy of access and simple in construction. The author illustrates an approved type. Faults have occurred due to creeping of moisture and apparently osmotic action. None but good quality compound should be used for accessories.

BEST MEANS OF MEETING FUTURE DEMANDS.

(*a*) *Constructive Foresight in Network Design.*—In densely populated industrial areas future demands are certain to be heavy; these can be met by applying principles already advocated. Distributed loads on medium pressure supply networks are less easy to predict, in view of the application of electricity for cooking, electric washing and other domestic purposes, apart from lighting.

The erection of large block buildings presents special problems, the total load attaining 500-1,000 kw. each. District loads should be delivered by electrical high-tension mains at 20,000 volts to centres and distribution effected at 6,600-11,000 volts supplying transformer chambers. Continuous-current areas would probably have to be eventually scrapped, but possibly mercury arc rectifiers with alternating current could be used. Larger mains than those now in use are objectionable and the solution must involve higher pressures.

Fig. 3 shows the relative costs of supplying an area of one square mile by three-phase 4-wire 400/230 volt mains fed from 6,600 volts transformer chambers, and supplying the same area by three-phase 300 volt mains with 300-400 volt or 230 volt transformer for every four services. The latter is cheaper, but the former the better commercial proposition as the 6,600 volt mains can supply large demands along the route.

Every opportunity should be taken of improving power factors. This often presents difficulties, as consumers are reluctant to install synchronous motors, phase advancers, &c., involving duplication of plant. The growing use of single phase welders and furnaces with erratic and varying power factors is a trouble, and the method of charging for such energy deserves consideration.

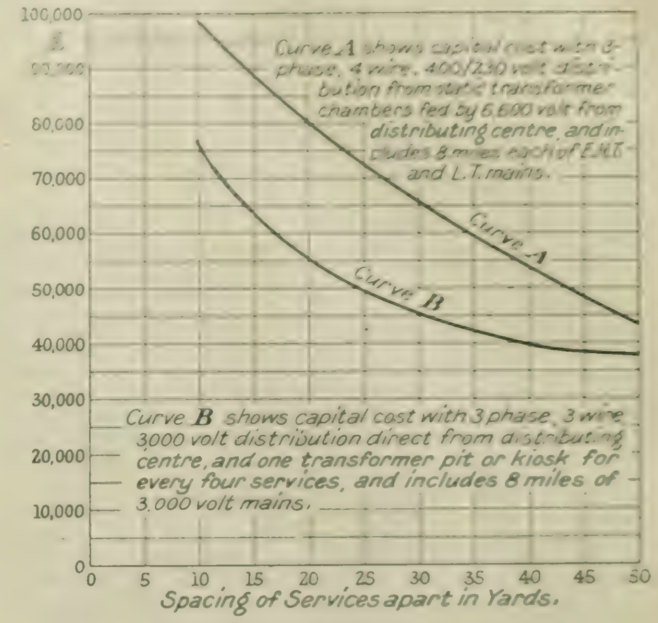

FIG. 3.

DESIGN AND STANDARDISATION OF SUBSTATIONS AND STATIC TRANSFORMER CHAMBERS.

(*a*) *Buildings* must be situated in dry places, dust-proof, and built of solid material. Fluff prevents good operation of switchgear relays, &c. Dirty insulators frequently cause trouble, and dampness is not conducive to continuity of supply. Roofs and buildings must be strong and fire-proof. Buildings should be of stone, brick or reinforced concrete. Design can only be standardised to a limited extent, and future extensions of switchwork must be kept in mind. Standardisation of parts of buildings, grids or ventilating louvres, concrete blocks with holes cast in to receive bolts, fastenings, &c., can be standardised with advantage. Adequate ventilation is vital. 350 cubic feet of air per minute per kw. loss for oil-cooled and 70-90 cubic feet for airblast transformers are required. Underground chambers generally demand forced cooling by fans.

(*b*) *Equipment of Transformer Chambers.*—Here again, hard and fast standardisation is undesirable, but switchgear cubicles should be confined to one type, purchased from the same manufacturer. One might adopt three standards sizes of oil switches of breaking capacities of 50,000 k.v.a., 150,000 k.v.a., and 300,000 k.v.a. Fuller agreement as regards rating of switches is most desirable, and the publication of the results of the B.E.S.A. researches should help in this direction.

DISCUSSION.

Mr. C. H. WORDINGHAM said that elaborate calculations as to maximum economy and the proper current density were out of place for distributing networks; the only thing of real value being experience. A good deal had been done investigating the carrying capacity of underground mains laid under varying conditions, and interesting results had been arrived at. With regard to earthing the Institution report had set up the theory that earth connections ought to be able to carry the maximum current the main fuses would allow to pass. For such a purpose nothing less than special conductors would be of use for carrying out the rules, and tremendous expense would be therefore involved. He thought the only solution was to employ leakage relays to cut off the installation if the earth current exceeded quite a moderate figure, and something of that sort would be necessary in connection with the problem of earthed distributing mains the author spoke of. The trend of modern practice was to wipe out direct current as far as possible and to distribute alternating current.

Mr. NORMAN STANHLAND (Hornsey) said the author mentioned as one of the disadvantages of the solid system chemical or electrolytic action on the lead. At Hornsey they first laid (solid) cables lead-covered only, and had electrolytic action along the tramway track. The soil was clay and soon attacked the lead. They got over the difficulty by laying armoured cables solid, and no sign of deterioration had been found after 15 years. He had taken careful readings of the drops of cables armoured and laid solid at the time of maximum load, and did not find any real difference. The disintegration of the lead and the consequent destruction of the insulation by moisture could be overcome by laying the armoured cable solid. They had imported earth to fill in the trenches, but that was only a temporary cure because the small amount of good soil was not enough to neutralise the result of the surrounding bad soil.

Mr. F. Ayton (Ipswich) said he hoped the low-tension continuous current system would have an extended life. He hoped to have the first mercury vapour rectifier sub-station in this country working in Ipswich in three months time. By the meeting next year he would perhaps be able to tell the members whether there were any disadvantages in that arrangement.

Major H. H. Bell (Hull) said one of the most heterodox things the author had said was they should abolish armouring. If they did they would be making one of the most unmechanical metals perform a function it was never intended to perform. It would reduce the cost of mains, but if the author were wrong the result would be awful to contemplate. It was interesting that all the large Edison Companies had two distinct portions to their network, one being the continuous current portion, which was not growing as regards area, but was gaining in physical load. The suggestion that a gradual change over from one to the other would take place was therefore doubtful. The extensions in the outer areas, involving the greater losses would naturally be on the alternating current system. He had recently completed a lengthy e.h.t. pole line, and found the objection of the farmers to the grant of wayleaves, the small size of the fields, and the embargo upon the placing poles in any other position than in dikes or hedgerows imposed impossible conditions. The larger of the two sub-stations of which the author gave designs was expensive, probably costing from £1,400 to £1,600. Probably the sound principle would be to make the sub-station fit the size of the plant installed, and make more scientific arrangements for the ventilation. They wanted more information on the question of the breaking capacity of switches.

Mr. S. E. Fedden (Sheffield) said Mr. Gillin was using 6,600 volts generation to step up to 33,000 volts. Why not generate at 11,000? He had used 11,400 volts generating pressure for over ten years, and had never had a high pressure breakdown on an alternator. The 11,000 volt 0·25 section cable was a handy size. It was easier and cheaper to carry out the switching on the generating pressure than to switch the large current used at the lower pressures. The only suitable protection for large feeders in a large system was split conductor in its improved state, with, possibly, Beard protection. Other protection devices could not be used because the capacity currents with large e.h.t. networks upset them. For alternating current distribution he kept to 0·25 sq. in. for long distribution mains, and for short congested areas he went up to 0·35 sq. in. He was not sure yet whether he would use single, two or three-phase for the cooking and heating load. The author, referring to coupling up distribution systems, said finally all these systems would merge into one. He (Mr. Fedden) hoped they would not.

Mr. F. W. Purse (West Ham) said when he went to West Ham he found a daring type of sub-station or transforming station, introduced by Mr. Seabrook 12 years ago. It abolished brickwork for covering the transformer. There was a corrugated roof and an unclimable railing round the whole arrangement. In another case where there was not much space the switchgear was put on the top, and the sub-stations below. There was perfect ventilation right through. In days when they wanted to keep the cost of switchgear down and when they ran high-tension mains to power consumers the arrangement was quite satisfactory.

Mr. S. J. Watson (Bury) remarked that he had considerable lengths of overhead lines working at from 6,000 to 11,000 volts. Much of the development of many of the busy industrial districts would never have taken place but for the use of overhead wires. He did not find their maintenance excessive, and when faults occurred they could be repaired in much less time than underground cables. Duplication would often not be commercial. As e.h.t. distribution had now become standard it seemed most wasteful to put down low-tension direct current networks. He agreed with Mr. Fedden that it was better not to interconnect low-tension networks.

Mr. J. H. Brooking (St. Helens Cable Company) said Bradford's decision to dispense with armouring was a momentous one. Whatever system was put down would depend largely on the maintenance, and even with the best system of cables might give unending trouble after from five to 10 years unless it was under a thoroughly good mains superintendent. Mains superintendents varied in practice. Trouble in maintenance was usually put down to the cable makers, but this was nearly always quite wrong. There was an absence of communication between the gentlemen responsible for the systems in various towns which some time back led to mains being laid on one system on one side of Regent-street, London, while the same system was being pulled up on the other side.

Mr. H. Webber (Keighley) gave some lurid details of the solid three-wire system, for which he was responsible. He was inclined to agree with the author as to the non-armouring of cables provided the soil was suitable. The men who worked on the roads seldom put their picks into gas services. ("Oh, oh.") The nation's prosperity should not be risked by using overhead wires.

Dr. S. Z. de Ferranti said in order to make electricity efficient and to supply at the lowest possible price, the primary considerations were the cost of getting the current to the customer and the cost of getting it to the eventual object for which he used it—to what Edison called "translating devices." As the cost of the mains was a large part of the whole cost it was necessary that a great amount of work should be done on that subject. Mr. Gillin said it was now accepted that paper was the right insulation for mains. To some of the younger members it might be interesting to know that some 31 years ago the London Electric Supply Corporation had to devise mains of its own to transmit current from Deptford to London, and used for insulation ordinary brown paper treated with the residue from making Field's Ozokerite candles. Twelve miles of that main was still taking current at 11,000 volts up to London.

At the conclusion of the meeting members, delegates and visitors, including ladies, were entertained to luncheon by the Bradford Electricity Committee, under the chairmanship of Councillor Wilfrid Turner.

In the afternoon visits were paid to the Phœnix Works of the English Electric Company at Thornbury, the special features of which were described in our issue of June 25, 1920, and to the Valley Road Station of the Bradford Corporation, which was dealt with in our issue of June 18, 1920.

The Ilkley party returned to Ilkley by special train on the Midland Railway, and in the evening were guests at a social evening given by the Ilkley Urban District Council.

Wednesday, June 23rd.

The meeting this morning was held in the King's Hall, Ilkley, beginning at the fairly civilised hour of 10 o'clock. In spite of this, those attending showed considerable diffidence in entering the hall, and having entered almost equal modesty in occupying the front seats. The reason for the first attack of diffidence was probably due to the fine weather and to the desire to talk to as many friends as possible. This attitude has been accentuated by the numerous hotels over which the party is spread; while the second may be ascribed to the violence of the colouring of the back curtain in front of which the Council sat. This colouring quite outshone that of nature outside. Incidentally, it is a little tactless to sit at the back of the hall and then complain because you cannot hear the speakers. On the other hand, most of those taking part in the discussion would do well to have lessons in voice production before attending next year's Convention. It is interesting on the Prince of Wales' birthday and Coronation Day to note the shadow of royalty over the Convention, the meetings at Ilkley being held in the King's Hall, and in Bradford at the Queen's Hall.

The business to-day consisted of a Paper by Mr. I. V. Robinson on "Power Station Design in Relation to Thermal Efficiency," which we give in abstract below:—

Power Station Design in Relation to Thermal Efficiency.*

By I. V. ROBINSON, Wh.Sc.

(British Electrical and Allied Manufacturers' Association.)

This paper outlines various modern developments in power station design leading to greater thermal efficiency, arising from (1) Increase in the range of working temperatures of steam; (2) Saving of low grade heat; or (3) Increase in the size of generating units.

Increase in Range of Working Temperatures of Steam.

To improve the thermo-dynamic efficiency of any heat engine we must increase the initial temperature and lower the final temperature of the steam.

(i.) *Upper Limit.*—Steam at 650°F. to 700°F. is now successfully used in many stations and the final limit has not yet been reached. Pressures of 300 lb. to 350 lb. are usual in large stations, and, in the near future, pressures of 500 lb. may be generally used with a total temperature of 700°F. to 750°F. for large units. However, an increase of pressure in itself decreases the thermal efficiency of a turbine. Thus (*a*) higher steam densities increase the clearance losses in reaction and the disc and windage losses in impulse turbines, (*b*) with a decreasing superheat and increasing pressure the steam sooner loses its superheat and becomes wetter, (*c*) with greater pressure and greater available heat drop, more stages or rows are needed to maintain the same efficiency ratio—this is not always possible within practicable limits, and (*d*) dummy leakage losses in reaction and diaphragm leakage losses in impulse turbines increase with rising pressure.

But with a fixed initial temperature of 700 deg. an increase in pressure, by increasing the available heat drop, improves the turbine efficiency. The extra cost of the boiler plant, pipes, valves and turbines, with a high steam pressure, must be considered. Cast steel would have to be largely used especially for all parts subjected to temperatures of 500°F. or above.

(ii.) *Lower Limit.*—Here there is less scope for improvement.

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* Abstract

With a natural supply of circulating water from river or sea at 55°F., a vacuum of 29 in. can be obtained economically. With cooled water a temperature of 75 deg. to 80 deg. is possible with average atmospheric conditions, and a vacuum of 28 in. is economical. With water at 50°F. a vacuum of 29·1 in. has been used. Beyond this vacuum no great progress can be made unless in exceptional circumstances. In general higher vacua reduce the relative thermal efficiency of the turbine but effect an overall improvement in the steam consumption. Present practice suggests that with water temperatures of 80°F., 75°F., 60°F., 55°F. and 50°F., vacua of 28 in., 28·25 in., 28·80 29·0 in. and 29·1 in. may be expected.

Saving of Low Grade Heat.

The condenser remains an important item, but progress has been made—(*a*) by heating the condensate to high temperatures, using steam tapped from the main turbine, and (*b*) by re-heating the steam after partial expansion in the turbine until the original superheat is restored.

Some heating is essential, as with a vacuum of 29 in. the condensate leaves the condenser at 65°F. to 70°F., which is too low for the economisers. Initially this temperature was raised to about 100°F. by utilising the exhaust from various steam-driven auxiliaries. A good case can be made out for raising the temperature to 150°F. or even 300°F., if the heat in the flue gases is used to heat air supplied to the furnaces. If steam be abstracted from the turbine and used in a surface feed heater to heat the condensate from the main condenser, the latent heat of the steam so abstracted is returned to the boiler. With about 23 per cent. of the total steam tapped the feed could be raised to about 225 deg., giving a total of 300°F. It is not desirable that the whole heating should be done in one heater. Steam should not be tapped for heating until it has lost all its superheat, as it is most efficient in the turbine when superheated.

By such measures the overall efficiency ratio of the turbine is slightly improved, but as the heat available for useful work in the turbine is reduced, an increased quantity of steam has to be supplied to the turbine. The effect of high feed water temperatures upon the waste flue gas temperature must also not be overlooked.

Instead of heating the feed entirely by tapped steam, tapped steam could be used up to a point and steam from auxiliaries used for the final heating. The method of re-heating the steam after partial expansion has not yet been applied as a commercial proposition. Against a theoretical saving in the coal bill there are the annual charges on the extra cost of the inter-heaters and the cost of operation. Feed heating by auxiliary and tapped steam from the turbine appears more attractive

Size of Generating Sets.

The factors limiting the maximum size of generating sets are concerned with transport rather than design and construction. The feature determining capacity is the last wheel or row of blades. The maximum disc that can safely be transported by road is 12 ft. diameter, which would give blades 4 ft. long and an area after the last row of blades of 201 sq. ft. If the leaving loss is $2\frac{1}{2}$ per cent. of the initial available heat drop and the steaming conditions are 300 lb. 250 deg. and 29 in., the exit velocity of the steam is 765 ft. per second. Taking the dryness fraction of the steam as 0·95, this last row of blades will pass 920,000 lb. of steam per hour, which, with a consumption of 9 lb. per kilowatt-hour is equal to 100,000 kw. This output of 100,000 k.w. could be obtained from a single turbine even with 29 in. vacuum. No machine shop at present has the equipment to handle and machine the large castings required, but equipment is merely a question of money. The real difficulty, apart from cost, is suitable material. The 12-ft. disc would probably be of chrome nickel steel, but its manufacture would present difficulties. A turbine with this diameter of disc would be bladed on site. The cylinder would have to be sub-divided for transport to a greater extent than usual, a vertical longitudinal joint being required. Similar sub-division has already been made with marine turbine cylinders. As most alternators for outputs above 10,000 kw. are now wound on site, larger units would involve no departure in this respect. Given the demand there are no insuperable difficulties to prevent any suitably equipped shops turning out a turbine for a normal out put of 100,000 kw.

In the larger sizes of turbo-alternators the material has been so reduced that the alternator attains practically its maximum temperature rise in two hours. It is customary to specify a 25 per cent. overload for two hours, and a large modern alternator could carry the 25 per cent. almost indefinitely. Hence the British Engineering Standards Association's maximum continuous rated machine should be adopted as a standard, preferably for all sizes, and we might then abolish momentary overload entirely

Speed of rotation has an important bearing upon output. The 12 ft. disc with 4 ft. blades should not attain a tip peripheral speed of more than about 900 ft. per second, or 860 revs. per min. In practice, this turbine would run at 750 revs. per min. for 50 cycles or, for 60 cycles, possibly at 900 revs. per min. At 750 revs. per min. the mean blade speed would be 628 ft. per second, which is reasonable and below the speeds now used in many turbines. The maximum output varies inversely with the square of the speed, the vacuum (29 in.) and leaving losses (2½ per cent.) remaining constant. Speeds and outputs would be connected as follows

Revs. per min.	860	1,000	1,200	1,500	1,800	2,400	3,000	3,600
Kilowatts—	100,000	74,000	52,000	33,000	22,900	12,800	8,200	5,700

The outputs at 2,400 and 3,000 revs. per min. are already exceeded, due to—(1) the turbine being designed for a lower vacuum with reduced volumes; or (2) An increased leaving loss; or (3) special arrangements of the last row of blades.

For one or other of these reasons machines are now being built or are running for outputs of 10,000 kw. at 3,000 revs. per min. and 16,000 kw. at 2,400 revs. per min., but no machine is yet on order in this country for the output stated above for 1,500 revs. per min., the largest being 25,000 kw. In the United States a 45,000-kw. set is running at Detroit at a speed of 1,200 revs. per min. In the United States they have constructed turbines for outputs of 6,000 kw. at 3,600 revs. per min. and have in hand others for outputs of 7,500 kw. at this speed. At 1,500 revs. per min. there have been turbines for outputs of 35,000 kw. constructed. All these American turbines are rated on the maximum continuous output, so that their stated capacities should be reduced by 20 per cent. for comparison with British turbines.

On the score of reduced steam consumption there is no decided advantage in going beyond 30,000 kw. normal capacity. A similar limit is reached as regards capital cost. Already rail transport is impossible with the larger portions of most of the 15,000-kw. to 29 000-kw. sets now being constructed. Capital cost per kilowatt will probably decrease up to say 30,000 kw. normal; after that it will probably rise.

When considered from the operating side it would appear that the limit is certainly not above 30,000 kw., but, in all but a few stations, much below it. Apart from special circumstances justifying special sizes of turbines, it appears—(1) that the maximum and most economical (thermally and financially) size of turbine is 30,000 kw. normal; (2) that the maximum size of power station is one designed to carry a maximum load of 180,000 kw. with 240,000 kw. installed.

If two such stations were comparatively close together and could be linked a larger turbine might be justified.

Drive of Auxiliaries.

In determining the method of driving the station auxiliaries we must consider—(1) the main turbines must not start non-condensing, and (2) each main unit should be self-contained as far as possible and not dependent upon any other plant for its continuity of running.

An all electric drive appears to be necessary from the point of view of efficiency in a modern high pressure station. Separate condensing turbo-generators are quite satisfactory, and if exhausting into a feed heater are highly efficient. With a 25,000 kw. main set a 1,000 kw. auxiliary set would provide all the power required unless there was a large demand for cooling towers.

Maintenance of Efficiency.

It is now proposed to insert blades made of various materials in turbines that have given trouble owing to blade erosion or corrosion and observe their condition from time to time. The materials being so tried include monel metal, phosphor bronze, mild steel, 3 per cent. nickel steel and stainless steel, &c. Usually erosion does not commence until the steam has lost its superheat and become wet, and is greater the higher the steam velocity. The maintenance of efficiency is affected by other factors; if the shaft whips, the gland and diaphragm clearances or in reaction turbines, the tip clearances will be increased with an increase in consumption.

Condensing Plant.

The whole art of condensing plant design owes its existence to the turbine. A good design of condenser (1) allows the steam to spread over the whole length of tubes easily; (2) reduces the drop in pressure from steam inlet to air pump suction to a minimum; (3) works on the counter-current principle; (4) concentrates the cooled air at the air pump suction, the degree of cooling depending upon the relative sizes of the air pump and the condenser for their respective functions.

All condensers are now based upon the counter-current principle. Twin condensers are used for very large condensers, but are not necessary for surfaces up to 40,000-50,000 sq. ft., and there is not much need for condensers of larger size. The rotary air pump, using either a water jet or a combination of a water and steam jet, has been developed almost entirely within the last 12 to 14 years. The desire to reduce the number of working parts led engineers to devise means of doing away with the water jet. As a result the steam jet ejector has been developed and is now in general use. A development which is coming very much to the front at the present is the "closed" feed water system to prevent the condensate absorbing air en route from the condenser to the boiler.

Guarantees and Testing.

Owing to the present high cost of coal and the higher load factor always given to the latest and most economical turbine in any power station, many contracts for large turbo-alternators are placed on steam consumption guarantees. The normal method of the contractor stating his consumption with a penalty or bonus should this figure, plus or minus a margin of 2·5 per cent., be exceeded or improved, is quite satisfactory. Penalty and bonus are reminders of the early days when the art of turbine design had not advanced to its present standard. There is now only a remote chance that either penalty or bonus will be payable in connection with a contract placed upon competitive tenders from responsible manufacturers.

In testing, the chief difficulty with large sets is to provide a steady station load. An hour's run is quite sufficient and some advocate even shorter periods.

Overall Thermal Efficiency of Power Station.

For all stations it is possible to obtain a Willans line connecting fuel consumption and units generated per day. Mr. J. W. Shaw records that at one time the fuel consumption per unit generated at the Bradford Valley Road Station was equal to

$$2{\cdot}32+\frac{60{,}000}{\text{Daily Output}}\ \text{lb.}$$

Such an expression allows the fuel or heat consumption to be calculated for all daily load factors, and the actual consumption should be checked against this regularly. On account of the varying calorific value of different fuels, it is far better to refer to heat units per unit generated than to lbs. of coal. In a modern power station with a daily load factor of 40 to 50 per cent. a value of 20,000 B.Th.U. per unit generated should not be exceeded.

Conclusions.

The Author's conclusions are summarised as follows:—

1. That steam pressures of 350 lb. per square inch (gauge) and total steam temperatures of 700°F. are quite suitable, and that these figures may soon be raised to 500 lb. and 750°F.

2. That vacua should be as high as possible, the vacuum temperature being about 21°F. above the water temperature at 80 deg. and about 26°F. above if the water temperature be reduced to 55°F.

3. That heating the condensate by the use of steam tapped from the main turbine is desirable, and that the heating can, under certain conditions, be carried with advantage up to a temperature of 300°F. by exhaust steam from auxiliaries where available.

4. That reheating of the steam after partial expansion in the turbine does not promise an adequate return.

5. That the manufacturer could, if called upon, design and construct turbines and alternators for any size up to 100,000 kw., but at a very great expense.

6. That the economical limit in size with a vacuum of 29 in. and leaving losses limited to $2\frac{1}{2}$ per cent. is probably about 30,000 kw., which would run at 1,500 revs. per min.

7. That auxiliaries should be electrically driven, the power being obtained from an auxiliary turbine exhausting into a feed heater.

8. That in comparing air extracting systems due consideration must be given to the boiler losses incurred in raising steam used in connection therewith.

9. That a closed feed water system should be adopted.

10. That overall consumptions be expressed in British Thermal Units per unit generated and not in lbs. of coal.

11. That a maximum consumption of 20,000 B.Th.U. per unit generated be the objective in large stations.

DISCUSSION.

Mr. I. V. Robinson, in introducing his Paper, said it was different from what it would have been if he had been speaking individually. He sent a *questionnaire* to all the members who were interested in heavy plant, asking for their views on the design and thermal efficiency; but many of the replies were contradictory, and generally he was short of material he could use. If that discussion formed a real exchange of views of the users and manufacturers of heavy plant, manufacturers would be pleased.

Mr. A. Q. Carnegie (C. A. Parsons & Co., Ltd.) said the new power station of the Newcastle Electric Supply Company at Carville had been running with an inlet temperature of about 700°F. for about four years; none of the difficulties experienced had been due to the use of constructional materials. The increased temperature was found to produce certain strains on the blading due to expansion effects brought about by change of load. The further sub-division of the shrouding strips on the blade tips completely got over this trouble. One of the simplest, and perhaps most satisfactory, tests for a blading material was the Sankey test; this showed that there were quite a number of materials suitable for blade making whose strength and toughness under turbine temperatures were perfectly satisfactory. Blade deterioration did not occur in reaction turbines except to a very slight extent at the exhaust end and at the back of the blade, where it did not effect the efficiency of the turbine. It would be a very good thing if station engineers would make a practice of carrying out a repeat of the official test—say once every year. Test results on different machines at Catville lay so closely together that it was almost impossible to distinguish them on the curves, showing a remarkable achievement in uniformity. They also showed that the newest machine had no advantage over the machine which has done $2\frac{1}{2}$ years' work. The use of fine tip clearances could be avoided in modern reaction turbines by the adoption of end tightened blading. The radial clearance could be made as large as desired, the usual figure being $\frac{1}{16}$ in. in small sizes and $\frac{1}{4}$ in. in large sizes. The shrouds on the blade tips could be adjusted to run with safety with an axial clearance ranging from 8/1,000 in. to 15/1,000 in.

Mr. W. M. Selvey said advances were being made in design because the load justified putting in plant of such size and efficiency that the smaller stations were getting up to the efficiency of the larger ones. He was afraid Mr. Robinson's calculation that interheating would not produce any great advance was a fairly true one. It was not necessary to go into expensive experiments on a new system until the theoretical possibilities had been thoroughly explored. A great deal of money might be lost by expensive experiments which would be unnecessary. The contents of the boilers were generally water, steam, magnesia, lime, gypsum, &c., and it was the &c. that was responsible for blade erosion. The bad conditions could all be reduced in a properly cared for turbine. The best nickel steel or even mild steel for turbine blades had stood perfectly satisfactorily for a number of years with good boiler conditions. The closed feed system would not get all nor most of the air out of the system, and it was unnecessary to get it out, as there were other ways of preventing the trouble. He was amazed at the $2\frac{1}{2}$ per cent. and 5 per cent. allowed in testing. If they were to have 3 or 4 per cent. margin on testing they had better not test.

Dr. S. Z. Ferranti said electrical engineers had before them the very definite problem of getting coal, or the result of coal, to the consumer at the lowest possible cost, which was another way of saying their machinery and business methods must be made efficient. Mr. Robinson said the advance in thermal efficiency arising out of the action of the manufacturers might be classified as due to three things: the increase in range of working temperature (he agreed with that); the saving of low-grade heat (that was the throw away losses in the low-pressure turbine); and the increase in size of generating units. There were several things besides; one of them was the thermal cycle, because, although with steam, apparently, all turbines might work on the same thermal cycle, there was a good deal to be considered in the actual utilisation of the heat. The boiler house was largely responsible for excellent test figures not being borne out sufficiently well in practice. The principal direction in which one should work was to get boilers to maintain their efficiency, irrespective of the time they had been in use. They should be designed, if possible, so that the stand-by losses were avoided or greatly reduced. If one went in for the higher steam pressure, the plant was more costly to put in and maintain. How were they going to get a 500 lb. plant for less capital than the 200 lb. plant, and how was it to be made as cheap and easy to maintain? The author referred to "bleeding" the turbines of steam for feed heating. In certain conditions that showed on paper a saving of 5 per cent.; but it was disappointing when one came to look at it. The object of heating the feed water was to prevent dew forming on the top of the economiser, and so prevent wastage of the plant by having cold water in the tubes of the feed heaters and economisers, and not really to give an improved thermal efficiency. Progressive feed heating when properly applied was a real thermal saving, as it was a means of heating feed water without a degradation of temperature. Degradation of temperature was fatal to economy. No saving was too trivial to take into account if power was to be made really cheaply. He had come to the conclusion that they would get central stations which in the near future would return on the switchboard electricity to the extent of some 28 per cent. or more of the energy in the fuel. What were wanted were not laws to promote the complication of electricity, but laws which would prevent individual zeal from bringing about confusion in electricity supply. In his Presidential Address 10 years ago he said he had come to the conclusion that, in order to supply electricity for all purposes it would be necessary to have a conversion efficiency of not less than 25 per cent. That had not been reached, but they were going rapidly in that direction.

Mr. Geo. Wilkinson (Harrogate) said two things were open to them: to improve efficiency of production or to increase their statutory charges. If they were going to get a big improvement on present waste, they would have to resort to a hybrid electric power plant. There were possibilities in the introduction into their steam turbine stations of some form of internal combustion engine. He thought he could make out a case for an improvement of 10 to 15 per cent., which would change the aspect of the industrial and commercial side considerably. The economiser was a source of weakness, and entailed more danger to the men than formerly, because it was put above the boilers. It also entailed additional height in the boiler house and additional cost. A safe piece of apparatus, which could be used instead of the economiser, was an air heater with deflectors inside. Its upkeep was small, and it gave a valuable result in the boiler house from a thermal point of view. The advantages were higher boiler efficiency, smaller boiler plant, cheaper housing for a given output, less danger due to bursting of cast-iron pipes on the high pressures, proper control of output in response to sudden demands, a smaller and cheaper condensing plant, less water required for a given output for condensing purposes.

Mr. M. G. S. SWALLOW (Richardsons, Westgarth & Co., Ltd.) believed the correct thing to do was to divide the air pump units into two, and have each air pump unit capable of dealing with the maximum quantity of steam in the condenser, and with sufficient margin under ordinary air-tight conditions that only one air pump unit was required. The second was a stand-by for cases where excessive air leakage occurred. Although the two-jet steam pump was simpler mechanically, and the combined steam water jet pump required a larger motor and pump, the economical gain was decidedly in favour of the combined pump.

Mr. F. AYTON (Ipswich) said his experience was that corrosion occurred not in the running, but in the standing period. If water vapour were eliminated from the interior, it would go a long way to eliminate the trouble. In a set at Ipswich a draught of air was passed through the turbine when standing.

Mr. J. E. LEA (Lea Recorder Company) said the author's statement about passing the condensate through a closed meter and a surface feed water heater, instead of being passed over a weir for measurement, was of a sweeping character. One objection to air was on account of the vacuum and the trouble of getting the air out of the condenser again, and another was said to be corrosion. He could quote numerous instances where, with no precautions taken to exclude air, there had been no corrosion, and also where the purest water was used there had been most corrosion. Corrosion in certain steam plants had been attributed to absorption of oxygen in passing over a weir. The cause was due rather to the excessive purity and super-softness of the water. The condensate which emanated from a modern condensing plant was by no means such an innocent and gentle liquid as might be supposed.

Mr. P. V. HUNTER (Callender's Cable & Construction Company) agreed with Dr. Ferranti as to the importance of small gains in efficiency. When load factors were bad, it was not worth while putting in economisers to get a 5 per cent. gain; but now load factors were so high and plant was run so many hours such a gain was of great value. He was a little disappointed with Dr. Ferranti's figure of 28 per cent. as a possible maximum thermal efficiency. The question of more efficient utilisation of coal seemed to boil down to this: Could we utilise the low-temperature heat which was at present thrown away? It might be possible to use it for stimulating plant growth. The North Tees station, which was practically ready to run, was designed for a steam pressure of 500 lb. per square inch, a temperature of 700°F. and a thermal efficiency 24 per cent. He hoped that would be obtained when difficulties with steam pipes and joints and things of that sort had been got over; but it was only worth while if large units were employed and the load factor was about 80 per cent.

The AUTHOR, in reply, said a *questionnaire* was sent to the members of the I.M.E.A. asking whether they had trouble with their turbines, and whether they would have the experimental blades fitted to them. He did not say the closed system would entirely eliminate the air in the condensate, but that it would retain it at a minimum of about ½ per cent. He suggested that progressive heating should be done in four stages. The 7,200 H.P. internal combustion plant referred to by Mr. Wilkinson had 18 cylinders. He thought many engineers would not sleep well if they had to rely on those machines.

In the afternoon a large number of members, delegates and visitors with their accompanying ladies travelled by special train to Bolton Abbey, where they amused themselves by visiting the ruins, having tea and jumping the "Strid." Others played golf. Others did we know not what.

The Annual Dinner which was held this evening at the King's Hall, Ilkley, was a function largely attended by both sexes, the principal guest being Sir John Snell who, besides being Chief Electricity Commissioner, is a past president and honorary member of the Association.

In responding to the toast of the "City of Bradford" (proposed by Major H. RICHARDSON), Councillor WILFRID TURNER, Chairman of the Electricity Committee, reiterated the sentiment that Bradford was a progressive city and would watch with greatest interest every step that was made in electrical development.

Mr. S. T. ALLEN (Wolverhampton), in proposing "Our Guests, including the Ladies," said the Association was very pleased that all the sections of the great electrical industry to which they were so proud to belong were represented there that night.

Sir JOHN SNELL, in reply, paid the tribute to the part played by the wife of the electrical engineer during the time of stress and peril through which they had lately been passing. He felt that his appointment to his present position was directly due to his experience as a borough electrical engineer and as a member of the Council of the Association. Great good was obtained by attendance at the Convention owing to the informal conversations and the admirable Papers which did more good in promoting economy, the true development of electricity and the good of the nation than reading books and even than attending the more formal meetings of the Institution. Referring to the work of the Commissioners, he said this could only be made successful with the help of the engineers, and it was a most hopeful sign that there was such a disposition to co-operate. This augured well for the development which was going to take place during the next few years.

Mr. LL. B. ATKINSON, in proposing the "Incorporated Municipal Electrical Association," said it appeared to him that the only people who did not believe in the I.M.E.A. were the I.M.E.A. themselves. The support which the Association received from the authorities was simply preposterous. It could not do the work it was supposed to do on such inadequate financial resources. Policy with regard to electricity supply was changing, and the work of generation was passing from the municipalities simply because of lack of concerted effort. And unless there was more co-operation in future distribution would also tend to become nationalised.

The PRESIDENT (Mr. T. Roles), in reply, said the value of the Association must depend on the value they themselves set on it. To increase its value there must be more funds and a permanent staff, and that required greater municipal support in order that they might meet other similar associations on level lines.

Thursday, June 24th.

The Ilkley party again travelled to Bradford by special train, the late hour at which the gathering last night broke up seeming to have little effect on the number attending. The meeting was held in the Queen's Hall, Morley-street. Mr. J. W. BEAUCHAMP read a Paper on "The Standardisation of Tariffs," which we give in abstract below :—

Tariffs for Domestic Electricity Service.*

By J. W. BEAUCHAMP.

(Director and Secretary British Electrical Development Association.)

In November last, when the E.D.A. circularised engineers regarding domestic tariffs and single-meter systems, the majority of replies favoured a single-meter system, and considered a fixed and running charge tariff essential for development of domestic electrification; it was considered that such a tariff would not much affect cost of wiring, and that the real difficulty lay in finding an accurate and equitable basis for the fixed charge. Other systems were mentioned, but some objection was found to most of them.

PRINCIPLES.

In these notes the domestic or household application of the subject alone is considered. Systems of charging for power or large supplies have become to some extent standardised, and requirements as between such consumers vary greatly, whereas household supplies have features in common and characteristics which differentiate them from all other classes of business, so that special tariff treatment becomes possible. *The domestic tariff systems in general use* include: (*a*) *Flat rates per unit with meters*, with or without variation related to maximum demand, hour of the day, units used in terms of time or capacity of installed apparatus, &c. (*b*) *Fixed and unit charges.* With the fixed charges based upon maximum demand, capacity of apparatus installed, rent, ratable value, size of room, capacity of the premises, &c., and in addition a flat unit charge by meter. (*c*) *Contract rates*, without meters.

Class (*a*) still forms the majority. Class (*b*) contains some notably successful attempts to solve the domestic tariff problem. Class (*c*) is applicable only to cases where time and extent of use are under control, and the growing use of electricity for heating and power as well as lighting seems likely to preclude its extensive use when generation is effected with costly fuel.

To the domestic tariff reformer interest is centred in Class (*b*).

A system which secures all fixed charges entailed by the consumers' use of supply, counts all units, needs only one meter, allows any circuit and outlet to be used for any purpose and drops the average cost of the units as the consumers' load factor rises, would be ideal.

The tariff should secure more business, mould the character of additional business so that it becomes increasingly remunerative or results in lower average cost, and render possible large extensions of the class of supply provided for without fear of loss or unnatural increase in gain.

So far as regards domestic tariffs, great attention has been given to the requirements of the individual consumer; but has not the time arrived when we should think less of the particular consumer and more of the effect caused by adding him to the remainder of the users—*i.e.*, his influence on the average. It may simplify the formation of a domestic tariff basis to consider a number of average houses en bloc. In framing a tariff scale it appears safe and equitable to start by charging a minimum amount which, varying somewhat with the seasons, shall not be less on the year than the cost entailed by the smallest service and meter which it is practicable to put in, its maintenance and the expense of reading and handling the account.

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* Abstract.

In some cases such a minimum charge might exceed 20 units per quarter at the statutory maximum rate per unit, but one should keep the minimum as low as possible. Where ample maintenance is carried out at the expense of revenue, one may expect easier terms for repayment for permanent and lasting items.

Hitherto in most fixed and running charge tariffs the usual lighting account has been taken as the basis of the fixed charge; but the electricity supplier must expect to share the benefit of increasing efficiencies in lamps with the consumer, so that we must look to cooking, heating and power appliances to bear a portion of the standing charges on station and mains. Hence, in addition to the minimum, further fixed charges must be secured in relation to the capacity of apparatus of any kind installed, adjustment being made for diversity factors. The total fixed charge so arrived at should be put to the consumer as a subscription, reviewed at intervals and adjusted upwards or downwards in accordance with changes in the capacity and character of his apparatus.

Formation of a Practical Tariff.

Assuming that the fixed charge must be related to the consumer's maximum demand, the alternatives are to use a demand indicator, which is unduly costly, or to formulate a periodical estimate, which involves an undue amount of inspection.

Any practical solution of this problem must involve a compromise, and the following proposals are put forward as a basis for discussion:—

(I.) Fixed and running charge tariffs based upon (*a*) rent, (*b*) rateable value, (*c*) apparatus installed, (*d*) maximum demand, observed or estimated; (*e*) size, number and purpose of rooms; (*f*) estimated allowance in units for normal lighting.

(*a*) and (*b*) are not always indicative of the demand for electricity. (*c*) checks growth of installation; (*d*) needs expensive instruments, or else is very rough and ready; (*e*) is promising, if based on class and type of house rather than on exact details; (*f*) has given good results, but may raise difficulty as efficiency of lighting increases.

Expenditure on lighting of any kind depends upon (*g*) the size of the house, (*h*) the number of occupants, (*i*) their habits. The electricity tariff reformer can base his fixed charge upon (*g*), but cannot in practice consider (*h*) and (*i*).

A mixture of (*e*) and (*f*) seems promising. Say, for example, (1) a fixed charge per annum, payable at equal quarterly instalments, or otherwise, to equal the amount payable at current flat lighting rates for a portion (say two-thirds) of the lighting consumption normal to the house; (2) in addition, all units used up to, say, 150 per cent. of the lighting consumption normal to the house to be charged at a rate equal to, say, one-third of the usual flat lighting rate; (3) all further units used to be charged at a rate as low as it is desired to offer for additional domestic consumption. On this basis, (1) would regard the character and size of the house; (2) the number and habits of the occupants; and (3) encourage fuller electrification.

(II.) An alternative method, safer in regard to fixed charges, and offering more encouragement to long hour use, is as follows:—

Using one watt-hour meter for all purposes; taking into account the capacity of the electricity consuming appliances connected; making a *primary* fixed charge at a certain rate per kilowatt per annum on a certain percentage of the capacity represented by some of the appliances in use; making an additional and *secondary* fixed charge at a different and lower rate per kilowatt per annum on certain percentages of the capacity represented by the other appliances in use.

Thus, we might have:—

A primary charge of a £ per kilowatt per annum on 75 per cent. of lamp capacity; a secondary charge of *a* or *b* £ per kilowatt per annum, on 25 per cent. of cooking range capacity; 10 per cent. of occasional fire capacity; 0 per cent. of flat iron, fan, &c., and small utensils or machine capacity. A flat rate charge per unit for all units consumed for any purpose. A minimum on the account provided by statute or in some less amount.

The secondary fixed charge could be avoided and all capacity calculated at a single rate per kilowatt for fixed charge. To overcome the objection to inspection of appliances appears difficult, but the "spread out" fixed charge renders errors less important. It would be desirable to associate the fixed charges with the size of the consumer's fuse—a variant of the current-limiting system.

Demand and Diversity.

It is desirable to keep internal wiring simple, but alternative switching with a view to keeping down peak demand and improving load factor deserves attention. In the electrical kitchen the principle becomes easily applicable. Washing machines, general utility motors, &c., might be switched alternatively with the cooker, so that either could be used, but not both at once. Again, if a consumer has a 5 kw. range, there can be no objection to giving him also a 5 kw. geyser, provided that it is switched alternatively with the cooker.

The general use of electricity in dwellings will certainly bring big business, but will require foresight. At the generating station extension has to proceed in big steps every few years. Similarly, our residence networks must be put down in advance and on generous lines, and their cost met by extensive selling campaigns, hire of appliances and a simple attractive tariff.

The group diversity factor of appliances cannot be higher than their time of performance divided into the hours of the day over which they are generally used. Small geysers used to meet occasional needs for hot water and taking 10 minutes to operate cannot have a diversity value higher than, say, $\frac{16 \text{ hours} \times 60}{10}$, or 96. Similarly, for kettles the figure is 36. For irons, sweepers, washing machines and similar appliances, say 10 to 15. All appliances of this class might be regarded as producing a "group" demand of about one-twentieth, or 5 per cent. of the capacity connected. So far experience suggests that the group diversity of cookers used separately in houses of the same class may lie between 4 and 6; but experience with standardised appliances used in large numbers by people of similar habits and meal hours is yet to come.

DISCUSSION.

Mr. F. W. **Purse** (West Ham) said that at Carlisle in the days of the Point Fives consumers saved from £1 to £5 by adopting the rateable value tariff without adding any apparatus to their installations. Even at ½d. a unit for heating and cooking there was no rush to install additional apparatus. The rateable value system did not materially increase business, while it increased the engineer's worry. The system boosted the business of the manufacturers at the expense of the electricity department. The cooking and heating apparatus his sales department touched was very small as the price was against them. It was a mistake to charge too little for the heating and cooking load as from the labour-saving point of view alone it was worth its proper price. There was not sufficient information at present to enable a standardised tariff to be put forward for heating and cooking. It was up to the makers to produce a meter after the style of the Merz m.d. indicator, and to turn them out in thousands or tens of thousands. They must measure on the maximum demand of a private house, having regard to the diversity factor, if the diversity factor of heating or cooking could be ascertained. The author advocated thinking less of the particular consumer, but they had to think of him or he would think of himself.

Mr. A. H. **Dykes** thought a standardised tariff impossible in view of the differences between such an undertaking as Sheffield and an undertaking in the South of England. Committee members wanted educating on the principles underlying charges. The flat rate would have to go. If the Electricity Commissioners would allow a very high maximum price, consumers could be offered alternative tariffs which would pay the suppliers and still pay the consumer better than the maximum flat rate. A charge must be framed for the large domestic consumer which depended on demand. If the consumer knew in advance what his maximum fixed charge was going to be it would go a long way towards solving the tariff difficulty. The manufacturers should get together and produce some apparatus which would warn the consumer when the demand he contracted for was being approached. Such a system would enable the standing charges for all kinds of apparatus to be covered. A good system was the two-rate system with a lower rate for current taken at peak times. It was a disgrace to the electrical engineers that they had on their systems miles of small houses lit by gas or oil, and which he had proved could be lighted more cheaply electrically. To get those the fixed price light system was necessary. There was a big future before undertakings which got from working class houses a revenue of 16s. a lamp per annum.

Lieut.-Col. W. A. **Vignoles** (Grimsby) said the difficulty in selling electricity to small householders was that the greatly increased cost of wiring and laying of mains had raised the fixed charges, and unless domestic consumers took electricity for purposes other than lighting the prices would have to be considerably higher than 8d. He was convinced that a tariff in which there was a fixed charge and a small running charge was the one to adopt. If the telephone system was used there must be some inspection to see the consumer did not increase his maximum demand. To sell electricity in small houses for heating and other purposes one must help the consumer to succeed in what he was using the current for. People would not rush for current even at ½d. per unit. They must be rushed after. He suggested that the convention should appoint a committee of engineers, who, taking Mr. Beauchamp's Paper and Supplementary Notes as a basis, should present a report on this subject. The Association might also invite power companies and ordinary companies to co-operate.

Mr. C. H. **Wordingham** said whatever they might charge for electricity it was worth it. They could not afford to make household pets of individual consumers. The first thing to decide was whether they were going to charge in proportion to the cost of producing the energy or in proportion to the value of the service rendered. The general idea amongst electrical engineers was that they should charge in proportion to the cost of production. In framing a tariff four points should be kept in view: (1) Nothing should be left to the judgment of the individual officer, *i.e.*, there should be a charge which could be published broadcast,

(2) the charge should have some proportion to the cost of production, (3) there should be a uniform method, (4) they should allow for the diversity factor of the individual consumers, but not for diversity between different consumers. A flat rate was wrong, and a contract price per lamp per annum was equally hopeless. Mr. Beauchamp had made a strong point of charging for houses *en masse*. His argument was sound from the point of view of what it cost, but the man who had to pay the bill did not like to be averaged.

Mr. E. E. **HOADLEY** (Maidstone) said most systems of charging or electricity for domestic use suffered from one or two defects. Either they were too complicated to appeal to consumers or they were too unfair to appeal to engineers. His experience at Maidstone convinced him that stronger steps should be taken by the electricity supply industry to obtain a cooking load. There were a number of houses where lighting was wholly electric where an odd radiator or other current consuming device had been tacked on to the lighting wiring. That was all very well some years ago when radiators were about 1 kw., but now they were 3, 4, and 6 kw. It might be worth while to investigate charges for lighting through demand limitators, with a fixed charge for the lighting, and giving the consumer a flat rate for everything else on a separate circuit. If apparatus were too expensive for consumers to buy they all had hiring powers.

Major H. **RICHARDSON** (Dundee) gathered to-day that the basic principle of charging was one consisting of a standing charge and a small running charge. At Dundee they had simplified their methods on the following lines: They had retained the pay-as-you-burn system with alternatives under three headings, the industrial user for power, the shop, general warehouse and office user, and the domestic user. One standard running charge was applied to every consumer. For the coming year this was ⅞d. per unit. The standing charge was fixed on the demand, though this was difficult to ascertain with the small user. He had found that the floor space did bear a close relation to the demand, and they adopted a charge of 2s. per quarter per 100 sq. ft. floor space of the living rooms, a higher rate per 100 sq. ft. being charged for shops and warehouses.

Bailie W. **SMITH** (Glasgow) said in Glasgow they charged an average of 800 hours per house per year at the maximum demand rate, 4¾d. per unit.; any current beyond the 800 hours was charged at ¾d. per unit. The consumers were not dissatisfied, and there was no loss by supplying them at the price through one meter and one set of wires.

Mr. L. L. **ROBINSON** (Hackney) was of opinion that the only true method of charging for current which would adjust the price to the cost was the Hopkinson method. He did not agree that the consumer who demanded to pay for what he burnt should be neglected. They should have a flat rate equal to the average paid by m.d. consumers with a maximum demand of 1½ hours per day. It was difficult to justify the sale of current for heating in an industrial area at a rate lower than the power rate. On cold mornings his system had an additional load for heating equal to 10 per cent. of the whole maximum demand. They had a flat rate, a straight m.d. system and a telephone system for consumers to select from. The telephone system was not popular.

Mr. F. M. **LONG** (Norwich) said his experence of the rateable value as the fixed charge had been entirely satisfactory. The lighting charge could be high enough to cover all the charges on the station. Heating and cooking did not much affect his peak load.

The **AUTHOR**, in reply to the discussion, said manufacturers were prepared to make better and cheaper cookers in large quantities, but they wanted the supply engineers to prepare a market for them. The E.D.A. was working with the manufacturers and the supply interests on this question of cooker design, and he hoped the result would be that the manufacturers would let him issue some statement to the electricity suppliers as to what they were prepared to do.

At the conclusion of the discussion, on behalf of the Association, the **PRESIDENT** presented Mr. H. Faraday Proctor with a Queen Anne silver tray, a wrist watch and a cheque as a token of the appreciation of the members of his valuable services to the Association for 25 years on the Council and for 15 years as Hon. Secretary, and Alderman **JEPHCOTT**, M.P., also on behalf of the Association, presented Mrs. Faraday Proctor with a dressing case.

Mr. **FARADAY PROCTOR**, in expressing his and Mrs. Proctor's appreciation of the gifts, remarked that a matter the Association should consider shortly was its attitude in regard to the new Joint Electricity Authorities. He feared the Association's present constitution would not admit of officers of the Joint Electricity Authorities being members. It had always been a municipal association, and they had looked upon the companies as their friend the enemy. He hoped it might be for the advantages of the association and not inconsistent with its past efforts that there should be a branch of the association which might include representatives of Joint Electricity Authorities, and if such things were created, District Boards. He would rather see some little expansion of that association to provide for those poor men who would be homeless than see a multiplicity of associations.

The members, delegates and visitors were again entertained to luncheon by the Bradford Electricity Committee, and subsequently visted the mills of Messrs. Sir Titus Salt, Bart, Sons & Company, Ltd., at Saltaire. These mills were described in THE ELECTRICIAN of June 18th, 1920.

Later in the afternoon there was a reception by the Lord Mayor of Bradford at the Cartright Hall, Lister Park, and the journey back to Ilkley was made by special train.

In the evening there were meetings of the Association of Municipal Electrical Engineers and the Committee members, while dancing took place in the King's Hall.

Friday, June 25th.

This morning the only item on the official agenda was the Annual General Meeting; unofficially at most of the hotels there was a great rush to obtain cabs and generally to cast the beauties of Ilkley behind one as quickly as possible.

Mr. H. **FARADAY PROCTOR** proposed and Mr. S. E. **FEDDEN** seconded a motion for the adoption of the Annual Report and Accounts. We give the report in abstract below.

ANNUAL REPORT.

The membership of the Association stands at 369, of whom 185 are Committee members and 184 chief electrical engineers. This is [illegible] more than last year. Ald. G. H. Robinson, of Bradford, and Mr. W. W. Lackie have resigned their seats on the Council and the vacancies were filled by Ald. E. Vaughan, of Maidstone, and Mr. W. C. P. Tapper. Mr. H. R. Barge also resigned from the Council. Mr. P. M. Heath, Deputy Town Clerk of Manchester, was appointed honorary solicitor on the resignation of Ald. G. Pearson.

The Council have appointed the following eight Standing Committees: The Executive Committee, or Emergency Committee, to deal with all matters of emergency with power to take executive action; the Finance and General Purposes Committee; the Editing Committee; the Centres Committee; the Remuneration and Conditions of Employment of Chief Engineers' Committee, to consider matters submitted by the A.M.E.E. (Great Britain and Ireland) or representations from engineer members of the I.M.E.A. as to alterations in conditions of employment, payment of salaries, or any other matters appertaining to the personal position of the engineers and managers of municipal electrical undertakings; the Remuneration and Conditions of Employment of Staff and Employees' Committee, to consider and report upon any questions relating to salaries, wages and other matters concerning conditions of employment of staffs and employees of municipal electrical undertakings; the Selection Committee; and the Law and Parliamentary Committee.

An "Agreements" Committee has also been appointed to deal with the preparation of standard forms of agreements. Under the Electricity (Supply) Act, 1919, local authorities have powers to hire out electrical apparatus, and the Committee is drawing up a standard form of hiring agreement which will be applicable to all municipal electrical undertakings. At a later date the preparation of an agreement for wayleaves for overhead lines will receive attention. Standing orders have been made by the Council to govern the work of the Council and Committees.

THE B.E.D.A.

Consideration is being given to the question of future municipal representation on the Council of the British Electrical Development Association with a view to increasing the number to be elected by subscribers. The I.M.E.A., as a founder, is entitled to one representative, and subscribing municipal electrical undertakings to a further representative. The municipal members of the B.E.D.A. will, however, be entitled to elect representatives to the Council, possibly to the extent of six members, who will be additional to the I.M.E.A. representative.

The Council note with satisfaction the large measure of support from all sections of the electrical industry which the British Electrical Development Association has received, and urge all members of the I.M.E.A. to join that Association. A large percentage of the funds now contributed are expended on direct propaganda, in addition to which most valuable internal work is being carried out.

The B.E.D.A. has given assistance to the Council on a number of important matters, as: The registration of contractors, complaints concerning service charges, tariffs for supply, design of cooking appliances, housing in relation to electricity supply, smoke abatement—evidence to Ministry of Health.

In work of this kind the B.E.D.A., representing, as it does, every section of the industry, is able to act as a medium for the exchange of experience and ideas, and to bring about discussions between different interests, the more valuable because under its ægis there is little danger of conclusions being arrived at without the knowledge of all parties concerned in providing the public service of electricity.

Following the resolution passed at the meeting of the I.M.E.A. Committee members in June, 1919, a Committee Members' Committee was formed to consider the salaries of chief engineers.

HEATING AND COOKING APPARATUS.

Last autumn the Council was asked by the B.E.A.M.A. to render assistance in resisting the free importation of American heating and cooking apparatus. It was felt, however, that in view of the fact that this class of apparatus is undergoing a process of rapid development, it is desirable that new ideas and designs should be obtained and tested, and the Council therefore decided it was not advisable to support this action. The Council also decided to form a Committee with the B.E.A.M.A. to go fully into the existing position in regard to cooking and heating apparatus, with a view to possible improvements; this work has now been taken over by the British Electrical Development Association. Investigations are in progress and the B.E.A.M.A. and I.M.E.A. are ready to render every possible assistance.

Joint Industrial Councils.

The National Joint Industrial Council for the Electricity Supply Industry has now been in existence just over a year and much useful work has been carried out. Thirteen District Councils (practically all of which are working) have been arranged.

The expenses of the Council were estimated at £500 for the 12 months, and the I.M.E.A. has had to find one quarter of this amount, viz., £112. 10s. This is a heavy call upon the revenue of the Association, already faced with a deficit from last year of £88. The chief business which the National Joint Industrial Council has had in hand during the year has been the establishment of basic rates and uniform conditions of employment for the electric supply industry. In the North-West district the basic rates have already been agreed; in other districts the arrangements for such are in a forward state.

In November, the E.P.E.A. approached the N.J.I.C. and asked that their rates of salaries and conditions of employment, &c., might receive consideration. As the Trade Unions object to staff associations being represented on their side, and the Ministry of Labour will not agree to two Industrial Councils for the one industry, a Conference of employers and the E.P.E.A. met at the Ministry of Labour, a member of the Ministry being present, and agreed to establish a Joint Board of Employers and Staff Associations. Considerable doubt seems to exist amongst the members of the I.M.E.A. as to how far they are bound by the findings of the National Joint Industrial Council and Joint Board of Employers and Staff Associations. The Minister of Labour has stated that the findings of the various Industrial Councils cannot be made binding until the Unions and the Employers' Associations are mutually agreed that the same shall be made binding on all parties to the agreement. The Council of the I.M.E.A., however, consider that as the Industrial Council for the electricity supply industry is composed on the employers' side of six I.M.E.A. representatives out of a total of 12, the undertakings belonging to the Association should adopt the decisions arrived at.

Negotiations are still being carried out with the authorities regarding compensation to officials who may lose their positions through any re-organisation carried out under the Electricity (Supply) Act. The Council hope that it will be possible to have Section 16 of the 1919 Act modified to effect this by the addition of a clause in the Electricity (Supply) Bill, 1920, now before Parliament.

Turbine Joint Committee.

Undertakings have been circulated by the British Electrical and Allied Manufacturers' Association (B.E.A.M.A.) Turbine Joint Committee to obtain information regarding turbines of different types running in a number of power stations, with a view to carrying out experiments by the manufacturers with various qualities of blading material. The information obtained has now been analysed.

Co-operation with the B.E.A.M.A.

The Council appointed a Committee to act jointly with the B.E.A.M.A. on the various matters affecting the interests of the members of the two Associations. A Sub-committee has considered the clauses put forward by turbine builders with regard to guarantees and performances of turbo-alternators, and have provisionally agreed to standard schedules of guarantees and performances to be embodied in specifications.

Another Sub-committee has met with regard to conditions of sale and contract for cooling towers, and have also provisionally agreed to standard schedules of guarantees and performances. These standard schedules are recommended for acceptance and general use by members of the I.M.E.A.

The question of coal supplies to electric power stations has given the Council much concern. In August last, at the invitation of the I.E.E., the Council appointed representatives to take part in a deputation to the Coal Controller, which was fully representative of the electric supply industry. In regard to the question of adequacy of supplies, and the quality of the fuel, the Controller gave a promise that it would receive immediate attention. As to the question of the relation of price to the quality of fuel, the Controller stated that it was being gone into, and that the electric supply industry might hope for some satisfactory result in the near future—a hope which, it is needless to say, has not so far materialised.

Co-operation with the B.E.S.A.

The Sectional Electrical Committee (No. 22) of the B.E.S.A. consists of 14 sub-committees and 21 panels, and on each of these the I.M.E.A. is represented—in some cases by two members. The work of standardisation carried out by the B.E.S.A. is of the greatest importance to the electric supply industry, and the Council hope to have the support of the engineer members in putting forward the views of municipal electrical undertakings on these varoius Committees by members. This can only be done by engineer members agreeing to serve on the Committees and Panels, and it is hoped Municipal Electricity Committees will support this work by granting the necessary permission for their engineer to do this and paying out-of-pocket expenses. The Council feel that if the work is distributed among a larger number of their members the result will be more satisfactory.

Other matters under consideration are the I.E.E. Model General Conditions of Contract, the Registration of Wiring Contractors, Charges for Laying Mains and Services, Smoke and Noxious Fumes Abatement Committee of the Ministry of Health, Fire Insurance in connection with Municipal Apparatus in Sub-stations on Consumers' Premises, Battery Maintenance Contracts, Valuing and Assessing of Electric Supply Undertakings, and the Great Northern Railway Company's Bill.

The N.A.L.G.O. and A.M.E.E.

For some considerable time the I.M.E.A. has been affiliated with the N.A.L.G.O., but your Council has decided that as the interests of the chief engineers are now in the hands of their own Association (A.M.E.E.), to discontinue such affiliation.

The necessity of the Association adopting standing orders to govern the conduct of the business at general meetings has been apparent for some time. The hon. solicitor has prepared such orders, which are given in full in the report.

The Electricity Commissioners are prepared to recognise the I.M.E.A. as an association under the Electricity (Supply) Act, and applications for powers to pay subscriptions should be made by undertakings to the Commissioners.

The Council has considered the question of travelling scholarships, and after full consideration, has decided to resuscitate them in the form of books or instruments.

It has been resolved that the subscriptions shall be, in the case of an engineering member, associate member and an associate, the sum of 1s., and in the case of the Committee appointed by a local authority to have control over the municipal electrical undertaking in accordance with the undermentioned scale: Under 5,000,000 units sold, 5 guineas; over 5,000,000 and under 20,000,000, 10 guineas; over 20,000,000, 15 guineas. During the year the Committee members were asked to subscribe an additional £2 each to meet the deficit of £88 for the year 1918-19; although this payment was voluntary, only one undertaking refused to comply. The account of £112. 10s. has been rendered by the National Joint Industrial Council as this Association's proportionate payment of the total annual expenditure. If the work of the Industrial Council is to be continued adequate funds must be available. To meet the account from the Industrial Council £200 War Loan Stock had to be realised at £180. 14s. A perusal of the annual accounts will show that the general and secretarial expenses have been kept to the lowest possible level, but it cannot be said that the Association is paying its way. The increased subscriptions, which the majority of undertakings have agreed to pay, will enable the Council, it is hoped, to meet the expenditure for the ensuing year, but should it become necessary for the Association to have its own offices and a paid technical secretary, it is certain that the subscriptions will have to be still further increased.

Mr. H. Faraday Proctor (Bristol), dealing with the Electricity Supply Bill, said the Council had two days ago passed the following resolution, which he submitted for adoption by the members:—"That this Association is of opinion that no efficient progress can be made by Joint Electricity Authorities formed under the Electricity (Supply) Act, 1919, unless there are incorporated in the schemes or Orders confirming the same satisfactory financial arrangements, and that it is therefore of paramount importance that the financial clauses 12, 13, 14 and 15 of the Electricity (Supply) Bill, 1920, be passed into law at the earliest possible date; that a copy of this resolution be sent to the Prime Minister, the Minister of Transport and the Electricity Commissioners; that all Local Authorities who are members of this Association be urged to pass resolutions similar to the above and to use their best endeavours, through their Members of Parliament and otherwise, to secure the desired end." He said that already difficulty had been experienced in drawing up schemes for the constitution of Joint Electricity Authorities, owing to the absence of financial clauses in the Electricity (Supply) Act, 1919. The financial clauses of the 1919 Act had been re-introduced, and he thought there were no two opinions as to their necessity.

Mr. F. Ayton (Ipswich) seconded the motion.

Mr. Faraday Proctor, at the request of Mr. S. J. Watson (Bury), then gave some information as to the scope of the financial clauses. In doing so, he said that another influential Association, though equally agreed as to the urgent necessity of these clauses, thought that the Government should find the money, because they retained power to direct certain works. But it would be difficult to persuade the Government to find all the money which they (the undertakers) were going to spend.

The resolution was carried unanimously.

Councillor W. Turner (Bradford) moved "That this Association hereby places on record its opinion that in connection with any schemes which may be put into operation, as a result of the Electricity (Supply) Act, 1919, and any amending Acts, the control, generation and main transmission of electricity should, as a general principle, be placed in the hands of duly elected representatives of the district in which the electricity generated and transmitted is to be used, and that a copy of this resolution be sent to the Prime Minister, the Board of Trade and the Electricity Commissioners; resolved further that all local authorities who are members of this Association be strongly urged to pass a similar resolution and use their best endeavours to ensure that effect is given to the principle contained in such resolution."

Bailie W. B. Smith (Glasgow) seconded.

Mr. F. W. Purse (West Ham) asked whether the resolution covered ownership as well as control, and the hon. solicitor (Mr. P. M. Heath) expressed the opinion that it did.

Mr. H. R. Burnett (Barrow-in-Furness) said the resolution as drafted would prevent any representatives of railway companies and other large consumers sitting on the Joint Electricity Authorities. The resolution would have disastrous results in many districts.

Mr. P. M. Heath thought control implied the word ownership. He suggested altering the wording to "the ownership of the authorised works and the control, generation and main transmission of electricity." The resolution did not define how the public representatives should be appointed. That could be dealt with after the resolution adopting the principle had been passed.

Mr. S. J. WATSON supported the principle underlying the resolution, but remarked that there could not be local control in the usual meaning of the term unless the local authorities were prepared to purchase outright the undertakings of companies operating in their areas.

The PRESIDENT said it was intended that that should be the case.

The resolution was carried unanimously.

Lt.-Col. W. A. VIGNOLES (Grimsby) moved "That the Council be instructed to consider the question of developing the sale of electricity for domestic purposes and especially (*a*) tariffs, (*b*) the use of electricity for heating, cooking and other domestic purposes." If the resolution were passed the Council would approach the Electrical Development Association and ask them to approach manufacturers connected with the E.D.A. and get a joint committee appointed to go into this question.

Mr. R. C. KILCH (Battersea) seconded the motion and said the question of apparatus should be tackled before dealing with tariffs. He suggested that a co-operative society might be established amongst the municipalities to make apparatus.

The resolution was carried unanimously.

Ald. A. R. JEPHCOTT, M.P. (Birmingham), moved "That this Association in general meeting desire that all municipalities be advised that it is their (the Association's) opinion that all awards of the National Joint Board should be duly observed." If the awards were not carried out the Whitley Councils might as well be scrapped.

Ald. W. WALKER (Manchester), chairman of the National Joint Industrial Council for Electricity Supply, supported the resolution, and after some discussion it was carried unanimously.

The PRESIDENT then announced the result of the election of Officers and Members of Council, as follows :—

President : Mr. H. Richardson (Dundee) ; *Vice-President :* Mr. S. T. Allen (Wolverhampton) ; *Hon. Secretary :* Mr. A. C. Cramb (Croydon) (re-elected) ; *Hon. Solicitor :* Mr. P. M. Heath (Manchester) (re-elected) ; *Hon. Treasurer :* Mr. H. Faraday Proctor (Bristol) (re-elected).

Council : Committee Members.—Ald. T. P. Bird (Birmingham) ; Col. A. Sinclair (Swansea) ; Ald. W. Walker (Manchester). *Engineer Members : Small Towns*—Mr. E. E. Calvert (Finchley) ; *Large Towns*—Mr. J. H. Bowden (Poplar) ; Mr. A. Nichols Moore (Newport, Mon.) ; Mr. F. W. Purse (West Ham) ; Mr. S. J. Watson (Bury).

Votes of thanks were accorded the Bradford Corporation and its officials, the Chairman of the Electricity Committee, Councillor Turner, being referred to especially, Ilkley Urban Council and its officials, and the retiring President (Mr. T. Roles) and Mrs. Roles.

Mr. T. ROLES, in acknowledging the compliment, said he desired to give a special tribute to Mr. J. Senior, of Ilkley, and to Councillor Mrs. Arnold, of Bradford, whom he believed to be the first lady member of an Electricity Committee.

In the afternoon a small party made an excursion to the Nidd Valley and Pateley Bridge, a trip which included an inspection of the Bradford Corporation's waterworks. This brought a most successful Convention to a close.

THE PRESIDENT OF THE I.M.E.A.

The success or failure of any Convention depends primarily on the qualities of those who are entrusted with the duty of organising it. This is specially true of the Ilkley Convention, whose success may be justly attributed to the hard work of the President, Mr. Thomas Roles, chief electrical engineer and manager of the Bradford Corporation Electricity Supply Department. This work was carried on under extreme personal inconvenience, for Mr. Roles, as his friends know, has been in poor health for some time past. Nevertheless he managed to get through the Convention with conspicuous ability, and we all hope he will shortly recover his full health.

Mr. Roles was born at Brighton in 1875, received his technical education at the Brighton Technical School and joined the Brighton branch of Electrical Supplies and Fittings Company, Ltd. He afterwards entered the service of Messrs. Crompton & Co., being employed by them in connection with the erection of the station of the Hove Electric Lighting Co., Ltd. When that station was started up he was transferred to the staff of the Company. In March, 1895, he became assistant electrical engineer at Aberdeen, and subsequently obtained a position in the Leicester Corporation Electricity department in order to gain experience of high tension alternating current working. He afterwards served as mains engineer at Leicester until, in August, 1900, he was appointed generating engineer at the Poplar electricity works, a position he held until March, 1904, when he was promoted chief assistant electrical engineer to the Bradford Corporation.

On February 1, 1907, he succeeded to the position of city electrical engineer and manager at Bradford, and since he has held that position he has been responsible for the installation of three-phase generating plant with a maximum continuous rating of about 35,000 kw. During his tenure of office at Bradford many improvements have been introduced, and considerable attention has been paid to the development of the business side of the undertaking, including the extension of the motor and hiring accessories department and the opening of showrooms, &c. The electric driving of the textile mills in that city has also been greatly developed, as has the use of electricity for heating and cooking purposes.

Mr. Roles was chairman of the Yorkshire Local Section of the Institution of Electrical Engineers during 1914-15, and is chairman of the Yorkshire Electricity Supply Linking-up Committee. He was a member of the National Electrical Power Supply Committee and of the Electric Power Supply Committee of the Institution of Electrical Engineers. During the war he acted as representative for the Yorkshire district for the Comptroller of Coal Mines, and he has served on the Council of the Incorporated Municipal Electrical Association, except for a period of one year for which it was necessary for him to retire under the Articles of Association, since 1912.

MR. THOMAS ROLES.

Parliamentary Intelligence.

A Select Committee of the House of Lords has amended the HALIFAX Corporation Bill, which authorises extensions of the tramways and of the electricity supply area, &c. Owing to the opposition of Huddersfield Corporation which complained of competition with their system, the projected new line to Elland was struck out. The Bill also sought powers for a comprehensive scheme of electricity supply for a district consisting of Huddersfield, Halifax, Brighouse, and adjacent areas.

Sir JOHN SNELL said such a scheme had been in contemplation for a long time, and the desire of the Commissioners was to avoid what he might call the parochial distribution of electricity in the interests of the public and of economy, and to establish big generating stations for the widest possible distribution. Any waste of public money was to be deprecated by giving local authorities competitive powers for supply or distribution.

After hearing evidence in support of the Halifax proposals and in opposition by the Yorkshire Power Company, the Committee declined to grant the powers asked for.

Notwithstanding the strenuous opposition of Leith Corporation before Select Committees of both Houses of Parliament the EDINBURGH EXTENSIONS BILL, which incorporates Leith and its electricity undertaking, &c., has been passed. The Port of Leith will continue to retain the title of the Port of Leith, and half of the municipal representatives of the Dock Commission shall be members of the Leith wards of the City of Edinburgh.

The NEWCASTLE-UPON-TYNE CORPORATION BILL, which authorises the Corporation to construct and work additional tramways and tramroads, to run motor omnibuses, &c., has been passed by a Select Committee of the House of Lords. The Bill has already passed the House of Commons.

The Bill, which authorises an increase of rates and charges on the tramways of the WREXHAM AND DISTRICT TRANSPORT CO., has also passed both Houses of Parliament.

Imperial Wireless Telegraphy.

The report of the Imperial Wireless Telegraphy Committee, which was appointed by the Secretary of State for the Colonies in November last, has been issued as a Command Paper (Cmd. 777). The committee consists of Sir Henry Norman, Bart., M.P. (chairman), Mr. F. J. Brown, Dr. W. H. Eccles, Rear-Admiral F. L. Field, Prof. Sir Joseph Petavel, Sir John Snell, Mr. James Swinburne and Mr. L. B. Turner. The secretary is Brig.-General S. H. Wilson and the assistant secretaries Lieut.-Col. C. G. Crawley and Mr. F. W. Phillips.

The Committee were required to prepare a complete scheme for Imperial wireless communication, and in so doing to consider what high power wireless stations it was desirable on commercial or strategic grounds the Empire should possess, to prepare estimates of the capital and annual costs of such stations, to examine the probable amount of traffic and revenue which might be expected and to place the stations recommended in the order of their urgency.

THE OBJECTS OF THE SCHEME.

In the course of the enquiry numerous witnesses representing not only the naval and military authorities, but official and commercial interests were examined. To determine the present amount of wireless traffic the Post Office staff kept 24-hour intercepting watches upon the working of the chief European long range stations, and also obtained information regarding delays and interruptions, speed of working, number of repetitions required, &c. It appeared that the repetitions in most cases were very numerous, requests for V's for adjusting purposes frequent, and that the rate including repetitions does not exceed 5·13 words per minute.

It is pointed out that the objects to be served by an Imperial scheme of wireless communication are two, strategic and commercial. As far as conditions of working are concerned commercial wireless requirements being much more exacting than strategic requirements a good commercial service will more than fulfil every strategic need with the one exception that strategic stations must be provided with some means of protection from hostile attack.

THE REQUIREMENTS OF A SATISFACTORY SERVICE.

Commercially the three chief factors of a satisfactory wireless service are reliability, speed and cheapness. At present no satisfactory commercial wireless service is in operation anywhere over a distance of 2,000 miles. A consideration of the methods of generating powerful magnetic waves shows that the arc system is thoroughly well established and proved for long range wireless communication. It presents no unsolved technical problems, is covered by no valid patent, is simple to design, can be produced by any competent manufacturer of electrical machinery, is easy to operate, and its results are known. In spite of its pre-eminence at the present moment for long range wireless transmission the Committee do not, however, consider that it could be used to provide a satisfactory commercial long range service as they have defined the term.

THE THERMIONIC VALVE.

The high frequency alternator can hardly yet be regarded as established, and in any consideration of its qualities the difficulties and drawbacks attending its construction and operation must not be overlooked. These machines demand extreme accuracy in manufacture, are high in initial cost, require skill in operation, and much auxiliary machinery. On the other hand, the thermionic valve has revolutionised wireless practice during the past five years. An Admiralty station in the United Kingdom fitted with it held regular communication with a force 1,600 miles away, while military communication between London and the Army of Occupation in Germany is maintained by transmitting valves at each end. The Post Office will shortly communicate by the use of valves with ships over a range of at least 1,200 miles by means of stations of small power. Experiments made at the Wireless School show that there is every reason to anticipate that it will be possible to deliver 120 kw. to the aerial by this method, and that this may even be increased to 240 kw. if necessary. The advantages of the valve system over the other methods are summarised as being single frequency working, high efficiency, low energy consumption, no keying difficulties, less cost and easy maintenance.

LOCATION AND FINANCE OF STATIONS.

The question of the location and finance of the proposed Imperial wireless stations is then fully considered. It is pointed out that proposals for an Imperial Wireless Chain usually contemplate links of about 4,000 miles. For these distances all spark systems are obsolete, and the high frequency alternator has been insufficiently tested in prolonged operation. The arc system would therefore have to be adopted. It is, however, impossible to say, beforehand, what power would be required at such ranges for a satisfactory commercial wireless service, *i.e.*, a 24-hour day service not subject to frequent interruptions and repetitions, reliable, working at high speed and at a capital cost and annual expenditure sufficiently low enough to attract a large traffic, and so more speedily become self-supporting.

The cost of a pair of stations in England and India equipped with the smallest arcs likely to effect this communication would be £615,000, and the annual charges £155,000. It is not certain however, that this power would be adequate, and it would be unwise to incur the cost of larger arcs until the results of the working of an arc of greater power than any hitherto constructed are made public. As a result of this consideration it is concluded that an Imperial Wireless Chain of 4,000 mile links bridged by arc transmission is inexpedient on both technical and economic grounds. Further consideration shows that the chief countries of the Empire can be connected by links of about 2,000 miles, and communication over these distances can be effected by the employment of thermionic valves. This system, the Committee remarks, is undoubtedly in the line of future development of wireless telegraphy, and promises to cost less than the arc system to install and operate.

DETAILED PROPOSALS.

A Post Office wireless service operated by the arc system will shortly be in operation between England and Egypt. This service should carry all the African traffic through a new valve station near Nairobi and the ex-German station at Windhuk. For the Indian, far Eastern and Australian service it is proposed that valve stations should be erected in England, near Cairo, in India, at Singapore, at Hong Kong, and on the north or west coast of Australia. If this scheme is adopted official, commercial and press traffic will be carried reliably and the essential strategic needs will be met. Communication between England and India can best be secured by similar valve stations in each country, but a satisfactory commercial service between western Canada and Australia would be extremely difficult to inaugurate at the present stage of development.

The capital cost of the scheme outlined above is estimated at £1,243,000, complete depreciation is estimated at £425,000, the estimated revenue being £325,000. The opening years of operation would show an annual loss of about £100,000. Nevertheless it is considered that the proposals made represent the quickest and most economical method of inaugurating a satisfactory Imperial service on the latest scientific lines. The loss would doubtless decrease year by year, and become profit in ten years time, and in any case may be regarded as negligible in comparison with the benefits conferred.

A WIRELESS COMMISSION.

The chain of stations, at least three-quarters of the material of which would be supplied by commercial manufacturing firms should be completed in two years after the issue of the plans and specifications. To carry out these recommendations it is suggested that a wireless commission should be appointed to plan the stations and to secure the necessary co-ordination in the work. The construction of the stations to the plans furnished by the Commission should be entrusted to the Engineering Department of the Post Office.

THE MARCONI SCHEME.

A lengthy reference is made in the report to the proposals submitted to the Government by the Marconi Company, and noticed in THE ELECTRICIAN of March 12, 1920. The Committee find these proposals too vague to admit of detailed comment, and consider the scheme one of such scope and magnitude and involving such large capital and heavy expenses that even if it carried the whole of the traffic handled to-day by all the cable companies serving the same regions it could only be remunerative by duplicating the Postmaster General's system of inland and continental telegraphy and by competing with the State telegraph systems of the various overseas Governments. The Committee are further of opinion that if fully carried out it would be prejudicial to the interests of free wireless and independent research. They add that upon the technical side of the proposals the information given affords no basis for judgment, and the Committee do not accept the extreme claims made for the Franklin type of aerial. They point out that the only Franklin patents which can be traced of the nature suggested are No. 24,098 of 1914 and 5,789 of 1915, and if these constitute the basis of the above claim; other methods of accomplishing the same object are known to wireless science. All such methods are based on the employment of loop aerials. They express regret that they have not the opportunity of examining Mr. Franklin upon this matter and upon the results of this invention. On the other hand, the Committee are of opinion that if the Imperial wireless traffic were carried by the State long distance wireless traffic to foreign countries might properly be left to the commercial companies.

Two Large Mercury Rectifiers.

Messrs. Power-Rectifiers Limited have supplied us with a couple of photographs of mercury arc rectifiers for large outputs which we reproduce herewith, and which will probably be of considerable interest to those contemplating extensions to their substation converting plant. Rectifiers of this class, which are manufactured by Messrs. Brown, Boveri & Co., Baden, Switzerland—are nowadays being used on a considerable scale, due to the advantages they present in connection with high efficiency, reduced attendance and lower building costs.

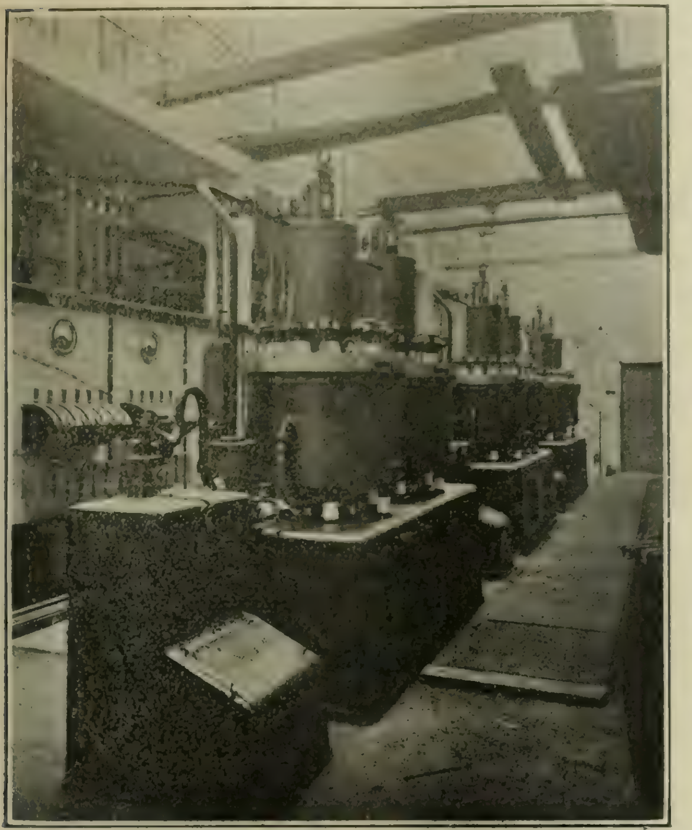

Fig. 1.—A Bank of Mercury Rectifiers. Capacity 920 kw.

The larger illustration (Fig. 1) shows a bank of six mercury arc rectifier cylinders in groups of two, each group being provided with its own vacuum pump set, out-put 920 kw. at 230 volts direct current. This equipment is installed in a Continental motor-car factory.

The smaller illustration (Fig. 2) shows the latest form of large cylinder for out-puts up to 900 amps. per cylinder. The anodes are provided with radiators, while the cylinder is mounted on insulators fitted to a foundation ring very similar to that on the first photograph. The flange with cock for connection to the vacuum pump is seen at the upper part of the cylinder, just below the lifting bolt.

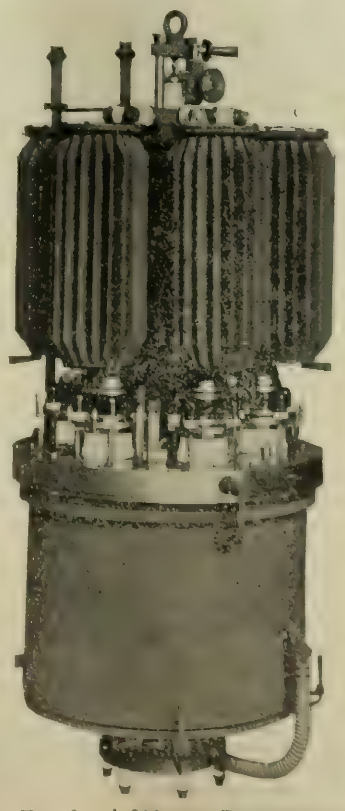

Fig. 2.—A 900 amp. Rectifier.

Correspondence.

STRAY LOSSES IN TURBO-ALTERNATORS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: It is most regrettable, and no credit to the state of engineering knowledge in this country, that so simple an explanation of stray load losses as that put forward in your columns recently should have caused a "shock" to one of your readers. Joking apart, however, it is quite clear that Dr. Barclay has not clearly understood the part of the article he criticises.

To take his second point first: turbo-rotors in which the central part is slotted usually have such slots closed by magnetic wedges, so that the surface is magnetically smooth, and there are, therefore, no ripples in the air-gap flux due to this slotting below the surface. Where the exciting winding is carried, however, whether the wedges are magnetic or non-magnetic, a ripple is set up, causing tooth pulsation.

If the winding extends over two-thirds of the pole-pitch, then, assuming a sine wave distribution and neglecting the increased air-gap reluctance due to the slot openings, it can easily be shown that 50 per cent. of the flux will be carried by the slotted portion and 50 per cent. by the smooth part. If, however, the distortion were the maximum of 90 deg., then 86·6 per cent. of the flux would be carried by the slotted portion. Since, however, the pulsation loss, like most other core losses, varies as the square of the variation in flux, the loss would increase in a still greater proportion.

Taking, therefore, the square of the sine wave as a representation of the relative magnitude of the pulsation loss, the relative figures become 39 and 94 per cent. in the two cases considered above.

While at full load the distortion is not so great as this, yet it is sufficient to make a very large increase in the pulsation loss. It is perfectly clear that as a rotor slot is moved across a stator tooth there must be a diminution of flux in the latter, particularly if the rotor tooth is as wide or wider than the stator tooth, and though the variation in itself may be small, yet at the periodicity at which it is changing, usually well over 1,000 per second, the loss is, comparatively speaking, enormous.

Dr. Barclay's rendering of my remarks on the difference between Stalloy and Lohys is so entirely contradictory to my actual statements that I can only refer him back to the original article.—I am, &c., Laurence H. A. Carr

Stockport, June 25, 1920.

ENGINEERING EDUCATION IN AMERICA.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Apropos "the fundamentalists of American education," referred to by you in the issue of June 4th last, there is nothing to get excited about. As the "Newer Thought" has it, you have only to believe long enough and it will surely happen.

Really, if you also will believe it hard enough, the so-called fundamentals taught here will be enough to people the world with Heavisides and Newtons and Kelvins.

It is still more athletics and still more economics (*sic*) that will turn out Gibbs's and Rowlands and Henrys; but, then, who was this Gibbs fellow anyhow?—I am, &c.,

A Former Purveyor of Trifles

In order to maintain and to improve the existing cordial relations between themselves and their employees, Messrs. Rashleigh Phipps & Company, Ltd., have adopted an Investment Scheme. The share capital of the Company is £50,000 in £1 shares, and of these 5,000 are Employees' shares, and 45,000 are Ordinary shares. The issued capital consists of £21,000 ordinary and £2,000 employees' shares. Dividends are to be paid in the following order: First payment: 6 per cent. per annum on employees' shares, or just over 1d. in the £ per month. The Second Payment: 6 per cent. per annum on the ordinary shares. The surplus will be divided among members holding employees' shares and members holding ordinary shares in proportion to the capital paid up on the employees' and ordinary shares held by them respectively. The shares will be issued at par to employees, but on leaving they must re-sell their shares at par to the Company for re-issue to other employees.

Legal Intelligence.

Marconi's Wireless Telegraph Company v. Hamilton.

This case was mentioned to Mr. Justice Astbury on Monday. Mr. Hogg, K.C., said he had a motion on behalf of plaintiffs to continue an injunction granted ex parte last week by Mr. Justice P. O. Lawrence to restrain defendants from publishing certain documents contrary to the terms of an agreement in writing entered into by him. An affidavit had been filed by the defendant, who now appeared in person.

Mr. Justice Astbury: I am interested in a company that used to be connected with the Marconi Company, but it is no longer connected with it as far as I know, and do not know why anyone objects to my hearing the motion.

Mr. Hamilton, who said he had not had an opportunity of instructing counsel, handed in a written statement.

Mr. Justice Astbury read the statement and handed it to Mr. Hogg. After some discussion, his Lordship said there was a suggestion of guilt and things of that kind, but it was absolutely false. There was a time when he had an interest in the American Marconi Company, but he understood that had now ceased.

Mr. Hamilton said he had no objection to his Lordship hearing the motion. He wished to cast no reflection on his Lordship. The information in the letter was conveyed to him and he thought he ought to show it to the Judge.

His Lordship, after reading the letter, arranged with Mr. Justice Lawrence to hear the application, "nominally" for him.

Commercial Topics.

Electric Development in South America.

In a recent report by the United States Bureau of Foreign and Domestic Commerce it is stated that the next few years will afford good opportunities for the sale of electrical plant and supplies in Uruguay. A big international power plant on the river Uruguay, which is projected by Argentina, Brazil and Uruguay, would be capable of supplying 2,500,000,000 units per annum. Other plans for the erection of hydro-electric works are also under consideration.

* * * * *

Pre-War German Debts.

It is now announced that, as a result of communications which have passed between the British and German Clearing Offices, British creditors and debtors may communicate in writing with their German debtors and creditors direct with regard to pre-war debts or debts arising out of pre-war transactions or contracts, with the sole object of ascertaining the particulars of indebtedness between the parties, provided that no proposal or suggestion is made for the payment or settlement of such debts except through clearing offices, and that the party so communicating shall retain true copies of such communications and the original replies thereto.

* * * *

South African Trade Openings.

It is reported that there is a big demand for electrical goods, fittings and wiring materials, porcelain and wire rope. In a recent issue of the "British and South African Export Gazette" it was stated the oil engine is at present supreme as a power motor in South African farms with the wind motor—invariably of foreign manufacture owing to the strange indifference of British makers—a good second. Attention is being drawn to the waste of water power in numerous districts, and attempts are being made to educate the agriculturist as to the possibilities open in this direction. Our contemporary thinks there is a good opportunity open to machinery firms, more particularly as the commercial opportunities are not limited to the handling of small dynamos and the necessary material, but the door is opened to a new and highly profitable business in lighting fittings and such domestic convenience as electric fans, irons, washing machines, cooking and heating apparatus. Such plants are not unknown in South Africa. Isolated cases exist where enterprising farmers have had them in successful operation for years One house in British East Africa, holding an American agency, has been making a big and successful push lately with electric motors adapted for agricultural purposes. South Africa should provide a still larger field if similar propaganda were pursued in districts offering water-power facilities, and it should be realised that there are few which do not.

Personal and Appointments.

Mr. E. Jordan, of Rawtenstall, has been appointed works superintendent at Aylesbury electricity works.

Prof. I. M. Heilbron, D.S.O., D.Sc., Ph.D., has been appointed to the chair of organic chemistry in the University of Liverpool.

On the 23rd ult. the degree of D.Sc. of the Oxford University was conferred upon Prof. Sir Richard T. Glazebrook, K.C.B., F.R.S.

Dr. W. E. S. Turner has been appointed to the new Chair of Glass Technology and Mr. Joseph Husband, B.Sc., A.M.I.C.E., to the Chair of Civil Engineering at Sheffield University.

Burnley Corporation is recommended to increase the salary of Mr. J. E. Starkie, borough electrical engineer, from £800 to £1,000 by annual increments of £50.

Mr. C. Burgess, manager of the tramways at the Hartlepools, and who is leaving to take up a similar appointment at Walsall, has been presented by the Hartlepool tramway employees with a solid silver rose bowl.

Electricity Supply.

Bodmin Town Council has invited the local electric Lighting Company to submit estimates of the cost of public and private lighting.

The electricity charges at St. Annes-on-Sea are to be advanced by another 6⅔ per cent. The minimum charge is to be 10s. per quarter.

Belfast Corporation has applied for sanction to a loan of £30,000 for mains extensions, &c.

Criccieth Urban Council has decided to engage an electrical engineer to report on the possibility of using water power for generating electricity for public and private lighting.

Ballycastle (Co. Antrim) Urban Council has refused to purchase the local gas works as the members think that electricity supply should be introduced for public and private lighting.

Brierfield Council is applying for sanction to borrow £5,000 to lay extra electric cables. Many householders are now applying for power, and 50 applications have been received during the last two months.

In order to provide for public lighting and also for lighting of the new houses and streets at Oakenshaw the Willington Urban Council has entered into negotiations with Messrs. Strakers & Love, local colliery owners.

Bristol Electricity Committee has arranged to give a bulk supply of electricity to the Keynsham Electric Light & Power Company, and also to supply electricity to private consumers in Brislington. The Corporation has also agreed to extend the supply mains to Mangotsfield within 18 months.

In reply to representations made by a deputation from the local Trades Council and the Electrical Trades' Union, who fear unemployment owing to the inability of the Nottingham Electricity Committee to supply consumers with power or light, the Committee states that they are doing their best, but they cannot meet all the demands until the new plant has been installed.

Haslingden Council has decided that the maximum cost to be incurred for installing services for domestic and small power consumers shall not exceed £5. The prices of current for lighting has been raised to 7d. per unit, and for power 100 per cent. over pre-war rates. It was agreed to enter into no further contracts for the supply of electricity for a term of years, and notice has been given to terminate the agreement with Messrs. Nobell's, Ltd. The offer of Messrs. Porritt to pay 0·45d. per unit, plus £4 per kilowatt for the first 200 kw. used, and £3 per kilowatt over that amount, has been confirmed.

The report of the City Accountant on the working of the Peterborough Electricity Department for the year ended March 31 show revenue £18,298 (compared with £12,168 in previous year) and working expenses £13,765 (£8,497), leaving gross profit £4,533 (£3,671). After providing for interest and repayment of capital and £651 for depreciation of investments, there was a net deficit of £1,058 (£1,283). Cost per unit was 2·965d. (1·966d.) exclusive, and 4·121d. (3·049d.) inclusive of capital charges. Units sold were 1,090,507 (1,016,376) at an average price of 3·825d. (2·695)d. Maximum load was 825 kw. (633 kw.) and load factor 15·44 (18·33) per cent.

The Electricity Commissioners suggest an extension of the Back o' th' Bank generating station, Bolton, beyond the immediate intentions of the Electricity Committee. The present capacity is 16,000 kw., and the Committee have on order a 12,000 kw. set, and also one of 6,000 kw.; but it was suggested that a 12,000 kw. set be substituted for the 6,000 kw. set. The Commissioners express the opinion that it would be a mistake to get rid of the 6,000 kw. turbo-generator, and that it would be better to extend the buildings so as to enable a second 12,000 kw. set to be installed, bringing the total capacity to 46,000 kw. This would involve an extension of the boiler house, the installation of further boilers and other extensions which would cost the Committee something like double the £370,000 they are already committed to. The Borough Electrical Engineer is to report on the suggestions of the Commissioners.

The manufacturers and power users of Sheffield are naturally protesting against the Corporation's new flat-rate system of charges for electricity. The situation was considered on Monday by the local branch of the Federation of British Industries, when Mr. W. Clark, managing director of Vickers (Limited), said the Council's decision was made on a catch division, 18 members not having recorded their vote. The decision meant that the users of electric light were going to have the advantages of prices owing to the extraordinary amount of current used for power. His firm, along with others, had made large extensions during the war for the nation's need, and had adopted electric power as an emergency. He said emphatically that to increase further the charges to power users was altogether an immoral thing. Mr. C. Siddall, of the Sheffield Forge and Rolling Mill, said some firms were making arrangements for the electrification of their entire works. If the flat rate policy was persisted in, they would either have to utilise their own waste gases for power, or cancel all orders for electrification. Power users might shut their electrically-driven works down and not use any of the Corporation current. Ultimately, a resolution was passed strongly protesting against the Council's decision on the grounds that the cost per unit, both in capital and running costs, was considerably higher in the production of electricity for light than for power purposes, and that with equal charges the consumer of electricity for power would be called upon to meet more than the just proportion of the cost. The meeting called upon the Corporation to consider their decision. The local Chamber of Commerce has decided to send a deputation to the Corporation on the matter.

Electric Traction.

The Light Railway Commissioners have submitted the LLANTRISANT Light Railway Order for confirmation, and objections must be lodged with the Ministry of Transport by July 12.

Already, after receiving an advance of 9s. per week as the result of an arbitration award following their strike at Easter, the tramway employees at MANCHESTER have decided to send in a demand for a further £1 a week, with a threat of a strike if the demand is not met.

The employees of the GLOSSOP Tramways, which are owned by the Urban Electric Supply Company, are out on strike. The men claim a 6s. weekly advance, but the manager of the company points out that the tramways have been running at a loss for a number of years, and that it will be necessary to raise fares if increased wages are to be paid.

The accounts of the GLASGOW CORPORATION tramways department for the year ended May 31 show a deficit for the first time in its history of £108,531, compared with a surplus of £14,772 in 1919. The year's revenue was £1,721,577, including traffic receipts £1,716,490. The expenditure last year was: Traffic expenses, £856,111; general expenses, £225,872; maintenance and repairs, £317,520; power, £152,742; Clydebank bridges, £2,314; and European War (payments to dependents of employees serving with H.M. Forces), £3,601—a total of £1,558,161 against £1,249,988. The balance carried to net revenue in 1919 was £281,331, which, with interest on investments (£10,564), amde a total of £291,896. On this occasion the balance is £163,416, which, with £13,345 interest from investments, makes £176,761. The appropriations on this occasion have been: Rent of Paisley lines, £11,092; interest, £3,891; sinking fund, £1,714; income tax, £81,295; Parliamentary expenses, £1,056; renewal and depreciation, £186,242—a total of £285,293, leaving a deficit of £108,531. The working expenses for the past year show one decrease compared with the preceding year—£69,268 on amount paid to dependents of employees serving with the Forces; but on the other hand, there are the following increases: Traffic expenses, £181,944 (including traffic wages and ticket check £135,216, cleaning cars £22,487, uniforms £18,422, cleaning track £2,418, and fuel for depots £2,051); general expenses, £50,868 (the principal item in which is taxes £38,732); general repairs and maintenance, £98,012 (including permanent way, £39,528, electric equipment of line £5,582, buildings £9,416, and cars £41,577); power expenses £46,056 (including fuel £27,067, wages £4,499, and repairs to ducts and cables £13,434); and Clydebank bridges £561.

In consequence of the higher fares the number of passengers continue to drop. Last week, although 20,000 additional car-miles were run, the total passengers were 8,702,462, a decrease of 1,071,009 from the corresponding week. The revenue (£45,395) shows, however, an increase of £12,478.

Imperial and Foreign Notes.

In a report by the U.S.A. Trade Commissioner at Constantinople (Mr. E. G. Mears) it is stated that there are great possibilities for hydro-electric, mining and industrial development in TRANSCAUCASIA. Existing hydro-electric stations represent only 6,725 H.P., but surveys indicated that over 350,000 H.P. is possible.

It is estimated that there is sufficient water power available in the UNITED STATES capable of developing a minimum of 26,736,000 H.P. and a maximum of 51,398,000 H.P. Of this total nearly 10,000,000 H.P. (maximum 26,736,000 H.P.) is in the Western States of Washington, Oregon, California, Idowa and Montana.

The Belgian Railway Budget Committee has reported on the scheme for the ELECTRIFICATION OF THE STATE RAILWAYS, which will be carried out in three stages. The first stage will embrace the whole of the lines connecting Brussels and Antwerp; the second, the Luxemburg and branch lines; the third, sections of the different lines radiating from Brussels. On the Brussels–Antwerp line it is first proposed to run 38 trains a day of a carrying capacity of 550, for travellers only; this will involve the electrification of 54 miles of main and about 9½ miles of secondary line.

In a dispatch to the Department of Overseas Trade, H.M. Consul at Vigo (Mr. Thomas Guyatt) calls attention to the new project for extending the Vigo electric tramway as far as Redondela. The distance from Vigo to Redondela is nearly 9 miles. At present the line goes in that direction as far as Los Canos (2 miles) and the company has decided to extend it as far as Chapela, another 2½ miles, but it is now proposed to make a further extension as far as Redondela, a total of 5 miles. British firms interested may obtain from the Department the name and address of an official in Vigo to whom communications might be addressed.

Business Items, &c.

The United Electrical Company (Birmingham), Ltd., have removed to 47, Summer-row, Birmingham.

Thomas Redman, Joseph Redman and Ernest Shaw Redman, machine tool makers, trading as C. Redman & Sons, at Parkinson-lane, Halifax, have dissolved partnership.

In order to deal more conveniently with his consulting work in the Lancashire district, Mr. C. H. Wordingham, C.B.E., M.Inst.C.E., has taken offices at 11, Mosley-street, Manchester.

Thos. Hague, Jeremiah Hague and Salisbury Wood, trading as Wood & Hague, ignition and lighting specialists, at 1A, Saunders-street, Southport, have dissolved partnership. Messrs. Hague continue the business under the same title.

Miscellaneous.

A system of urgent telegrams between France and Great Britain at triple rates was inaugurated on the 1st inst.

The George H. Alexander Engineering Company, Ltd., is being wound up voluntarily, and Mr. E. Bosley, 120, Colmore-row, Birmingham, has been appointed liquidator.

The Post Office & Telegraph Bill, which was read a first time in the House of Commons on Tuesday, raises the MINIMUM CHARGE FOR INLAND TELEGRAMS to 1s. as from Aug. 2, and increases the postal rates for newspapers and postcards.

Four Scottish firms of GLASS MANUFACTURERS have agreed to combine and form a new company, with a capital of about a million pounds. New works are to be erected at Edinburgh, and all kinds of glass ware, including optical and scientific goods, will be manufactured.

The RUBBER GROWERS' ASSOCIATION offer £5,000 in prizes for ideas and suggestions for extending the use or for encouraging new uses of rubber. One prize will be of £1,000, three of £500 each, ten of £100 each, and £1,500 will be divided among the remaining competitors. Particulars from the Secretary, 38, Eastcheap, London, E.C.3.

A COMMERCIAL RADIO-TELEGRAPH service will shortly be inaugurated in Argentina. Hitherto the radio stations have been mainly employed mostly for Government despatches. Radio stations are to be set up at the Patagonian ports of Gayman, Rawson and Puerto Gallegos, and one at Buenos Ayres.

An electrical engineering firm is to have the credit of inaugurating the FIRST AERIAL BEANFEAST PARTY. Employees of Messrs. Macdonald, Syer & Company, of Gray's Inn-road, have chartered a Handley Page aeroplane to convey them to Margate and back to-morrow (Saturday), for their annual outing.

Last week about 40 members of the SOUTHPORT branch of the ELECTRIC TRADES UNION, engaged by local electrical contractors, went on strike. Their grievance is that the Southport masters have declined to meet the official negotiating body of the Merseyside to which the Southport branch is affiliated, in respect to the formation of a set of rules and rates.

An ASSOCIATION OF UNIVERSITY TEACHERS has been formed and claims a revised scale of salaries as follows: Assistant lecturers, £300 to £400. Lecturers are divided into two groups (*a*) Grade I. (ordinary) lecturers, £400 to £650; and (*b*) Grade II. (special) lecturers, £650 to £900; professors' minimum, £1,100. All full-time University teachers on the permanent staff should have £650 as a minimum.

The staff of W. T. HENLEY'S TELEGRAPH WORKS COMPANY had a day in the country on Saturday, June 12, when Henley cables and Henley tyres blended in an outing to the Surrey Hills. The 227 members of the head office staff from Blomfield-street and New Union-street had a great day of enjoyment, and those who elected not to go must feel many regrets. The lovely village of Ewhurst, where the lunch and tea were taken at the Bull Hotel, must have been very embarrassed at having its population so suddenly—although temporarily— increased. Despite the rain the party thoroughly enjoyed itself, not the least part of the enjoyment being the char-a-banc run-out and home through what must really be the finest scenery within a day's motor ride of London.

A short Interim Report by the Ministry of Health COMMITTEE ON SMOKE AND NOXIOUS VAPOURS ABATEMENT deals with the domestic aspect of the question. There is a higher percentage of carbon and tar in domestic than in factory soot and it is, therefore, more obnoxious and adhesive than the latter. At least half the total output of smoke is domestic, and 6 per cent. of the coal burnt in domestic grates escapes as soot. Taking 40½ million tons as the amount of coal burnt annually for domestic purposes, the loss amounts to nearly 2½ million tons of soot (*i.e.*, waste fuel) per annum. The various aspects of the damage done by impurities in the atmosphere are briefly summarised, and some interesting photographs are reproduced to illustrate the effect of smoke and its concomitants, sulphuric and sulphurous acids, on public buildings. The total damage by smoke is indeterminate, but it is estimated that in regard to the weekly wash, Manchester—a smoky town—pays over a quarter of a million a year more than it would pay if it were as clean as, for example, Harrogate.

The Committee feel strongly that the new houses which are to be built must not perpetuate the smoke evil, and they have investigated various ways in which heat can be supplied without burning raw coal in domestic grates. The merits and demerits of coke, gas, electricity, central heating and a central supply of hot water are discussed. In a scheme investigated at Northfield, near Birmingham, there was an initial structural saving, estimated at £30 per house, effected by the substitution of smokeless for old-fashioned methods; but even supposing it cost a little more to avoid smoke, the Committee think it worth while. Sanction to housing schemes of local housing authorities or public utility societies should be conditional upon the provision of smokeless methods of heating, and among the conclusions are the following:—

Subject to the future possibilities of electricity as a heating agent, wherever a supply of gas is available, a gas cooker should be installed in lieu of a coal range. The cheapest and most efficient method of providing a supply of hot water, where a central supply is not practicable, is by a coke-fired boiler. A central hot water supply for detached houses is a desirable system, if it can be provided at a moderate cost. The system of installing separate central-heating plants in each house, heated by coke or anthracite, should be employed far more widely than at present. As far as practicable gas fires or hot water radiators (or electric radiators, subject to the question of cost) should entirely supersede the old-fashioned open coal fire.

Tenders Invited and Accepted.

Darlington Corporation invite tenders for a 5,000 kw. Turbo-alternator and Surface Condensing Plant. Specifications from the Borough Electrical Engineer, and tenders to the Town Clerk by July 16.

Edinburgh Corporation invite tenders for electric lighting installations in dwelling houses under their new housing scheme at Gorgie. Tenders to Town Clerk by July 13.

Wood Green Council require tenders by noon July 13 for electric wiring and fitting in the Town Hall and Bound's Green-road Schools. Specifications, &c., from the Clerk of the Council.

The Victorian Railway Commissioners require tenders by July 28 for a three-phase crane motor for N. Fitzroy sub-station. Specifications from the Commissioners' Offices, Spencer-street, Melbourne.

Warrington Electricity and Tramways Committee require tenders for two 6,000-kw. turbo-alternators. Specifications from the Borough Electrical Engineer and tenders to Chairman of Committee by July 13.

The New South Wales Department of Public Works, Sydney, require tenders by Aug. 2 for the supply of turbines and generators for the Barren Jack hydro-electric development.

Durban (Natal) Corporation invite tenders for supply and delivery of eight petrol or electric road wagons. Specifications from, and tenders to, Messrs. Webster, Steel & Co., 5, East India-avenue, London, E.C., by July 7.

The Spanish Government invite tenders (by July 10) for the erection of two wireless telegraph and wireless telephone stations, one in Valencia and the other in Palma de Mallorca. Tenderers must deposit 65,000 pesetas each station.

Hull Electricity Committee invite tenders for supply and erection of an electrically-operated overhead travelling crane. Specifications from the City Treasurer and tenders to the Chairman of the Electricity Committee, Guildhall, Hull, by noon July 12.

The date for the receipt of tenders by the New Zealand Public Works Department for synchronous condensers, service transformers and three-unit motor generator in connection with the Lake Coleridge hydro-electric undertaking has been extended to July 30.

In connection with the Waikato electric power supply, tenders are required for the supply and delivery c.i.f. Auckland of 2,400 pin insulators suitable for a line operating at 66,000 volts. Tenders to the Secretary, Public Works Tenders Board, Wellington, by July 31.

Grimsby Corporation invite tenders (by August 12) for the supply and erection of two water tube boilers, with economisers, fans, chimney, &c., a 3,000 kw. high pressure turbo-alternator and condenser plant. Specifications from the borough electrical engineer, Lieut.-Col. W. A. Vignoles.

Colwyn Bay Urban Council has accepted the following tenders:—W. T. Glover & Co., E.H.T. cables, £7,232 and l.t. feeders, £3,435; Bruce Peebles & Co., converters, £8,298; B. Thomas, switchgear, £7,093.

The Tramways and Electricity Committee of Halifax Corporation invite tenders for the supply and delivery of two natural draught chimney-type water-cooling towers. Specifications from the borough electrical engineer (Mr. W. M. Rogerson) and tenders to the town clerk (Mr. Percy Saunders) by noon, July 8.

Mansfield Council has accepted the tender of the Western Electric Company for cables at £9,838.

Southend Council has accepted the tender of Ledward & Beckett for 600 tubes and 300 bends for the condenser at £4,575.

Hammersmith (London) Borough Council recently invited tenders for the supply of two 10,000 kw. turbo-alternator sets, but as the lowest tender for the two was £14,000 above the Electricity Committee's estimate, only one set has been ordered. The tender of Messrs. C. A. Parsons & Company for the turbo-alternator, at £41,100, and that of Hick, Hargreaves & Company for twin type condensing plant (at £14,952) have been accepted. The Committee has also purchased a 2,000 kw. set from Liverpool Corporation. Nine firms submitted 13 tenders for the turbo-alternator and condensing plant, the lowest being £53,600, and the highest £64,300. The contracts were, however, let separately.

Institution Notes.

In consequence of the great interest taken by members in the proceedings of the Liverpool Wireless Association, it has been decided to continue the meetings throughout the summer on the second and fourth Wednesday in the month. Mr. S. Frith, 6, Cambridge-road, Crosby, is hon. Secretary of the Association.

Mr. A. W. Berresford, of Milwaukee, Wis., has been elected president of the American Institute of Electrical Engineers for the ensuing year. The five vice-presidents are: Messrs. E. H. Martindale, Chas. Robbins, C. S. Ruffner, C. E. Magnussen and T. L. Robinson.

At a meeting of the National Illumination Committee of Great Britain on the 21st ult., the chairman, Mr. A. P. Trotter, tendered his resignation on account of his retirement to the country. Mr. Trotter's resignation was accepted with great regret, and Major Kenelm Edgcumbe (vice-chairman) was appointed successor. Dr. E. P. Hyde, vice-president of the Illuminated Commission and delegate from the American National Committee, attended to discuss the future policy of the Commission, and explain the views of the various Continental Committees he had attended. It was unanimously agreed that a meeting of the International Illumination Committee should be held in Paris next year to discuss technical subjects.

Companies' Reports, &c.

The Provincial Tramways Company has declared an interim dividend of 8d. per share on the ordinary shares.

The Farringdon Electric Light and Power Company, Ltd., was Struck off the Register of Joint Stock Companies on May 21.

The directors of the National Electric Supply Company, Ltd., have declared an interim dividend of 5 per cent. per annum (2s. 6d. per share) on ordinary shares for the half-year.

The directors of the India Rubber, Gutta Percha & Telegraph Works Company, Ltd., have declared an interim dividend of 2½ per cent. (5s. per share), tax free, on the ordinary shares.

At an extraordinary meeting of the Telegraph Construction & Maintenance Company, Ltd., on the 24th ult., a resolution was passed in favour of paying the directors' remuneration free of income tax in future.

An issue of 250,000 ordinary shares of £1 each is being made by the Low Temperature Carbonisation, Ltd., for the purpose of providing capital for the completion of the Barnsley works and for developing the company's business.

The receipts of the Taunton Electric Traction Company, Ltd., for 1919 (including £293 brought forward), amounted to £4,705, against 3,813. After deducting expenses, debenture interest, and making provision of £750 for renewals, there remains £214, which is carried forward.

The Peterborough Electric Traction Company, Ltd., has declared a dividend of 12 per cent. on the preference shares for two years to Dec. 31, 1917. A sum of £1,500 has been placed to reserve, £3,000 to renewal fund, £4,496 to repairs and maintenance, and £3,000 provided for renewals, £1,861 being carried forward.

The revenue of the Tramways & Light Railways Estates Company, Ltd., for 1919 was £838. After deducting expenses the surplus is £556, and with £814 brought forward the available balance is £1,370. After placing £100 to reduction of goodwill, £500 to reserve, a dividend of 3 per cent. for year has been declared, leaving to be carried forward £319.

The profit of the Kalgoorlie Electric Power & Lighting Corporation, Ltd., for 1919 was £5,451, compared with £10,622 in 1918. The heavy falling off in the profit is mainly attributable to the closing down of the principal mines by reason of labour troubles. Debentures to the amount of £7,475 were paid off, reducing the liability to £15,000 on Dec. 31, 1919.

The accounts of the Brotherton Ediswan Tubes & Conduits, Ltd for the year ended March 31 show trading profit of £12,835, and, after adding transfer fees and deducting amounts written off for depreciation of plant, bank charges and interest, directors' fees, excess profits duty, &c., a balance of £21,562 remains. The directors propose to pay a dividend of 25 per cent. on the ordinary shares.

Presiding over the meeting of Waygood-Otis, Ltd., last week, the chairman (Mr. Henry C. Walker) stated that, in spite of difficulties experienced in obtaining material, and the high and uncertain costs prevailing, the company had been able still further to improve its position. The net profit for the year was £48,760, against £27,252 in the previous year. After providing for depreciation of plant, directors' fees, reserve, &c., putting £3,000 to the pensions fund, and paying the preference dividend, the balance was £33,291, out of which they were paying 7½ per cent. on the ordinary shares. The stock and work in progress was £223,436, against £134,748 last year.

The report of the Electro-Bleach & By-Products, Ltd., for 1919, states that the profit, after deducting repairs, standing charges, depreciation, &c., amounts to £34,637, which, with £394 brought forward, makes £35,031. After deducting debenture interest and interim dividends paid in December, the available balance is £24,027. Of this sum £14,750 was required to pay the further interim dividend (on account of 1919) of 3½ per cent. on the preference shares, making 7 per cent. for the year, and of 7¾ per cent. on the ordinary shares, making 14 per cent. for the year, leaving £9,277. The directors recommend that £5,000 be placed to reserve and that £4,277 be carried forward.

The Guanajuato Power & Electric, the Michoacan Power and the Central Mexico Light & Power Companies report that for 1919 they earned enough to pay all operating and maintenance expenses, including depreciation and other items, also all of the bond interest (but not including payment of the principal of matured bonds or sinking fund provisions). The gross earnings were $1,131,289, and expenses were—for operation and maintenance, $580,998; reserve for depreciation, $156,221; extraordinary expense, $33,764; and taxes, $22,187, leaving net earnings $338,117. After deducting $339,403 interest on bonds, and $372 for other interest, there is a net profit of $61,381, compared with $41,749 in 1918.

Meetings of the ordinary and cumulative preference shareholders of the Bombay Electric Supply & Tramways Company, Ltd., were recently held to consider a scheme of reconstruction. Mr. F. C. Rimington explained that the main features of the scheme were that the whole of debentures and debenture stock and all other cash liabilities should be paid out of the cash in hand on the company going into liquidation, and that a new company should be formed with a rupee capital, and the undertaking transferred to that company in exchange for 180,000 preference shares of Rs. 50 each fully paid, and 540,000 ordinary shares of Rs. 50 fully paid; that three of such preference shares should be issued to the holder of each preference share and five of the ordinary shares to the holder of each ordinary share.

The directors of CROMPTON & COMPANY, LTD., report that for the year ended March 31 the net profit, after providing for depreciation, debenture interest, directors' fees, &c., and a reserve sufficient to cover excess profits duty, is £52,878. Adding £17,409 brought forward and deducting the interim dividend on the preference shares (£4,752), the balance is £65,534. The directors recommend that £15,000 be placed to general reserve fund, and £9,000 to depreciation of investments, that a dividend of 6½ per cent. on the preference shares, making, with the interim dividend, 10 per cent. for the year (£8,936), and a dividend at rate of 10 per cent. per annum on the ordinary shares (£14,422)be paid, leaving to be carried forward £18,177. In view of the continued expansion of the business and the increase in price of all materials, it is considered advisable that the limitation imposed by Article 80 of the Articles of Association on the borrowing powers should be removed.

For the year ended March the revenue of the NEW GENERAL TRACTION COMPANY, LTD., was £19,334 and the expenditure (including debenture interest and income tax) £7,363. With £7,818 brought forward, the total available is £19,789, and the directors recommend that £10,480 should be appropriated to the payment of a 4 per cent. dividend, and that the balance of £9,309 be carried forward. The traffic receipts of the Norwich Electric Tramway Company continue to expand, but unfortunately the constantly recurring demands for increase of wages and additional cost of materials have more than off-set the increase of gross revenue and the resultant profit is reduced by £2,484. A dividend of 2 per cent. was declared. The Douglas Southern Electric Tramway system, which was closed down during the war, re-opened during the last season under encouraging auspices and secured a satisfactory profit. The available balance of £2,134 was carried forward in view of heavy requirements for repairs, renewals, &c. There is no change in the position of the guaranteed investment in the Philadelphia undertaking.

The report of the ANGLO-PORTUGUESE TELEPHONE COMPANY for 1919 states that the capital expenditure amounted to £39,006, compared with £28,927 in 1918. The gross income was £109,313 (against £103,957), of which operating, management and general charges absorbed £76,238 (against £73,779), and royalties to the Portuguese Government £3,277 (against £3,107), leaving a gross profit of £29,797 (against £27,071). After payment of income-tax £2,768, providing for debenture interest and sinking fund and writing off £9,965 (being one-third) of the expense attending the issue of extension debenture stock, and new ordinary shares, the amount for disposal (including £8,207 brought forward) is £19,675. The directors recommend a further dividend of 4 per cent., making 7 per cent. for the year, leaving £8,828 to be carried forward. Owing to the persistent advance in wages and the greatly enhanced cost of materials the profits have recently undergone serious contraction, but the Government has authorised a substantial increase in the charges.

The report of the UNITED ELECTRIC TRAMWAYS OF MONTEVIDEO, LTD., for the year ended March 31 states that the gross receipts from the operation of the tramway system for the year to Oct. 31, 1919, were £443,694, an increase of £63,394. Operating expenses increased by £29,823, leaving a net increase of £33,571. The passengers carried were 54,883,919 (increase 6,955,313) and car-miles run 7,756,634 (increase 718,207). After providing for administration expenses and charging £47,519 for debenture interest, the credit balance is £86,344, making (with £10,669 brought forward) £97,013. After providing for redemption of debenture stock and of the preference and ordinary share capital, for renewals, &c., it is proposed to pay a dividend on the cumulative preference shares at rate of 6 per cent. per annum and to carry forward £7,032.

In moving the adoption of the report at the meeting last week the chairman (Sir George A. Touche, Bart.) said the company was now burdened with a standard of expenditure which was never contemplated when the concession was granted. Traffic receipts (£443,694) showed an increase of £63,394, and the number of passengers carried an increase of nearly seven millions. Although the coal bill was £12,000 less than in 1918 it was three times what it was in 1915. There was also a substantial increase in wages, while repairs and maintenance had cost considerably more than in previous years. After paying the preferential dividends the balance of £7,032 was carried forward. The application for a revision of fares had been considered by a Commission, which had expressed the view that the company should be allowed not only to balance its expenses with its revenue, but to obtain also the resources for a gradual recovery from the considerable losses of previous years.

At the annual meeting of MARCONI'S WIRELESS TELEGRAPH COMPANY, LTD., on Tuesday, the chairman (Senatore G. Marconi, G.C.V.O.) presided and gave an analysis of the report, which appeared in our last issue. Their affiliated companies were also making progress. They were still in a position of uncertainty as regards their interests in Russia. The reconstruction of the Canadian company had been completed, but it was not expedient to speak in detail of the many interests which they hold abroad and of pending negotiations. Progress was being made each year, their interests enlarged and their organisation extended.

The arbitration to which reference was made at the meeting last year and which had been agreed with the Admiralty in respect of the Lodge patent had just been concluded, but Lord Moulton, who acted as arbitrator, has not yet delivered his award. With regard to the claim against the Post Office for services rendered, they were still hoping that that also might be settled ere long in an amicable way. In that hope they had stayed their proceedings under the Petition of Right.

Referring to the Imperial Wireless Chain and to Sir Henry Norman's Committee, Senatore Marconi said their company had put forward a scheme under which they were prepared to erect, for their own account and at their own cost, a very complete chain of wireless stations throughout the whole Empire, which would not cost the country a single penny. In addition, they had offered that 25 per cent. of the profits derived from the service, after making proper provision for interest on capital and amortisation, should belong to the State.

Considerable advances had been made by Captain H. J. Round in the practical application of ionic valves, especially in regard to long-distance transmission, and also in the efficiency of the general arrangements employed at their high-power stations. Many new patents had been taken out or applied for, and a new device with which he first carried out tests on ships of the Italian Navy had been considerably developed by Mr. C. S. Franklin. By means of that arrangement electric waves are projected in one beam only in any desired direction, instead of being allowed to spread out in all directions. Great progress had also been made not only in wireless telegraphy, but in wireless telephony, which must soon be turned to very considerable commercial account, both in respect of telephoning without wires and in the application of the recently-acquired knowledge to telephony with wires.

Mr. Godfrey C. Isaacs (deputy chairman and managing director), who seconded the motion for the adoption of the report and accounts, dealt at some length with the report of Sir H. Norman's Committee, which is given in another column.

The directors' report of the GREAT NORTHERN TELEGRAPH COMPANY, LTD. (of Denmark) for the year 1919 states that it was impossible to repair all the European cables that were interrupted during the war. The large number of mines which had been scattered broadcast in the seas by the belligerents prevent the repair of one of the Anglo-Danish and one of the Franco-Danish cables. In addition, the cable between Libau and Petrograd remains interrupted. All breaks in cables that occurred outside the minefields have, however, been repaired. The second of the two cables between France and Denmark was put into working order in November last. During the whole of the year the Company's offices at Wladiwostock and Irkutsk kept up telegraphic communication between Siberia and foreign countries, via Japan and China respectively, but the internal strife in Russia and the wars between Russia and other countries have prevented the Wladiwostock and Kiachta routes from participating in the transmission of the heavy traffic between Europe and the Far East. In the beginning of the current year when affairs in Siberia became very unsettled and precarious, the offices at Wladiwostock, Irkutsk and Kiachta were obliged to suspend the service with places abroad for a short time. The telegraphic service was soon reopened, not only with Siberia, but also with a considerable part of Russia in Europe, including Petrograd. The transit route through Russia has not yet been opened.

Although the Company's European system has been crippled to the extent of an Anglo-Danish and a Franco-Danish cable, the traffic has been transmitted without excessive delay, owing to the Company being for a time in a position to put in as reserve the cables formerly used for the traffic exchanged with Russia. In the Far East, too, the local traffic has been subject to some delay, and both there and in Europe the strengthening of the existing routes by new cables has become an absolute necessity. The arrangement concluded in 1918 with the Government of Finland, and according to which the Company opened its own station at Helsingfors, has been extended by a new agreement which prolongs the co-operation between the Finnish Telegraph Administration and the Company by a score of years. An agreement on similar lines and for the same term of years has been entered into with the Government of Latvija,. Negotiations are also taking place with the Government of Esthonia, Lithuania and Poland.

The new cable steamer, which is to replace the "H. C. Orsted" in European waters, will be built at the Royal Naval Dockyard at Copenhagen. The cable depot at Tuborg has been removed to the new depot at the Free Port of Copenhagen. The directors propose to erect a building for its own use in St. Helen's-place. According to existing agreements rates have been reduced for the local traffic in the Far East, as well as for the traffic between Europe and America, on the one side, and the Far East on the other. A loan of 4,000,000 Danish crowns has been granted to the Finnish Government for the purpose of developing the telegraph and telephone system of Finland. Mr. O. C. Scavenius, of the Foreign Office, has been elected a member of the board. The directors point out that the recent increase of receipts is due solely to the fact that the traffic has grown beyond all expectations. In order to meet the increasing working expenses many telegraph administrations have raised the rates for internal telegrams; the international rates, however, remain unaltered, although it would seem to be necessary to raise them also, at all events so far as the European regime is concerned. The Company's immediate future, both in its financial and other aspects, will be strongly affected by the consequences of the war, one of these being the continued interruption of the Company's main route between Europe and the Far East through the old Russian Empire. After careful consideration, the directors recommend the distribution of a dividend of 22 per cent. only, notwithstanding the satisfactory result of the year's working. The receipts for 1919 were about £520,170 higher than those of 1918, but the total ordinary expenses increased by £448,362. Salaries and wages are £192,072 (60 per cent. higher); the expenses of ordinary supervision, &c., are nearly double those of 1918, as the three steamers were occupied with cable repairs for 502 days, against 242 days in 1918. For rates and taxes, the board have reserved £305,556 (increase £194,444), seeing that in the United Kingdom an increase of existing taxes, as well as new taxation, has to be reckoned with, and that in Denmark the exemptions, by virtue of which three-fourths of the income earned abroad was rendered free of income tax, have been abolished. Of the net receipts it is proposed to allocate £61,111 to the reserve and renewal fund, and £55,556 to the renewal fund for cable steamers. The balance carried forward is £96,252 higher than in 1918.

New Companies.

CASTLEDERG ELECTRIC SUPPLY COMPANY, LTD. (5,017).—Private company. Reg. in Dublin June 18, capital £6,000 in £1 shares, to carry on the business indicated by the title. Subscribers are S. Gailey and J. Crockett, Main-street, Castlederg.

DUNBLANE & DISTRICT ELECTRICITY SUPPLY COMPANY, LTD. (11,193)—Private company. Reg. in Edinburgh May 5, capital £500 in £1 shares, to carry on the business indicated by the title. First directors: H. J. Osborn and W. Sharp. Reg. office: 213, W. George-street, Glasgow.

DYNAMO & MOTOR REPAIRS, LTD. (168,374).—Private company. Reg. June 18, capital £10,000 in £1 shares, to carry on the business of electricians, mechanical and general engineers, dealers in electrical and motor apparatus, &c. Electrical Installations, Ltd., shall have the right, while holding 500 shares, to nominate a director. Reg. office: Mapesbury Works, Willesden-lane, Kilburn, N.W.

ELLERD-STYLES & COMPANY. LTD. (168,467).—Private company. Reg. June 22, capital £2,000 in £1 shares, to take over the business of an electrical, mechanical and aeronautical engineer, &c., carried on by W. Ellerd-Styles. First directors are: W. Ellerd-Styles and L. F. S. Young. Reg. office: 287, Upper-street, Islington, N.

HARTFORD ENGINEERING COMPANY, LTD. (168,085).—Private company. Reg. June 8, capital £5,000 in £1 shares, to take over the business of the Hartford Engineering Company, now carried on under the proprietorship of the Southport Electrical Supply Company, Ltd. Reg. office: Pine Grove, Southport.

HEYES & COMPANY, LTD. (167,085)—Private company. Reg. May 4, capital £20,000 in £1 shares, to take over the business of an electrical engineer carried on by W. A. Heyes at Wigan as Heyes & Company. First directors are W. A. and A. V. Hayes. Sec.: J. C. Muir. Reg. office: Waterside, Powell-street, Wigan.

JOHN PORTER ENGINEERING COMPANY, LTD. (167,411)—Private company. Reg. May 13, capital £10,000 in £1 shares, to take over the business of a general electrical and motor engineer carried on by J. Porter at North Shields. Permanent directors are W. Lilburn, J. C. Patterson, J. H. Richardson, J. Porter, A. Melrose, R. Saunders and R. W. Stranghan.

McREYNOLDS TROLLEY WHEEL COMPANY, LTD. (167,495).—Private company. Reg. May 15, capital £5,000 in 5s. shares, to carry on the business indicated by the title, and that of electric, railway, tramway and general engineers, &c. Reg. office: 11, Angel-court, E.C.

H. & F. MOORE, LTD. (167,649)—Private company. Reg. May 21, capital £2,000 in £1 shares, to carry on the business of machine builders, electricians, electrical, mechanical, telephone and general engineers, &c., and to adopt an agreement with H. Moore. Mrs. C. Stanton is first director. Secretary, F. E. Fordham. Reg. office, Albert Mill, Hinckley.

NATIONAL ELECTRIC WELDING COMPANY, LTD. (167,631)—Private company. Reg. May 20, capital £10,000 in £1 shares (4,000 preference), to carry on the business indicated by the title. First directors are F. E. Saunders, P. Buckley, N. D. R. Bruce and H. C. Wright. Reg. office. 6, Old Queen-street, Westminster.

NEW PROCESS ELECTRIC LAMP COMPANY, LTD. (167,268)—Private company. Reg. May 8, capital £5,000 in £1 shares (3,000 preference), to take over the business of electric lamp manufacturers and agents carried on by S. Coxon and W. A. Williams at Canning-place, Liverpool, under a similar title. First directors are S. Coxon and W. A. Williams.

TAGGART & WILSON, LTD. (11,252)—Private company. Reg. in Edinburgh May 20, capital £6,000 in £1 shares, to carry on the business of general merchants, electricians, electrical and general engineers. Secretary, R. T. Ballantyne, 2, Windmillhill-street, Motherwell.

TAYLOR & KAY, LTD. (167,339)—Private company. Reg. May 11, capital £2,000 in £1 shares, to carry on the business of manufacturers of lamp shades and electrical accessories, electrical engineers, &c. First directors are W. M. Groom, L. Wheeler-Taylor, H. Kay and H. E. Rainbow. Secy.: F. P. James. Reg. office: 327, Edgware-road, W.

TELEPHONE MFG. COMPANY (1920), LTD. (167,634)—Reg. May 20, Capital £600,000 in £1 shares, to take over the business of the Telephone Mfg. Co., Ltd., and to carry on the business of makers, hirers and maintainers of and dealers in telephones and telegraphs, &c. First directors are: F. T. Jackson, C. Cochran, J. MacMahon, T. H. Walker, C. E. Walker and C. Clare. Reg. office, Hollingsworth Works, Martell-road, S.E.

TOFIELD & ROBINSON, LTD. (166,892.)—Private company; reg. April 28, capital £10,000 in £1 shares, to carry on the business of electricians, electrical contractors, electrical, mechanical and general engineers, &c. First directors are H. C. Tofield, W. T. Hellaby, and B. French. Reg. offices, 165, Edmund-street, Birmingham.

UNO COMPANY LTD. (167,790).—Private company. Regd. May 27. Capital £5,000 in £1 shares. To carry on the business of electrical and general engineers, manufacturers of the "Uno" roaster, &c. First directors are: P. B. Benkert, W. Bennett and C. P. Bennett. Reg. Office: 90, Minories, Tower Hill, E. 1.

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Forty Years Ago.

(THE ELECTRICIAN, JULY 3, 1880.)

"THE ELECTRIC LIGHT,"—(Extract from the Leader): "The greatest source of light upon this earth is the Sun." That is the paradox with which Mr. Preece startled his immense and fashionable audience in the Albert Hall, when he delivered his memorable lecture on the Electric Light. We have heard the sentence called a "bull," but we prefer to call it a paradox, not only out of respect to Mr. Preece, but because it is a real paradox. A little consideration will show that all our sources of light upon this earth may be ultimately traced to the solar luminary.

THE TEMPLE LIBRARY.—We understand that it is proposed to introduce the electric light, but as yet no system has been adopted.

THE ELECTRIC LIGHT.—The Siemens system of lighting has been adopted at the Holyhead Harbour, also at the Victoria Docks Extension.

UNIVERSITY COLLEGE.—An effort is being made to secure the completion of the college buildings, and a meeting for this purpose was held at the Mansion House yesterday. The cost of the work of completing the buildings is estimated at £105,000, a part of which has been subscribed, and will be used for erecting a new section to the north wing, which it is hoped will be ready for students in October next.

EARTH'S MAGNETIC FORCE.—The report of the Astronomer-Royal states that the time scales for the declination, horizontal and vertical force, and earth currents are complete to the end of 1879, and the base-line values for the declination and horizontal force are formed for 1879, but not yet laid down on the photographic sheets. The dip observations are reduced to the present time, and the deflection determinations of absolute horizontal force to the end of 1879. The following are the principal results for magnetic elements in the year 1879: Approximate mean westerly declination, 18 deg. 40 min.; mean horizontal force, 3·911 (in English units), 1·803 (in metric units); mean dip, 67 deg. 36 min. 5 sec. (by 9 in. needles), 67 deg. 36 min. 54 sec. (by 6 in. needles), 67 deg. 37 min. 47 sec. (by 3 in. needles).

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—Dinner to the Pioneers of British Aviation; Lecture: "Naval Architecture in Aeronautics," by Commander Hunsaker, U.S.A.

"The Cabinet Maker":—"Colour and Form"; "Old English Needlework"; and "17th and 18th Century Tables."

"The Chemical Age":—"Refractory Materials for Chemical Purposes," Second of a series of Articles by A. B. Searle; and "Cold Vulcanization of Rubber," The New Peachey Process.

"The Fruit-Grower":—"Bird Life and Food Production"; "Science of Botany"; and "Cold Storage of Apples."

"The Gas World":—"A Study of the Refractory Qualities of Fire-brick," Analyses of some Gas Companies' Accounts; and "Mositure and Acid in Sulphate of Ammonia."

"The Hardware Trade Journal":—"Steel Wire and Wiredrawing"; "Hardware and Implements at the Royal Show"; and "Iron and Steel Production."

"Ways and Means":—"Sport for the Workers," by The Editor;—"Commercial Forestry," by Anthony Clyne; and "The Causes of High Prices," by John Johnston.

Prices of Metals, Chemicals, &c.

TUESDAY, June 29.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£101 0 0	—	—
Electro Wirebars	,,	£105 0 0	—	—
H.C. wire basis	per lb.	1s. $2\frac{11}{16}$d.	—	—
Sheet	,,	1s. $5\frac{3}{8}$d.	—	$\frac{3}{8}$d.
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. $7\frac{11}{16}$d.	—	$\frac{1}{16}$d.
Brass 60/40—				
Rod, basis	,,	0s. $10\frac{1}{2}$d.	—	—
Sheet, basis	,,	1s. $3\frac{1}{2}$d.	—	—
Wire, basis	,,	1s. $3\frac{1}{2}$d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£34 10 0	—	£1 10 0
Foreign or colonial	,,	32 0 0	—	15 0
Tin—Ingot	,,	245 0 0	—	£11 10 0
Wire, basis	per lb.	0 3 3	—	1d.

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Per ton £19.

,, (Roll Brimstone).—Per ton £19.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £43

Boric Acid (Crystals)—Per ton £74.

Carbon Bisulphide.—Per ton £60

Sodium Bichromate.—Per lb. 1s. 11d.

Sodium Chlorate—Per lb. $5\frac{1}{2}$d

Rubber.—Para fine, 1s. $11\frac{3}{4}$d.; plantation 1st. latex, 1s. $10\frac{3}{4}$d. per lb.

Shellac.—T.N. Orange, 680s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Coy.

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Notes.

Electric Railway Contact Systems.

THE Paper recently read on "Electric Railway Contact Systems" before the Institution of Electrical Engineers, by Sir PHILIP DAWSON, is on the whole reassuring, as showing that methods adopted on electric railways in this country are substantially sound. One point of interest is that the original designs on the Brighton railway have "made good," and are still practically the same as initially introduced, whereas on American and Continental lines the principles first adopted have been deserted. We hope, however, that this is to be regarded as evidence of forethought in design, and not merely as an instance of conservatism. The diagrams relating to maintenance of the overhead line work are instructive, as showing the great increase in cost of renewals and upkeep since the war. Part of this, no doubt, was due to exceptionally heavy war traffic and adjustment of lines to abnormal conditions, and it will be interesting to see whether the figures now become stationary or diminish, although an approach to those originally prevailing seems most improbable.

The Rail Drop Question.

SEVERAL interesting conclusions are drawn—for example, that the wear on trolley wires is practically proportional to the current collected, and is negligible when no current is taken; also that the maintenance of catenary wires is very substantially increased on lines where both steam and electric trains are run. Sir PHILIP points out one curious anomaly—namely, that the maximum allowance of 7 volts drop on the earthed return, imposed on tramways, is also applied to railways electrified under Parliamentary powers; whereas railways not so situated are operated on rail drops exceeding, for short periods, 20 times that figure. Either the B.O.T. requirement is unduly severe, or there must be on some railways an amount of electrolysis which will ultimately lead to trouble. The anomalous position in this respect certainly ought to be cleared up. Sir PHILIP does not attempt any comparison between the merits of conductor rails and the overhead system. But he indicates that the presence of a charged rail near the track must increase the cost of maintaining the permanent way, and men employed on track repairs have been already granted an extra 2s. a week in view of the presence of the live rail.

Australian and American Tramways.

THE schoolmaster turned pupil is not a sight that can be viewed without regret, and in saying this we do not refer so much to the recent overseas successes at lawn tennis as to the proceedings at the annual meeting of the Tramways and Light Railways Association. For on the latter occasion, as on the former, we were made acquainted with a good deal of overseas practice, and partook forcibly of what we had been too slow to absorb by ourselves. This is all the more distressing, for in tramway practice, no less than in lawn tennis, we were the pioneers. Mr. C. J. SPENCER, who was the exponent of American practice, pointed out the advances that have been made in the United States in car design, not only in the way of comfort, but in the way of better utilisation of floor space, and in the avoidance of complication by the adoption of either a "pay-as-you-enter" or a "pay-as-you-leave" system compared with the almost entire lack of system in this country. Such an arrangement adds not only to the comfort of both passengers and staff, but ensures that all fares are collected; and, incidentally, reduces labour costs. On all these counts, such an arrangement would seem well worthy of more serious consideration in this country than it has hitherto received.

The National Wage in Practice.

IN Australia, too, similar arrangements are being adopted, to the general benefit. As in America, after the usual preliminary objections, due to a distrust of new conditions, it was found that the men settled down to their work without difficulty, and are now more eager to do their turn of duty on the new cars than on the old ones. The recent agitation in favour of a national wage has, fortunately for the tramway industry of this country, been a failure, if Mr. PRINGLE'S experiences in Australia may be taken as a guide. He points out that the lower wage in country districts has never been an injustice, and that any attempt to impose a national wage can only bring disaster, and not benefit in its train. It is interesting to note that in both Australia and America the germ of the Whitley Council idea has been adopted in dealing with industrial disputes, and that the joint councils or other similar bodies are in successful working order. We are sure that along this road lies the solution of the majority of our present difficulties with Labour.

Coning and Corrugation.

Mr. Pringle also deals with another matter to which too great attention cannot be given by those concerned in the operation of tramway undertakings. This is the coning of rail and wheel treads. It has been urged by Mr. Pringle himself, among others, that both rails and treads should be flat, as coning is one among the many factors that seems to be responsible for corrugation. Others, including Mr. de T. Holt, consider that, as the majority of wheels wear to a certain profile, it is best to encourage this tendency by rolling the rails to the corresponding profile. Unfortunately, it is not always possible to separate one cause from the other in a series of phenomena, and so to determine exactly what its effect is or how that effect is complicated when other factors are introduced. We agree with Mr. Pringle that the matter requires careful investigation, and we hope that the Rail Standardisation Committee will not fail to make tests with a view to increasing our knowledge on this important subject.

The New Electrical Economies.

Councillor J. G. Graves, of Sheffield, is a man who holds peculiar views on the proper methods of charging for electricity used for power purposes. These views have obtained for him a *succès d'estime* (if it may be so described) which rivals, if it does not exceed, that recently accorded to Miss Mary Pickford. However, he is very modest about it all, and is quite willing to be convinced of his errors if anyone can tell him which of his facts are disputed and which of his arguments can be replied to. "How can it be an economic crime," he asks pathetically, "to sell equal quantities of the same article at the same price ?" Now, we believe that in the time he can spare from directing municipal affairs Mr. Graves conducts a large retail business, in which, no doubt, he works to the golden rule of selling articles for what they will fetch. Unfortunately, that rule cannot be applied to electricity supply. Or, to put it another way, the price of electricity must depend on its cost of production. To state the case very simply, so that Mr. Graves can understand it, it has been found that electricity used for power purposes can be produced, and therefore sold, for less than current produced for lighting. Doubtless it would be very agreeable for Sheffield and other places if they could sell the same amount of current as they now sell for power at lighting rates ; but the fact is they cannot, though Mr. Graves will probably refuse to believe us. Of course his scheme, to use his own words, is not impracticable, nor is it perhaps unreasonable ; but it is certainly unbusinesslike, and it is also unwise. For surely he must realise that the man who buys in large quantities is entitled to preference over the man who buys in small. We have no doubt that in Mr. Graves' own business, as in any other, that rule holds.

Performance of Contracts.

Some points of great importance were considered in the case of Hartley *v.* Hymans, which came before Mr. Justice McCardie last week. The action raised questions which are of constant recurrence. The principles enunciated apply to all engineering and commercial contracts, and the reserved judgment gives an elaborate exposition of the law upon the subject. The defendant ordered from the plaintiff a large quantity of cotton yarn, weekly deliveries of which were to be made, commencing in September and ending in November, 1918. Among the conditions was one that failure to deliver within the stipulated time rendered the order liable to cancellation. The first delivery (half the agreed amount) was not made until October 26th. The defendant made repeated protests against the delay, and urged further deliveries, which continued to be made until February 27th last. On March 4 the defendant wrote to the plaintiff that if his client cancelled on him he would have no option but to cancel the order ; on March 10th he sent instructions as to marking the goods, but on March 13th he abruptly cancelled the order, and refused to accept a consignment sent by the plaintiff.

Liability for Breach of Agreement.

On these facts the plaintiff sued for breach of the agreement, and, as the damages were agreed, the only point was as to the legal liability of the defendant. Cases on the sales of goods, especially where the time of delivery has been extended, raise difficult questions of fact and of law. Where a contract expresses a time for delivery, the question is one of construction only, and is therefore one of law for the judge ; but where no time is mentioned a reasonable period is implied, and what is a reasonable time is one of fact for the jury. In all commercial contracts time is deemed to be of their essence, and the judge so held in the present case. It is probable that the defendant could have repudiated the contract when the time for delivery had expired. However, he continued in correspondence with the plaintiff, and repeatedly urged delivery long after that time, implying either that he treated the old contract as still subsisting, or that he wished to make a new one. The plaintiff acted in this belief, and therefore we believe the judge was right in holding that the contract was terminated too abruptly and without reasonable notice. From the correspondence he inferred a new agreement that the original contract time should be extended—*i.e.*, until the defendant had given notice to the plaintiff requiring delivery within a reasonable period. Instead of taking this course, the defendant cancelled the contract abruptly, and therefore the Judge gave judgment against him for the agreed amount, with costs.

Higher Technical Education in Manchester.

The Manchester Education Committee is proposing to take a step which will have a very damaging effect both upon the future of the Manchester College of Technology and upon higher technical education in Lancashire. In October next it is proposed to limit the number of new students taking the full degree course in technology to 80, together with 30 scholarship students, though there is accommodation for about 240. It is, moreover, intended to fill the vacant places with a number of what are termed "non-degree" students, *i.e.*, boys of about 16 years of age, who only intend to take a two-years' course. What makes this more strange is that there is no lack of degree candidates for admission to the College.

A Retrograde Step.

The Manchester College of Technology, which has deservedly acquired an excellent reputation for the high character of its training, is one of the leading technical institutions of the country, and if the course suggested is adopted it will lower its status, and inflict injury on the cause of higher technical education. The important work of training skilled engineers and chemists, who are wanted for the industrial development of the country, will be abandoned in order to attempt the education of boys, the majority of whom will be incapable of taking full advantage of the higher work of the College. We should have supposed that before taking such a retrograde step the Committee would have been guided by the Principal of the College, but that gentleman has been publicly censured because of his opposition to it ! Some of the members cannot have a proper appreciation of the value of and urgent necessity for a sound system of advanced technical education. The standard of the College should have been raised rather than lowered, and we hope that the City Council, which has hitherto had a good reputation for its educational work, will reverse the decision of its Committee and allow Principal Garnett to get on with the work of the College in the proper way.

Mr. Garcke and the Bill.

It is a great pity that a man of such undoubted eminence in the electrical industry as Mr. Emile Garcke should have attacked the policy of the Government with regard to electricity supply in the way that he did at the annual general meeting of the British Electric Traction Company last week. In effect Mr. Garcke said that, while the Electricity (Supply) Act of 1919 was not a perfect piece of legislation, it at any rate removed some of their grievances, but that this good in it would be neutralised if the amending Bill now before Parliament were to be passed. That Mr. Garcke should have taken up this attitude is the more unfortunate as it ranges him besides those interests whose opposition to the Bill is not based on such pure motives as his. He represents a branch of the industry which has been very badly treated in the past; but this is no time for dwelling on grievances, and, if we are to progress in future, such considerations must give way to feelings of quite a different kind. It will not be long before all those who have the true good of the electrical industry at heart, among whom Mr. Garcke must certainly be numbered, will come to recognise this.

The B.E.T.'s New Development.

The recent operations of the British Electric Traction Company are another example of the oft-repeated tale that more work was done than ever before, but at a less profit. The receipts increased by £245,000, but the expenses increased by £339,000, so that the working balance was £94,000 less. The relation of working expenses to gross receipts was 74 per cent., as against 67 per cent. in the previous year. It is difficult to see how trading can be carried on at all under such conditions. Again, there has been a falling away of profits on the London undertakings with, as far as can be ascertained, an increased profit on the provincial undertakings since 1913. This is probably due to conditions in London, where a number of competitive services operate in a way which produces a minimum of good to themselves without very much assisting the demand of the public for better facilities. It is interesting to note that the company are so disgusted with the political environment of the tramways and electricity supply industries that they have determined to extend their enterprise by entering the ranks of those who produce cinematograph pictures. One unfortunate result of this policy is the resignation of Mr. Garcke from the chairmanship. Doubtless all the pros and cons attendant on the development of the new activity have been weighed, and the company doubtless feel that they are doing the right thing, though we feel it is a pity that such a step should be necessary.

Increase of Electricity Charges.

By a singular irony of fate, sec. 32 of the Electric Lighting (Clauses) Act of 1899, which was intended as a safeguard for consumers against excessive charges for electrical energy by supply companies, is now to be applied by the companies, who find, owing to post-war difficulties, that it is necessary to increase the statutory prices set out in their provisional orders. The section in question relates to maximum prices, and provides means for a periodical revision of a company's charges. Though the suggested procedure may be justifiable, and of service to some provincial companies, we think that neither the Ministry of Transport nor the Electricity Commissioners can exceed the limits of increase permitted by the Statutory Undertakings (Temporary Increase of Charges) Act of 1918. It will be remembered that this Act only permits an increase of 50 per cent. to local authorities, whilst in the case of a company it is limited to what is sufficient to pay a dividend on the ordinary shares or stock of three-quarters of the standard or maximum rate of dividend prescribed for the undertaking, or at three-quarters of the pre-war rate of dividend, whichever is the lower.

Suggested Procedure Inadequate.

The Acts of the power companies are, we believe, sufficiently elastic to cover their difficulties, but many of the companies which are operating under provisional orders had not reached a dividend paying basis in 1914, or, if they had, they paid such a small return on the ordinary capital that three-quarters of it would be quite inadequate under present circumstances. Further, in the majority of cases onerous agreements were scheduled to the provisional orders, and the companies find it difficult to get a reasonable modification of the terms of these agreements. The situation in regard to tramway undertakings has been fairly met by the Tramways (Temporary Increase of Charges) Act of this year, and we think that the difficulties of electric supply companies can only be removed by a similar measure. Some figures which we give on another page of this issue show how disastrous the condition of some of these undertakings is. Ingenious attempts to evade or to extend the plain effect of an Act of Parliament may be the subject of admiration by some, but we prefer the more straightforward course of modifying an Act by passing an amending Act. We believe, therefore, that the time has come for the Electricity Commissioners to promote a Bill to give supply companies facilities to run their undertakings on a proper commercial basis, and to enable them to pay a fair return on their capital.

Tramway Orders for Increased Fares.

In the case of tramways, the Minister of Transport has power to make interim Orders increasing the statutory maximum charges by such amount, not exceeding 100 per cent., and subject to such conditions as he thinks proper. To a recent Order affecting the Rochdale Corporation tramways, the Minister attached a condition which we would like to see applied to all municipal undertakings, whether tramways, electricity supply, gas or other public service. After setting out certain increases in fares, the order goes on to stipulate "that no surplus revenue, after paying the working expenses of the undertaking and providing for interest and sinking fund payments, shall be carried to the credit of the borough fund or applied in relief of rates until the Corporation shall have made such provision for repairs and renewals as the Minister may approve." During the war it was impossible to maintain the rolling stock and permanent way in an efficient condition, and there is still much to be done before the 1914 standard is reached. In fact, little progress has been made in wiping off the arrears of repairs owing to the shortage and high prices of materials, the advances in wages and other causes. Though the operation of the Rochdale Order is limited to six months, we think the condition will do some good, and we would gladly see the operation of the principle extended.

Electricity Supply Special Orders.

The draft Rules of the Electricity Commissioners governing applications for special Orders, which replace the old Provisional Electric Lighting Orders, will introduce a simpler and more expeditious procedure for obtaining authority to distribute electricity in a district or for acquiring land for the purpose of a generating station. Hitherto applications could only be made at a certain time of the year, and much unnecessary time and energy were wasted in giving notice to local authorities. In future an application for a Special Order ma be made at any time, but notice of the intended application must be advertised once in a local newspaper and once in the "London (Edinburgh or Dublin) Gazette." On or before the date of the first publication of the advertisement, which must contain the usual particulars of the applicants, area of supply, &c., written notice of the intended application must be served on any joint electricity authority and on any company or person with statutory powers to distribute electricity within the proposed area, and where it is proposed to acquire land for a generating station notice must be given to the owner and occupier, and also to the owners and lessees of any land within 300 yds. of the site. In this, as well as in the conditions as to the contents of the draft Order and the deposits to be made at the office of the Commissioners the existing practice is mainly followed. A sum of £35 will still be paid to cover ordinary expenses, but copies of the draft Order will now cost 2s. each.

Procedure on Objections.

Objections to the grant of an Order must be made to the Commissioners within thirty days of the first publication of the advertisement or of any notice served under the Rules, but the month of August is not to be included in this period. Special orders have to be laid before each House of Parliament for a period of not less than 30 days during which that House is sitting, and do not come into force until approved by a resolution passed by each House. In normal times Parliament sits only from about the middle of February to the end of July, so that the effective time for obtaining an Order is reduced to less than five months in the year. We also observe that the draft Order must incorporate the provisions contained in the schedule to the Electric Lighting (Clauses) Act of 1899, and as clause 81 of the schedule states that undertakers are not to be exonerated from any indictment, action or other proceedings for nuisance, this is distinctly unfortunate, for we believe that the time has come when all generating stations which supply or distribute electricity for public purposes should be freed from this serious disability.

Next Winter's Coal Supply.

The managers of our electricity supply undertakings had quite enough anxiety last winter with regard to coal supply to wish to repeat those experiences during the forthcoming months. The effects of control were such that the quality of the fuel was poor and its delivery uncertain. With the removal of control it was hoped that matters would improve, and that, except for the price, something approaching pre-war conditions would obtain. In a letter in a recent issue of "The Times," Mr. Edward Smallwood, Chairman of the Coal Merchants' Federation of Great Britain, deplores such optimism, pointing out that the general impression that coal will shortly be still further reduced in price is unjustifiably causing householders, gas companies and other large consumers, to hold back the orders necessary to replenish stocks. Last winter was an exceptionally mild one, and Mr. Smallwood thinks that, had this not been the case, there would have been disaster. And as there is little chance of next winter being so mild, and the demand for coal is continually increasing, unless the necessary supplies of fuel are secured now, large users especially may be placed in serious difficulties owing to a breakdown of our already overstrained transport facilities, if for no other reason. Mr. Smallwood is inclined to think that there is no hope of lower prices, and though, considering the quarter from which this idea emanates, we may be forgiven for receiving this opinion with a certain amount of diffidence, the state of things to which he calls attention is one worthy of close consideration and further examination.

The Gas Regulation Bill.

The gas industry are enjoying all the pleasure which is and has been for the past twelve months our own lot of discussing the provisions of a new Bill for regulating their affairs. The new measure provides for the repeal of the old Acts requiring undertakers to provide gas on a basis of illuminating power or calorific value, and substitutes a system of charging based on thermal units instead of the present charge by volume. This is a change which we have long advocated, and it is particularly necessary now that the gas produced is more and more used for heating and industrial purposes, and less for lighting. Gas companies will in future declare the calorific value of the gas they intend to supply, and the charges will be based on a unit of 100,000 B.Th.U., a repayment being allowed if the declared standard is not kept within 5 per cent. The chemical composition of the gas will also be under control, and the burners in use must be altered or replaced so as to enable the gas supplied to be burnt safely and efficiently. If the Bill passes, it would seem that all statutory undertakings will be selling on a heat basis, though why this should not apply also to non-statutory undertakings is not quite clear. As with the Electricity Act, so with this Bill, the main discussion is likely to range round the financial clauses, and in that matter we wish gas engineers all the success they deserve. At any rate, they cannot be said to be profiteers ; indeed, it has been rather the other way.

Electricity Supply in Paris.

The position of electricity supply in Paris is, as we have often pointed out, not unlike that which we at present enjoy in London. There are a number of small, relatively inefficient generating stations, which deliver energy at a pleasing variety of pressures and frequencies. Before the war a scheme, of which we gave details in The Electrician, had been put in hand for the modernisation of these arrangements. Hostilities, of course, prevented its development, but now unification and linking-up is more than ever necessary, for in Paris, as elsewhere, the demands for electricity have abundantly increased during the past five years. We are, therefore, glad to learn from the "Electrical World" that plans have been completed which will allow a great improvement in present conditions to be made. This will include the erection of at least one station of capital size. In case it may be thought this is rather a roundabout way of obtaining news, we hasten to add that the station in question has been designed and is to be built by Americans. A site for this purpose has been chosen on the Seine, close to the centre of the city, where it will be possible to erect a power station with a capacity of 200,000 kw. As a beginning, seven 35,000 kw. turbo-alternators will be installed, supplying current at a pressure of 60,000 volts and a frequency of 50. These turbines will be supplied with steam at a pressure of 325 lb. and at 320°F. superheat. Owing to the unfavourable rate of exchange, a good deal of the plant will be built outside the United States. It would be interesting to know whether any of the orders will come to this country. There should be some contracts that would be worth having.

A Large Electrical Combine.

The pooling of interests by electrical firms does not seem to be confined to this country, for, according to a recent announcement in Germany, an arrangement is about to be entered into between the Allegemeine Elektricitäts Gesellschaft and the Felten and Guilleaume Company. For some years there has been a close working relationship between these two firms, which is to be made still closer by an interchange of shares. In pre-war days an outstanding feature of the German electrical industry was the policy it followed of permeating concerns originally or nominally owned by interests established in other countries. It is obvious that such a policy, however good it may have been for the Germans, was not ultimately beneficial for the countries concerned, as many British and French undertakings learned to their cost. Nowadays the pendulum seems to have swung in the other direction, for it is stated that a group of non-German financiers has now a considerable interest in the Felten and Guilleaume concern. The present amalgamation is directed to counteract these interests, and it would be as well if electrical engineers in this country noted what is being done and profited by the example. At some time, not, perhaps, just at present, we shall be again competing with Germany in the world's markets. It will help us if, as it should be, the British Electrical Industry is wholly British.

The New Railway Policy.

The Ministry of Transport and the policy which its existence implies are receiving so much attention from so many different quarters that the plain man may be forgiven if he feels a little bewildered, and if he finds it increasingly difficult to winnow what is well-considered criticism from what is little more than political rancour. Railways interest an electrical engineer in two ways. He desires to have himself, his family, his employees and the goods which he makes and consumes carried expeditiously and comfortably at the lowest possible cost. He also feels that all these benefits will be realised more economically, especially as regards suburban passenger and goods traffic, if steps are taken to put in hand well-thought-out schemes of electrification. He is therefore anxious to know the effect of the establishment of a Ministry of Transport, and whether its policy is likely to improve our present conditions or otherwise.

THE EFFECTS OF COMPETITION.

Until 1914 competition between the railway companies was encouraged. Whatever the effect of this policy on the fortunes of the companies themselves, there is no doubt that it benefited the consumer. Fares actually, if not nominally, were low, trains were speedy and the service was generally efficient. If, on the other hand, there was a good deal of overlapping, if some of the undertakings were not financially sound, and if cut-throat competition brought its disadvantages, the balance was so preponderatingly in favour of the consumer that suggestions for improvements of their lot by the companies received scant sympathy. Nationalisation was looked upon as a policy of cranks, and even arrangements made between two or more companies to bring about more efficient working were frowned upon by the legislative authorities. Meanwhile, the consumer enjoyed a service such as it is highly probable he will not see the like of again.

NATIONALISATION AND THE MINISTRY OF TRANSPORT.

But the war has wrought a great change in our ideas of railway administration; and in no quarter is the change greater than among those who administer us. If rumours are to be believed, nationalisation had actually been decided upon, so that with one fell swoop competition would have been removed, and all the railway systems in the country brought under one management. But as a nation we are against nationalisation, and with such strong examples of how things should not be done as the Post Office, the Admiralty dockyards and the military arsenals it is not much wonder. The scheme, therefore, met with great opposition, and it has now been decided that the railways are to be handed back to their original proprietors, with the Ministry of Transport in control instead of in command; but with the very vital difference that employees and users, as well as shareholders, are to be given a say in the management. That is, management will no longer depend solely on ownership—an alteration the effect of which it is difficult to foresee. The statement which is now being reiterated that a Ministry of Transport is no longer required, therefore, seems at first sight both pertinent and unanswerable except in one way.

THE POSITION OF THE RAILWAY COMPANIES.

Matters, however, are not quite so simple as they seem, for the railway companies are not in the same condition as they were in 1914. Complicated agreements with regard to maintenance charges, abnormal wear and tear, dilapidations and receipts have been put in force during the war, and are still in force, the sum involved being estimated at some £500,000,000. The war has also meant that new work has had to be postponed, and must now be carried out at a greatly enhanced cost. Fresh capital must therefore be raised at a time when the companies can only offer a possible return of 2¾ per cent., as against a certain 7 per cent. obtainable elsewhere. To obtain this capital, which is vitally essential if the railways are to do the work required of them, Government aid is therefore necessary, and some Government control over the expenditure follows as a matter of course. This applies equally whether the capital is employed for widening works or for electrification and predicates a consideration as a whole of the extensions proposed to determine their effect on the communication of the country. The whole problem is really analogous to those with which electricity supply is now involved, with the Ministry of Transport in the place of the Electriciy Commissioners. To say that all this very important work could be done by the old Railway Department of the Board of Trade is to mistake the function of that somewhat fossilised institution, and to underrate the part that expert knowledge can play in developing the railway communication of the country.

GROUPING AND ELECTRIFICATION.

The suggested grouping of the various railway companies is, therefore, a step in the right direction. It certainly has advantages when the vital question of electrification comes to be considered. For no electrification scheme can be carried out without fresh capital, and, as we have shown above, to raise fresh capital will be difficult without Government assistance. Apart from this, in order to avoid confusion, some central body charged with the duty of laying down an authoritative policy is essential. We hope that this will be possible when the Traction Committee now sitting has issued its report.

That it is necessary will be obvious when we point out that the southern group of railways contains two companies which have already carried out electrification schemes on different systems, while the third has a scheme fully worked out, which probably differs in certain particulars from both the other two. Though absolute uniformity in electrification schemes is perhaps unnecessary, three methods of operation and three policies in one group is carrying individuality a little too far. The urgency of this question is evidenced by the announcement that the London & South-Western Railway have postponed the electrification of their Guildford and Leatherhead lines.

A Ministry of Transport will therefore have its uses. Nevertheless, it must be admitted that the Ministry over which Sir ERIC GEDDES presides is designed on over-generous lines, and is not required in its present form now that nationalisation has been dropped. And while the old Railway Department of the Board of Trade would be insufficient for the work, some body midway in splendour and extent, but higher in efficiency than either, might surely be devised to do this important national work. This department should as far as possible be confined to a consideration of technical questions, and dealings with labour should certainly be handled by a Whitley Council, or some similar body with like aims.

Electric Winding Engines and Mine Hoists.*

By H. H. BROUGHTON.

(Continued from Vol. LXXXIV., page 615.)

The reader who has taken the trouble to work out for himself the last two examples will now welcome the opportunity of testing his knowledge. To enable him to do so, we give below a summary of the calculations leading to the determination of the torque diagram for a complex compound shaft. The torque diagram is the key to the winder problem and, as we shall presently show, the determination of the constants of the electrical equipment is simple arithmetic and nothing else.†

Example.—Data are given below of a 10,000 lb. rock hoist for a complex compound shaft shown in Fig. 26. It is required to find the resultant total torque diagram for each of the following winding conditions:—

(*a*) Balanced winding from full depth;
(*b*) Balanced winding in the vertical portion of the shaft.

Given:

Rock	10,000 lb.
Skip	6,000 lb.
Shaft (Fig. 26)	875 ft. vertical. 3,300 ft. + 52 ft. inclined.
Rope	$1\frac{1}{2}$ in dia.; 3·55 lb. per ft.
Output per hour	94 tons from full depth.
Maximum speed	2,000 ft. per min.
Speed round bend	1,000 ft. per min.

Drums.—Twin cylindrical, 14 ft. dia.; $WR^2/g = 138{,}000$.
Sheaves .... $WR^2/g = 17{,}000$.
Loading time .... 20 sec.
Motor.—Three-phase, 50-cycle, 360 revs. per min.

Approximate Output of Motor.—Had the wind to be made at a uniform speed of 2,000 ft. per min., it would take $(3{,}300 + 52 + 875) \div 2{,}000 = 2{\cdot}11$ min. $= 126{\cdot}8$ sec. to raise the skip from the bottom of the inclined shaft to the surface. During this time a nett load of 10,000 lb. would be lifted a vertical distance of $(2{,}120 + 875) = 2{,}995$ ft. Hence, assuming that the motor output is twice that expended on the load,

$$\text{Probable H.P. of motor} = \frac{10{,}000 \times 2{,}995}{126{\cdot}8 \times 550} \times 2$$
$$= 860,$$

and the rotor of such a motor will have an inertia $(WR^2 \div g)$ of about 960 .

Drum Speed.—The drum being 14 ft. in diameter, and the maximum rope speed 2,000 ft. per min., it follows that the maximum speed of the drum $= 2{,}000 \div 14\pi = 45{\cdot}5$ revs. per min., and the gear ratio, therefore, is $360 \div 45{\cdot}5 = 7{\cdot}9$ to 1. A gear ratio of 8 to 1 will be used.

Sub-division of Cycle.—For balanced hoisting from full

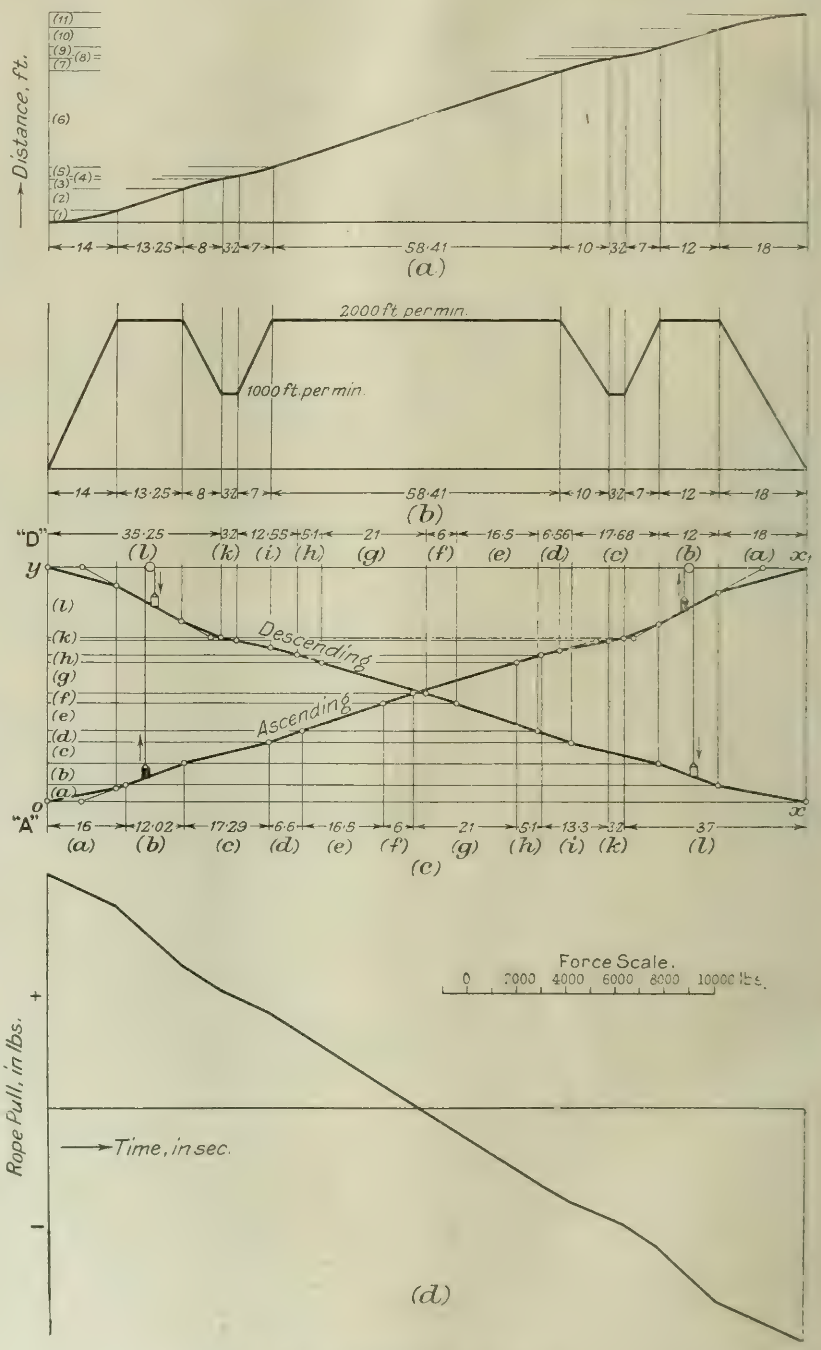

Fig. 25.—Unbalanced Rope Pull.

Table IX.—*Rope Pulls in Different Sections of Shaft.*

w = weight of rope = 3·55 lb. per ft. W_s *= weight of skip = 6,000 lb.* *W = weight of rock = 10,000 lb.*

Section of Shaft	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*k*	*l*
Length, *l* ... ... ft.	300	400	400	220	550	200	700	170	360	53	875
Inclination, θ ... ... deg.	43	42	41	40	39	38	34	32	30	(60)	90
Sin θ	0·68	0·67	0·66	0·64	0·63	0·62	0·56	0·53	0·5	0·87	1·0
Time to traverse, "A" ... ... sec.	16	12·02	17·29	6·6	16·5	6	21	5·1	13·3	3·18	37
„ „ "D" ... ... sec.	18	12	17·68	6·56	16·5	6	21	5·1	12·55	3·18	35·25
Pull due to rope = $wl \sin\theta$ ... ... lb.	724	957	933	522	1,230	440	1,386	321	638	163	3,100
Pull due to "A" skip = $(W_s + W)\sin\theta$ ...	10,900	10,700	10,550	10,200	10,100	9,900	8,970	8,500	8,000	(14,000)	16,000
Pull due to "D" skip = $W_s \sin\theta$	4,070	4,020	3,910	3,850	3,780	3,720	3,360	3,190	3,000	(5,200)	6,000

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† Probably the mining engineers who are reading these articles have already recognised the truth of this. For reasons best known to himself the electrical manufacturer claims that the solution of the winder problem necessitates highly technical and expert knowledge. Simple arithmetic, elementary science and a ten-inch slide rule form the necessary equipment.

depth an hourly output of 94 tons, at 10,000 lb. per wind, corresponds to $94 \times 2{,}240 \div 10{,}000 = 21{\cdot}1$ winds per hour each of $3{,}600 \div 21{\cdot}1 = 171$ sec. duration. Hence, under these conditions, the nett winding time available $= 171 - 20 = 151$ sec. After preliminary trials, and bearing in mind that, in rounding the bend, the speed is reduced to 1,000 ft. per min., the cycle is sub-divided as follows :—

	Period.	Duration, sec.	Distance travelled, ft.	
			During period.	Since beginning.
1	Initial acceleration	14	233·3	233·3
2	First constant speed	13·25	441·7	675
3	Retardation	8	200	875
4	Reduced speed, "D" skip round bend	3·18	53	928
5	Re-acceleration	7	175	1,103
6	Second constant speed	58·41	1,947	3,050
7	Retardation	10	250	3,300
8	Reduced speed, "A" skip round bend	3·18	53	3,353
9	Re-acceleration	7	175	3,528
10	Third constant speed	12	400	3,928
11	Final retardation	18	300	4,228

Total = 154 sec.

Plotting distance and time we obtain the curve shown in Fig. 25 (*a*), and immediately below this curve is plotted the speed-time curve, Fig. 25 (*b*). From these two curves, knowing the weight of the rope and the length and inclination of each section of the shaft, it is possible to determine the unbalanced pull due to the ropes at every instant throughout the wind.

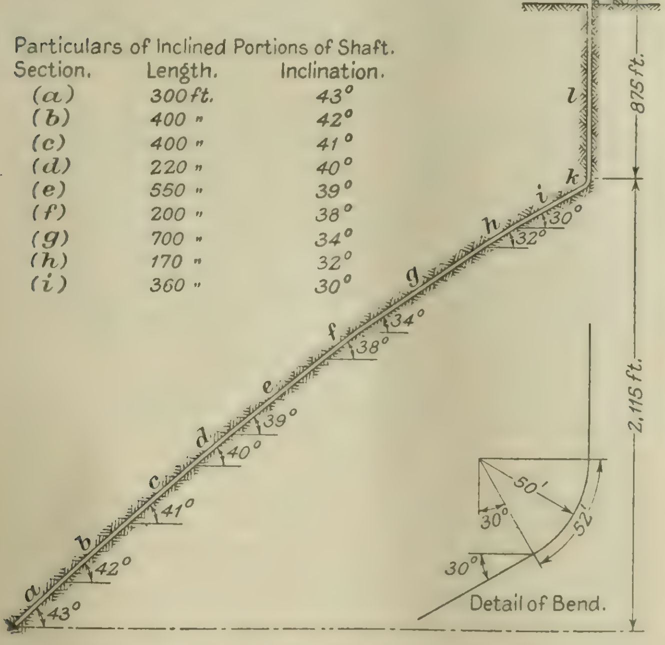

FIG. 26.—PARTICULARS OF COMPOUND SHAFT.

Rope Pull.—Referring to Fig. 25 (*c*), start at the origin *O* and mark off along *Ox* the time taken by the ascending skip to traverse each section (*a*) . . . . . . (*l*) of the shaft. Along *Oy* mark off the rope pull due to each section of the rope. The times and pulls referred to are set out in Table IX.

Projecting vertically and horizontally, and correcting for acceleration, slow-down and retardation, in the manner already described, we get the distorted sloping line Ox_1. Any vertical intercept between this line and the base yx_1 represents the pull due to the rope on the ascending side.

In like manner the rope pull on the descending side is determined. This is represented by the line *yx* on the base yx_1, and, as before, the vertical intercept represents rope pull. Clearly, therefore, the difference between the two intercepts at any instant represents, to a known scale, the unbalanced rope pull at the instant. Differences have been plotted in Fig. 25 (*d*), and from the diagram it will be noted that, in this case, a uniformly varying rope pull throughout the wind may be assumed without appreciable error.

(*To be continued.*)

Canadian Electricity Statistics.

The Dominion Water Power Branch of the Department of the Interior, in co-operation with the Dominion Bureau of Statistics, has recently published an analysis of the results of the annual census of central stations in Canada showing the position of this important industry at January 1, 1919. The report only includes statistics relating to stations which sell or distribute electrical energy for lighting, heating or general power purposes, other than that generated by industrial organisations for their own direct use. The stations are divided into two classes, viz., generating stations which include stations generating all or part of the power they sell or distribute, and non-generating stations which purchase their energy from some other station. The analysis further divides the stations, according to ownership and type of power used, into the following classes: Municipal, commercial, hydro-electric power and fuel power stations.

The total number of stations reporting is 795, of which 515 (or 64·8 per cent.) generate their own power, and 280 (35·2 per cent.) are of the non-generating type. The commercial stations numbered 377, and the municipal stations 418. Of the generating stations 332 are commercial and 183 municipal, while of the non-generating stations 45 are commercial and 235 municipal. The system of the Hydro-electric Power Commission of Ontario accounts for a large proportion of the municipal non-generating stations. The aggregate capacity of all primary power machines reported is 1,958,642 H.P., of which 1,841,114 H.P. is installed in main plants, and 117,528 H.P. in auxiliary or stand-by plants. Of the total for the main plants 1,434,196 H.P. (77·9 per cent.) was reported by commercial stations and 406,918 H.P. (22·1 per cent.) by municipal stations, while of the auxiliary plant equipment the former accounted for 110,853 H.P., and the latter 6,675 H.P. Another table presents by provinces the total capacity of prime movers of different types, and the dynamos installed in central electric stations. The figures are also given separately for main plants and for auxiliary or stand-by plants. According to source of power the total for all prime movers is divided as follows: From water 1,682,191 H.P., from steam 262,562 H.P., and from gas and fuel oil 13,889 H.P.

The relation of the installed primary power and dynamo capacity to population is given in a third table. The per capita analysis is given by provinces as this is the only feasible basis upon which such a comparison may be made. The average primary power installation of the main plants per thousand population for the Dominion is 209 H.P. The provincial averages on this basis are as follows: Yukon 1,135 H.P.; British Columbia 302 H.P., Ontario 277 H.P., Quebec 263 H.P., Alberta 129 H.P., Manitoba 121 H.P., New Brunswick 50 H.P., Saskatchewan 41 H.P., Nova Scotia 38 H.P., and Prince Edward Island 14 H.P.

Hydro-electric power is now served to practically every large industrial centre in Canada, and the rapid extension of the large distribution systems, together with the active hydro-electric construction at present in progress, is fast linking up the few centres which have hitherto derived their power from fuel. According to a recent census of developed water power in the Dominion 72·7 per cent. of the total is utilised in connection with the central electric station industry. Of the aggregate capacity of all prime movers installed in the main plants, 1,682,191 H.P. (91·4 per cent.) is derived from water, and including the prime movers of auxiliary or stand-by fuel plants the hydraulic installation represents 85·0 per cent. of the total. The percentage of hydro-electric power in the various provinces is as follows: Quebec 98·4 per cent., Yukon Territory 97·8 per cent., British Columbia 97·2 per cent., Manitoba 95·5 per cent., Ontario 95·4 per cent., Alberta 72·9 per cent., New Brunswick 37·6 per cent., Nova Scotia 18·5 per cent., and Prince Edward Island 16·8 per cent. Saskatchewan derives 100 per cent. of its central electric station energy from fuel. In Ontario, Quebec, British Columbia and Manitoba the steam plants which are auxiliary to hydro developments account for 113,330 H.P., or 69·2 per cent. of the total steam power installation for these provinces.

The total number of persons employed in the central electric station industry is 9,696, with salaries and wages aggregating $10,134,242. The total capital invested is $441,942,402, of which $396,547,217 represents the investment in power development and transmission and distribution systems, and $45,395,185 miscellaneous supplies and working capital. The commercial stations reported 71·7 per cent. of the total capital, and the municipal stations 28·3 per cent. The total revenue from the sale of electrical energy reported by all stations is $53,549,133, the commercial being 62 per cent., and the municipal stations 38 per cent. of this total. The total capital employed in hydro-generating stations is $364,479,961, or $218 per installed turbine horse power, and accounting for 90·7 per cent. of the total. The results of the census show a decided activity in the development of central electric stations. In connection with enlargements of existing plants the hydro-generating stations reported new installations contemplated for the immediate future amounting to 135,755 H.P. The ultimate designed capacity of existing hydro-electric central stations is 2,115,043 H.P.

Some Australian Tramway Experiences.*

By P. J. PRINGLE.

ONE-MAN CARS.

With the enormous increase in tramway operating expenses the financial future of nearly all tramways has reached a very critical stage. The new position can be met in three ways: (1) By raising the fares; (2) by putting the loss on to the ratepayers or shareholders, as the case may be; and (3) by further economies in the cost of operating. The introduction of one-man cars would seem to be an important solution of (3) in the case of many undertakings, and it is somewhat surprising that no undertaking here has adopted this principle.

We have many important examples of the successful operation of one-man cars in America. There are over 1,000 cars of the Birney safety type operating in about 100 different undertakings. My company who operate the electric light, power and tramway undertakings of Ballarat and Bendigo, Victoria, introduced one-man cars in May, 1913, on 8½ routes out of 11. Two other tramways in Australia and several in New Zealand have one-man car operation seriously under consideration. The one-man car has in many cases been able to effect a saving of nearly 50 per cent. in the operating costs, and we can also effect a saving of nearly 50 per cent. in our platform costs, which is sufficient to have a very important effect on the financial position.

BALLARAT AND BENDIGO ONE-MAN CARS.

Owing to certain wage awards in 1913 it was imperative to consider every possible economy. We are running to-day with a reduction of about 35 conductors. This represents a saving of some £6,650 per annum on a total tramway revenue of £50,000 per annum.

The average speed of the two undertakings is nearly eight miles per hour, and it has only been found necessary slightly to lower the previous scheduled speed on two of the routes. The cars are all single-deck, and are converted for one-man operation by attaching hinged gates to each end of the car on both sides. The rear ones are kept closed, the entrance and exit being effected by the front gates adjoining the motorman. The fare-box is hung behind the driver and adjoining the entrance into the car. Arriving at the terminus, the motorman carries it to the other end of the car. There are hinged notice-plates just above the dash, one side notifying "Pay as you enter" and the other side "Pay as you leave."

This system has the following advantages: Cars travelling from the suburbs to the centre of the town notify "Pay as you enter" at each end of the car, because passengers are picked up in small numbers along the route and leave the car often in bulk when they reach the centre of the town. Cars travelling to the suburbs notify "Pay as you leave," thus enabling the heavier loading in the centre of the town to be effected without any delay in the collection of fares. The "Pay as you enter" notification is a hint to passengers to get their fare ready before boarding, and the "Pay as you leave" notification gives them time when in the car to get their correct fare ready.

FARE BOXES.

The fare-boxes are of simple construction, the coin or token falling on to a plate inside the box with two sides glass, which plate can be tilted by the motorman, the fares then falling into the lower receptacle. A reflector is arranged inside the glass box, which assists in making the payment of a fare as public an operation as possible. This method constitutes a strong moral check, and missed or incorrect fares rarely ever occur. The motorman does not handle any fares, but only gives change when necessary or sells the tokens. One-man car operation, with passengers entering and leaving at the motorman's end, obviously leads to a reduction of accidents. In our case this reduction has been most marked; in fact, reduced to about one-eighth.

The Tramway Union did not take kindly to our innovation at the start, over-estimating the slight additional duties required by the motorman. But they now realise that the cars can be run with one man and give satisfactory service to the public, and that our finances cannot stand the cost of two-men operation. The motormen on one-man cars get 5s. a week extra, and the additional duties are so small that all the motormen press to take these duties in rotation.

RAIL SECTIONS.

The coning of rail treads and wheel treads is worthy of deep consideration by tramway managers, particularly as many object strongly to the proposed new standard increasing the coning from the now 1 in 20, when they consider that it would be better to revert to a flat rail and wheel tread. Ten years ago, when sending in my views to the Corrugation Committee, I strongly urged that rail and wheel treads should be flat, because I believed that coning tended to create corrugation. Mr. de T. Holt holds the view that, as the majority of the wheels wear to a certain profile, the rails should be rolled to agree closely with that profile. To effect this an inclined and rounded head is necessary. With new wheels and track true to gauge there must always be less wear on the flange side of the wheel owing to the side sway of the wheels. As the flanges become thinned this is accentuated. The coning of rail and wheel treads and the extent of filleting adjoining the wheel flanges has a bearing on the average wheel profile, and wheel treads may not necessarily wear to Mr. Holt's design if flat rail and wheel treads had been in use. Generally speaking, as the life of a rail is decreased by wear the coning of the rails is increased, and the serious amount of coning to be found on some of our tramways demands the closest investigation.

This loss of life through excessive coning assumes enormous importance with the present-day cost of rail renewal. An increase in the coning of rail treads by wear admittedly shortens the life of a rail; therefore, why not postpone this coning effect as much as possible by starting off with flat rail and wheel treads? I would suggest that the Rail Standardisation Committee should suspend their present proposals, and that careful tests on several systems should be made, as follows: (1) The extent of side swaying of the cars on systems both with badly and lightly coned treads and wheels compared with wheels turned up with flat treads; (2) that current consumption tests should be taken in the tests above; (3) that if any undertaking is to-day running with an original flat-rail tread in conjunction with a flat-wheel tread, the resultant coning of the rails should be carefully investigated.

The slipping effect on straight track, which must be present to the greatest degree with a coned rail and wheel may have a bearing on our corrugation troubles. When the above conditions are combined with the large diameter fillets to be found on many wheels, the slipping effect is intensified. It may be of interest to mention that on the Melbourne Cable Tramways rail corrugations are non-existent on routes over which single-deck cars run, excepting where there is excessive tight or slack gauge. On one route which is run with bogie cars very slight corrugations can be found in a good many places on straight track. This is due to the fact that a bogie truck will, when hauled by a cable, be subjected to more side-swaying action than a single truck, and that the presence of coning and wheel will in these circumstances have a more pronounced effect on wheel slip.

A comparison of the wear on the Edinburgh and on the Melbourne Cable Tramways shows that the coning of the rail treads in the former is four times as great as the latter, with very much greater annual rate of wear, and the life lost 23 per cent. as against 6·2 per cent.

DIFFERENTIAL WAGES.

Great Britain's recognised standard rate of wages has always varied in different towns and districts, and has been based to some extent on the cost of living and conditions existent in the localities. The addition of a fixed war bonus to the original basic wage has greatly reduced the percentage of differentiation, and the added percentage increase to the basic wage, plus the bonus, has only slightly retained the differential principle. The demands now being made in some quarters for a national wage endanger the differential wages which have always existed. Conditions in Australia show that should this country drift into accepting a national wage, then certain towns, districts and industries must be gravely affected. The question is one of great national importance, and in its effect on industries it must involve the well-being of both the employer and the employee. The exodus of industries from our big industrial congested centres to rural parts with a lower standard rate of wage has unquestionably been of vast importance to employees in the improved conditions which they and their families participate in. The lower wage has never been an injustice, because under the lower cost of living, existent in the rural parts, their position is often financially better. The attempt to impose a national wage is absolutely inconsistent and has no element of justice in it. Cost of living has been always the basis for a demand and for an agreement or an award. A fixed wage must do injustice to some workers at the expense of others. A time must come when rents will rise; and the local conditions in the various towns and districts must have a big influence on this, and in consequence must enter into the fixation of wages. An acceptance of a national wage would make it impossible to provide for these differences, which may be greater in the future than they have been in the past. The past effect of a national wage has been only too self-evident in Australia, and the gravest warning is necessary to those in authority that nothing should be done which should permanently injure the industrial welfare of this country.

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* Abstract of a Paper read before the Tramways and Light Railways Association.

Depreciation.

I have taken an active part, both with the Federal and State Income Tax authorities in Australia, in enabling electricity and tramway undertakings to be put on a fairer basis in regard to their depreciation allowances. We have also obtained the recognition of an important new principle in regard to certain depreciation allowances. Five per cent. depreciation on diminishing values has in the past been allowed on all power-station plant. This percentage is also allowed to any factory or works working approximately 305 days per annum (Sundays and holidays excluded), on the basis of 48 hours per week. It is obviously inconsistent to only grant the same allowance to undertakings which run continuously all the year round. The Federal authorities have considered this aspect, and now grant 10 per cent. depreciation on diminishing values for all power-station plant and 5 per cent. for all tramcars. With the enormous increase in the replacement cost of assets which compose our tramway and electrical undertakings, it is obvious that the old depreciation allowances wante ntire revision. If the replacement cost is double the original, then a 5 per cent. allowance is really only equivalent to 2½ per cent.; otherwise it assumes that the life is now double what it used to be.

Some Notes on Transportation in America.*

By C. J. SPENCER, O.B.E.

As in England, the main problem facing the tramway companies of America is finance. Costs have risen 100 per cent., whereas revenue has not advanced more than 8 or 10 per cent.. This has rendered necessary a complete overhaul of fare charge systems and methods of collection.

Flat Fare *v.* Zone System.

The natural inclination for the city worker to live well out causes the distance of travel per passenger to steadily increase, and expenses are therefore likely to increase faster than revenue. There is, therefore, a very acute controversy on the question of zone versus flat fare systems of payment. It is no easy matter to alter the habits of a population, and there is no doubt that in the States the five cent. flat fare has become exceedingly popular. There is also opposition from the management to the introduction of complicated methods, such as the ticket system. The Connecticut Company have now established one mile zones on the basis of a six cent initial cash fare for two zones or less, with a charge of three cents for each additional zone. Tickets can be purchased in quantities of 50 entitling the passenger to ride a mile for two cents. This charge is working out satisfactorily, and is showing distinct signs of retrieving the financial position of the Company.

Operating Costs.

When it is remembered that the cost of operating a tramway undertaking in this country is, at least, as high as the cost of operating an average undertaking in the States to-day, a simple question immediately arises—Why is it necessary to charge the American public a higher rate of fare for tramway transportation than anyone has dared to suggest will be necessary in this country? A satisfactory reply to this is by no means easy, but it would appear that the riding habit, at any rate with short-haul traffic, is not so great on the average American system as in this country. From a comparison of two American and two British systems it appears that the average number of passengers carried per car-mile on the English systems is in excess of the American systems—that the receipts per car-mile and the cost of operation are approximately the same, and, therefore, the only difference appears to be in the number of passengers carried per car-mile.

Double-deck *v.* Single-deck Cars.

It may be that the almost universal use of the double-deck cars over here provides some explanation, or, perhaps, the low initial rate of fare may be the cause of the larger short-haul traffic. At any rate, it is strange that the single-deck type is almost universal in America, and that experiments with double-deck cars have not been successful. Time spent in the consideration of the most suitable vehicle for the future would be well spent. On the question of average speed our friends in the States are not doing much better than we are doing, but one great hope of reducing working costs is in the direction of a greatly improved average speed of travel.

Features of Rolling Stock.

Considerable progress has been made in the design of rolling stock in the United States as compared to this country. The car which most of us are using to-day bears a remarkable resemblance to its prototype, the horse car. This is not the case in America, where the new type of car is essentially an electrically-propelled high-speed vehicle. The driver is covered in, the cars are universally equipped with power brakes, the partitions between the driver and the passengers and the passengers and the conductor have disappeared, and the whole floor space is utilised with the result that both the driver and the conductor are doing their work under much more comfortable conditions than tramway employees in this country.

The payment of the fare by the passenger before he takes his seat is almost universal. The days of the conductor struggling through a crowded car to collect his fares is a thing of the past. The cash is dropped, under the eye of the conductor, into a fare box, which automatically registers and counts the cash paid. The conductor, either by means of a pneumatic button or mechanical lever, controls the opening and shutting of the doors. The doors cannot be opened whilst the car is in motion, except in cases of emergency, and the car cannot be moved whilst the door is open. The use of this type of car has had the effect of practically eliminating alighting and boarding accidents on American systems.

"Pay as you Leave."

The very latest system in the States to-day is "Pay as you leave." This appears to be working with considerable success on the Connecticut system with its zone fare collection methods. The passenger boards the car at the driver's end and receives from him a slip of thin paper upon which is printed the zone in which the car stands at the moment the passenger enters. This is done very quickly by the use of an ingenious clip and packet of tickets. The passenger, after receiving his slip, takes his seat, and when he gets near his destination moves towards the rear of the car, informs the conductor that he desires to alight at the next stopping place, and hands him his slip, from which the conductor computes his fare, aided by a simple scale posted up in the car. By the time this transaction is finished the car has arrived at the stopping place, the door is opened by the conductor, and the passenger leaves.

The obvious criticism of this system is that some delay might take place when a number of passengers desire to leave at the same point, and have their fares to pay before leaving, but personal experience showed this is not so.

One-man Safety Car.

This is the latest development of rolling-stock design in the States. The Brooklyn Rapid Transit Company intend putting 200 of these on to their routes to deal with slack-hour traffic. These cars are very lightly built, well sprung to give smooth riding, are quickly accelerated from rest to full speed, and as quickly brought to a stand by means of the air-brake. The cost of operation is about half that of an ordinary heavy car, they are popular, and they certainly appear to meet all the requirements of normal traffic. The effect of the introduction of one-man cars was nearly to double the headways, but the essence of success was a simple fare collection system.

Coupled Cars and Peak Load.

As in this country the peak load is a great problem. Large coupled cars, with a conductor to each car but only one driver for the train of two and sometimes three cars, is fairly common practice. The great tendency is labour saving, and railway, rather than evolved horse-car practice, is being developed. Automatic couplers of ingenious design are in use, whereby all power circuits and brake connections are automatically made when the coupling takes place. On most of the systems in the States great attention is given to the designing of working schedules. On most systems a Traffic Research Department of considerable dimensions was deemed an essential part of the organisation, and the development and fluctuations of traffic were very carefully adjusted and scheduled alterations made to meet the changed conditions, with the result that greater efficiency of working was being accomplished. The old system of turning out a certain number of cars in the morning and letting them run all day, on the principle that it was a good average service to meet average conditions, had vanished.

Labour Conditions.

Operators in this country have generally accepted the statement without question that labour in the United States was very much better paid than labour in this country, and was therefore much more expensive. This was undoubtedly true in pre-war days, but it is no longer so. A tramcar driver or conductor receives to-day from 44 to 50 cents an hour—that is, 1s. 10d. to 2s. 1d. per hour.

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* Abstract of a Paper read at the Annual Meeting of the Tramways and Light Railways Association.

Common practice in the States is for a straight hourly payment to the men when actually on their cars in service. There are no signing "on" and "off" allowances; there is no payment for uniforms; these must be provided by the men to the Company's requirements; and there are no free holidays, so that on balance an American tramway employee is no better paid than his colleague in this country. Relations between the trade unions and the undertakings appear to be much the same as in England, and the same kind of controversies are taking place. In Philadelphia we found a "co-operative" system in operation bearing a strong resemblance to our Whitley Council arrangement in this country, which we were told was giving good results.

Labour-saving Devices.

A common arrangement is the employment of an Economy Officer, whose sole duty is to study every phase of working with one single object in view—viz., "economy of operation." The utmost use of labour-saving machinery is made in every department, and this is particularly true in connection with the maintenance and construction of permanent way, where most ingenious machines are in use for tearing up the roadway, digging out the trench, mixing concrete, &c., &c., with the result that the labour cost of permanent way reconstruction in the States is less than in this country at the present time. The present high cost of labour in all departments is very properly driving employers to consider the use of machinery wherever possible.

Electric Railway Contact Systems.*

By Sir **PHILIP DAWSON.**

Introductory.

There are two distinct types of contact systems used on electric railways, the conductor or live rail, only used at present with direct-current pressures of 500 to 1,300 volts. In the United States 2,500 volts has been tried, but abandoned, and so far there are no contact rails working anywhere at a pressure over 1,500 volts. With pressures of 3,000 volts direct current, or 6,000 to 16,000 volts alternating current, or 3,000 to 5,000 volts three-phase, the questions of safety and insulation make overhead conductors imperative. So far only three countries have decided to standardise any one system for general railway electrification—viz., Sweden, Switzerland and Germany, who have adopted the single-phase 16,000 volt 16⅔ period system with an overhead conductor. It appears probable that France may adopt the 3,000 volt direct-current overhead system. Italy has so far not arrived at any definite conclusion, although most of the electrified railways are on the three-phase 16-period 3,000-volt system. The United States has no definite standard, but the Pennsylvania Railroad appears to have decided on the single-phase system for future electrifications.

In this country the whole question is under examination. Where traffics are very intense and hours of service long, the overhead construction has to be a very different thing from that adopted for electric tramways. The factors of security and safety must at least equal those obtaining on the permanent way, and maintenance and supervision has to be carried out in very limited periods of time. Moreover, an overhead conductor can only be economically utilised where the currents to be collected from it are relatively small.

Overhead Conductors.

The overhead construction and the collector arrangements on the coaches or locomotives must be such as to make it certain that the collector bow will never be liable to come off the contact wire, and must also follow the contact wire with the utmost flexibility. Hence the ordinary tram trolley wire construction is unsuitable. The design must be such that, whilst minimising the risk of failures, the cost of maintenance and the time required for renewal or replacements of parts is reduced to a minimum; the capital cost must also be kept as low as possible.

It is satisfactory to note that, while alterations have been carried out in the United States and Germany, the overhead construction on the Brighton Railway in operation to-day is practically identical with that originally designed. On the Hamburg Suburban Railway the Germans adopted single insulation and a system utilising counterweights for keeping up the tension of the trolley wire, both of which have proved unsatisfactory. In the United States they at first adopted an entirely rigid form of overhead construction. It was found necessary to add a flexible wire under this triangular construction, as the solid conductor wire resulted in hammering and conduced to failures.

The Brighton Railway.—On the Brighton Railway the principles adopted in 1907 were: That the conductor wire should be as flexible as possible, and that all hard spots should be avoided. That double insulation was essential, and that the mechanical and electrical factors of safety of the insulators and overhead construction must be considerable. That all insulators should be placed in positions where they would be least subjected to the direct effects of the hot gases given off from the steam locomotives.

That, with the exception of complicated yards and cross-overs, the up and down lines should be sectionalised, whilst the complicated cross-over roads and yards were so designed as to be sufficiently short to be coasted over.

That insulators should be only utilised under compression, and that elastic substances should always be placed between the insulator and its solid support, and between it and the mechanical construction supported.

Provision was also made to preclude any possibility of moisture or water collecting and freezing, thereby fracturing the insulation.

Clearances.

Limiting factors in the erection of an overhead conductor system are the clearances at bridges, in tunnels under any other structures, and between the live conductors and the loading and construction gauges. On the Brighton Railway the contour of the bow practically follows the contour of the loading gauge, and under present conditions the ordinary running width of the bow is 18 in., or 9 in. on either side of the centre line. In future this stagger will be increased to a maximum of 1 ft. on either side of the centre line. The width of the actual collector strip is 9 in. greater on either side of the centre line, in order to allow for the rolling of the coach and for special conditions existing on very sharp curves.

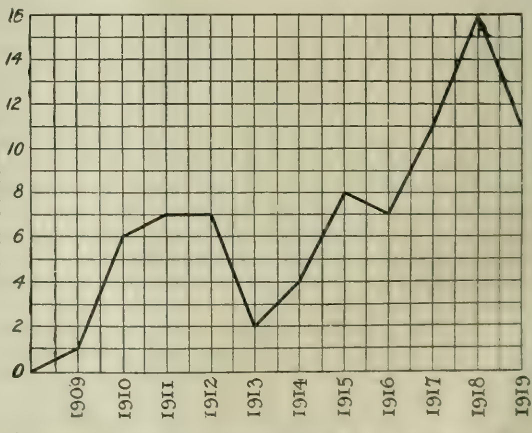

Fig. 1.—Overhead Defects causing Delays to Traffic Working Exceeding Three Minutes.

The general conditions of clearances which govern the construction are as follows:—

Height of Live Conductor above Rail Level.—The lowest live conductor on the L.B. & S.C. Railway is 13 ft. 9 in. above rail level—*i.e.*, 3 in. above loading gauge. This 3 in. clearance has worked quite satisfactorily, though 4 in. between loading gauge and live wire is preferred and considered satisfactory for 11,000 volts.

Electrical Clearances.—Four inches is the minimum vertical point-to-point electrical air clearance which should be allowed for voltages from 6,000 to 11,000; therefore a minimum of 4 in. vertically and 3 in. horizontally is provided from any part of the live bow—a clearance which also applies between overhead equipment and structures.

Minimum Standard Clearances.—Working on these principles, we can get a flexible overhead line construction within a minimum of 10 in. from the loading gauge to the structure—*i.e.*, within 14 ft. 4 in. above rail level, which 10 in. space is utilised as follows: 4 in.—Air clearance between loading gauge and underside of trolley wire;

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* Abstract of Paper read before the Institution of Electrical Engineers.

2 in.—Depth of flexible line construction; **4 in.**—Air clearance between top point of live construction and structure.

There are probably 20 cases of 6 in. overall from the underside of the live wire to the nearest structure, running satisfactorily to-day; and two of 4½ in., where there is a short space of about 12 ft. under footbridges. There are a few isolated cases where the clearances required for a live conductor are not available, and where the cost of alterations would be excessive. On the running lines so far electrified, equivalent to 70 miles of single track, there are only four instances of this kind. Three of these occur at the bridges at the entrance to or in Victoria Station, where it has been found necessary to install earthed conductors.

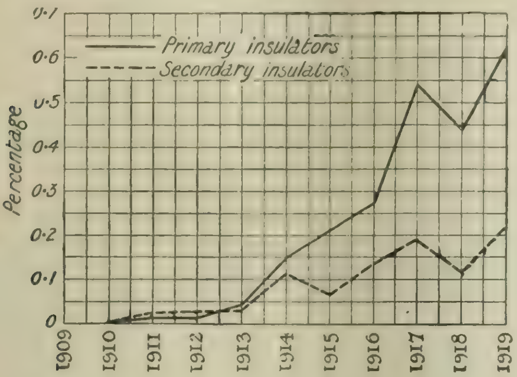


FIG. 2.—PERCENTAGE RENEWAL OF PRIMARY AND SECONDARY INSULATORS PER ANNUM.

SECTIONING OF SYSTEM.

The line has been divided into sections, which can, if necessary, be isolated from each other with a view to locating faults and minimising any delay caused thereby. The only satisfactory manner of doing this without limiting the speed at which trains can traverse such sections is by the use of air-gaps at the end of each section. Under ordinary conditions, this is an easy matter, as one conductor can be brought to a terminal and anchored whilst another conductor is started at the point of section, so that the collector bow on a short section runs in contact with the conductor wires of two adjacent sections. However, at certain points and crossings and complicated junctions this is very difficult. In Germany and in the United States it has been met by putting in section insulators mechanically connecting the adjacent sections. Experience has shown that this method caused flashing and knocking of the bow collector, causing complications and limiting the speed at which such connections can be negotiated. This difficulty has been entirely overcome by the special patented device designed for the Brighton Railway.

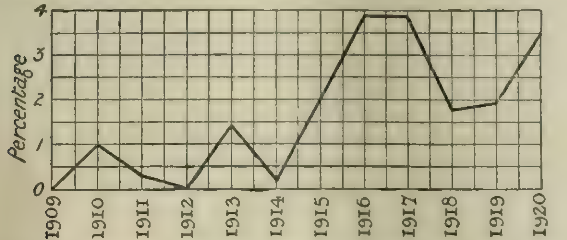


FIG. 3.—PERCENTAGE RENEWAL OF TROLLEY WIRE PER ANNUM.

Whilst on ordinary running lines the up and down lines are easily sectionalised, there are one or two cases of cross-overs, junctions and the yards of terminal stations, where this may become difficult, and the special air-gap insulator mentioned above has been of great assistance in overcoming such difficulty. Here the whole of the overhead line is electrically and mechanically connected, and formed into what is known as junction sections, so laid out as not to exceed a length which can easily be coasted over should a defect render it necessary for one such section to be cut out.

MAINTENANCE.

There is one section between Battersea Park and Peckham Rye on the South London line over which there is practically no steam traffic and which is practically entirely operated electrically. On other electrified sections, *e.g.*, the Crystal Palace line, a very heavy steam service also exists. From careful records kept during the last 10 years it can be shown that the maintenance costs and renewals of the overhead construction are very largely affected by steam operation.

The efficiency of the overhead system as regards the very small number of defects and delays arising therefrom is shown in Fig. 1. Fig. 2 shows the percentage of both the primary and secondary insulators renewed on the whole system per annum.

It is interesting to record that not a single primary insulator (out of 7,000 primary and 14,000 secondary insulators) has been renewed on the wholly electric section of the South London line. Measurements carried out during the last 10 years show that the wear on the trolley wire where no current is taken is nearly negligible, and is only appreciable when the current is heavy. The wear is, in fact, proportional to the amount of current collected.

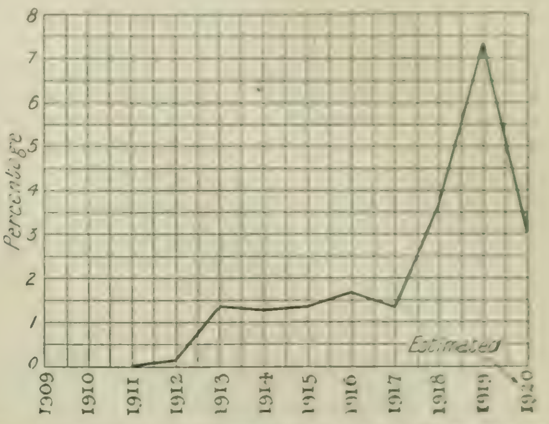


FIG. 4.—PERCENTAGE RENEWAL OF CATENARY WIRE PER ANNUM.

Figs. 3, 4 and 5 show the percentage of trolley, catenary and dropper-wire renewals during the last 10 years. Here again the large increase in these renewals during the years of war is practically entirely due to the extraordinarily heavy steam traffic.

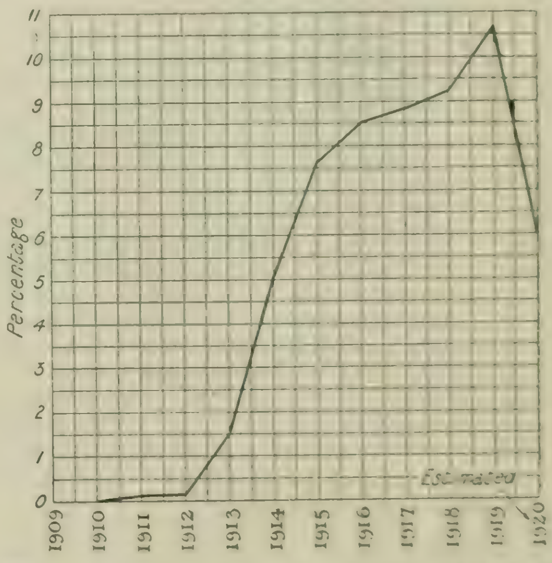


FIG. 5.—PERCENTAGE RENEWAL OF DROPPER WIRES PER ANNUM.

The influence of steam on the maintenance of catenary and dropper wires is again shown by results on a typical 1-mile section of the South London line, which is operated entirely by electric traction. Here not a single catenary wire (out of 150 miles) has been renewed.

Confirmation is afforded by the comparison of two parallel lengths of a mile on the Crystal Palace line, one with very little electric and very heavy steam operation and the other the local line on which there is a mixed steam and electric service; here again the lines over which there is the greatest steam traffic are subject to the greatest cost of maintenance.

The experience gained on the Brighton Railway, where very great precautions were taken in order to ensure absolute safety of operation, has shown that a simpler form of construction and one which will considerably decrease the cost of construction and maintenance can be adopted, and one has been designed and tried and will be employed in connection with any extensions which may be carried out.

(*To be concluded.*)

Reviews.

Principles of Transformer Design. By Alfred Still, M.Inst.C.E. (London: Chapman & Hall, Ltd.) Pp. xii.+216. 10s. 6d. net.

Purdue is a live university, and Prof. Still is one of its most active ornaments. We are becoming accustomed to a regular output of thoughtful, well-written books on electrical subjects from his pen, laid down on lines that should make them of considerable use to students.

We could wish, however, that Prof. Still had been able to devote the time necessary to the preparation of a really exhaustive treatise on transformers. We cannot suppose him to be ignorant of the need for it, and so must conclude that he has up to now been too busy to write it. The fact that his preface announces that "there may be a limited demand for it by college students taking advanced courses in electrical engineering" tends rather to disarm criticism essentially based on the utility of the volume to the engineer engaged in the design, manufacture, sale, or operation of commercial transformers; yet we feel that such criticism may still have a legitimate field of usefulness, as serving to indicate, in some measure, the requirements of the situation.

It is at least unusual, in this country, to describe the ordinary power or lighting transformer, as a "potential transformer." The term is not inaccurate, but custom has localised it, and attached it to the small transformers which are used in connection with instruments or relays.

Prof. Still grows misleading when he states, on p. 24, that "the mechanical features of transformer design are not of sufficient importance to warrant more than a brief discussion." The tone of the whole of the seven-page dissertation which follows, with its recurrence of "merely" this and "merely" that, is such as will give the student an entirely erroneous idea of the nature of the bracing problem. The prolongation of the life of a transformer, just as in the case of any machine, animal or individual, is at the very least as important as its successful birth or construction. We believe that the bracing of coils and leads in American practice would fail by a long way to satisfy the requirements of the British market, and if young designers are taught to regard the question on the lines indicated here we begin to see a reason for this fact. A transformer may be all taut and trim when newly built, but after prolonged running in hot oil, with bumping loads tending to move the coils, what is likely to be the condition of the insulating material, particularly in the case of high voltages? It is not only necessary to brace against the hammer-blows arising from short-circuits or fluctuating loads, but it is necessary to provide means for automatically taking up shrinkage.

We think it would be clear to most students that efficiency is the quotient of input into output. Whether the input and output are expressed in watts or watt-hours the result is the same, and it is not necessary to state how the input is made up. Therefore, we can get rid of the ratio given on p. 74 in a somewhat unwieldy form.

The use of external coolers through which the oil is passed is steadily growing as a means of rating up transformers and so achieving economy. Prof. Still devotes three lines to it on p. 15, but when considering forced oil circulation in more detail on p. 106 he deals only with the forcing of the circulation of the oil within the tank.

The calculation of the internal reactance of transformers has always appeared to us empirical in the extreme. The calculated result, we think it safe to say, always requires modification by a large constant to make it agree with the result obtained in practice, and Prof. Still does not help us much in the matter. He also perpetuates an objectionable feature which found its way into some British practice from a transatlantic source—the use of inches and centimetres in the same formula. Certainly he does it unblushingly, and expressly declines in a footnote on p. 127 to apologise for so doing, but it is a nasty habit, and we would be glad to see the last of it.

The use of three-phase transformers in British and Continental markets has not by any means come to an end yet; and not all designs consist "merely" (again) of three single-phase transformers. Prof. Still dismisses the subject in a couple of paragraphs on p. 154.

The calculations regarding the hot-spot temperature are interesting and useful, but due note should be taken of the sentence on p. 173, stating that "there will be no local 'hot-spots' if adequate ducts for oil circulation are provided around the coils." Well, we'll hope for the best!

The growth of the use of electric furnaces was, like the progress of aviation, a striking feature of the war. Nearly all of them owed the possibility of existence to the alternating-current transformer. In this book, published since the conclusion of hostilities, we learn (p. 177): "Electric furnaces are built to take currents up to 35,000 amperes at about 80 volts—usually three-phase." And that is all!

There are some useful notes on the Cowan-Still regulator; the book has an index, and a list of the symbols employed. Why does not Prof. Still fall in line with the International practice, and use kV, kVA, instead of Kv., k.v.a.? There is a misprint at the foot of p. 202.

We have endeavoured to point out what we consider the shortcomings of the book; but, of course, there is a great deal in it that is useful, particularly to those for whose use it professes to have been written. There is, however, ample room for a thoroughly good and up-to-date treatise on modern transformer practice, and we live in hopes that we may yet have the pleasure of reviewing such a treatise.

A. J. Cridge.

Correspondence.

GAS *V.* ELECTRICITY.

We have received the following correspondence from Sir Dugald Clerk:—

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I have pleasure to forward for publication copy of a letter which I have addressed to the Editor of "Gas," Nuneaton. The letter explains itself.—I am, &c.,

London, June 29. Dugald Clerk.

TO THE EDITOR OF "GAS."

Sir: In your editorials which appear weekly in the enterprising Nuneaton journal "Gas" you generally agree with the views of the energetic gas engineer, Mr. George Helps. I am accordingly somewhat surprised to read your leader of June 16 and find that you strongly condemn the method of calculating the thermal efficiency of gas generation, by means of the ordinary process of carbonisation, which was used by Mr. Helps in his British Patent Specification No. 111,495 entitled "Improvements relating to the Manufacture, Utilisation and Combustion of Fuel."

Mr. Helps deals with the thermal efficiency of "straight" coal gas at page 5 of the specification as follows:—

PRESENT GAS WORKS PRACTICE.

Carbonising Coal-Coke Making.

Coal carbonised—15 tons.
Quality—Good dry coal, very little dirt or ash.
15 tons of coal at 30,000,000 B.T.U.'s per ton=450,000,000 B.T.U.'s.

Result of Carbonising Tons.	cwts.	qrs.		B.T U.'s.
2	10	0	150,000 c. ft. of straight coal gas of 600 B.T.U.'s	90,000,000
10	17	2	Coke, 11½ cwts. per ton for sale 172½ cwts. of 13,850 B.T.U.'s per lb. (dry coke) 3 cwts. per ton being used for carbonising...	267,600,000
0	15	0	Tar, 10 galls.=1/20th ton on 15 tons 15 cwts. at 13,850 B.T.U.'s per lb.	23,300,000
0	15	0	Liquor, 105 lb. per ton 105 × 15 say, 15 cwts.	—
0	2	2	Differences, Impurities removed in purifiers, washers, &c., and ash...	—
				380,900,000
			Loss by difference ...	69,100,000
15	0	0		450,000,000

Analysis of Loss.

336 lb. of coke used in fires ...	...	—
336 at 13,850 B.T.U.'s per lb.	...	69,800,000
Say	...	70,000,000

Summary.

70,000,000 B.T.U.'s out of 160,000,000, *i.e.*, 70,000,000+90,000,000 have been expended to get a gas containing 90,000,000 B.T.U.'s and therefore 44 per cent. has been lost and the efficiency of the process is 56 per cent.

Mr. Helps calculates the thermal efficiency of gas making as 56 per cent. by a method which is quite correct. It is the only method which could be used by an instructed scientific man on the assumption that the gas has to bear the whole heat loss of the process. I used the same method in calculations made at the end of 1918, although not then aware of Mr. Helps' publication. You correctly state the equation as :—

$$\text{Thermal efficiency of gas generation} = \frac{\text{Heat units in gas}}{\text{Heat units in gas} + \text{heat units expended and lost in manufacture of gas.}}$$

Mr. Helps calculates the thermal efficiency of gas generation in the instance chosen by him as 56 per cent., and my calculation as to gas generation by the Gas Light and Coke Company is correctly quoted by you as 47·8 per cent.

You are quite in error in designating the formula as arbitrary. You make many interesting but quite fallacious calculations in the remainder of your article which I may deal with later.

My present purpose, however, is to ask you to oblige me by giving me information as to Mr. George Helps' present views. Does he agree with your article or does he adhere to the method used by him in explaining the carbonising process in his specification of 1917, No. 111,495 ?

As I find from the "Electrical Times and Lightning" that you courteously supplied them with advance copies of your article before publication, I am following your courteous practice and posting copies of this letter to other Gas Journals and Electrical Journals.—I am, &c.,

London, June 26th. Dugald Clerk.

We have received from Mr. George Helps the following reply to Sir Dugald Clerk's questions :—

TO THE EDITOR OF THE ELECTRICIAN.

Sir : The letter from Sir Dugald Clerk of the 25th inst. is incidentally very interesting, as it shows how wide apart may be the view point of men both of whom may be given some credit for being able to express their opinions in print.

The extract from my specification 111,495 of 1916, which Sir Dugald Clerk refers to, was put in to compare with another process, in which the whole of the coke was gasified. The thermal efficiency of "present gas works practice, carbonising coal-coke making," given as an example, shows 56 per cent. efficiency. The proposed gas-making process, which follows it in the specification, and with which it was compared, is not referred to by Sir Dugald Clerk. This is headed "Gasifying Coal-gas Making," and claims 83 per cent. efficiency.

I was comparing a process of partial gasification of coal (which I designated "coke making") with a process of complete gasification of coal. Further, the figures of working, showing how the efficiencies are calculated, are given in detail. Surely such a comparison is legitimate, which is more than can be said for Sir Dugald Clerk's.

In his case, to arrive at the figure of efficiency given for the process of gas making, of 100 parts of coal (80 per cent. carbon) only 50 are gasified, as roundly 50 parts of carbon in the form of coke are left over and allowed for at 100 per cent. efficiency. On the other hand, to arrive at the figure of efficiency given for the process of electricity generation, the whole of the 100 parts of the original coal is consumed (gasified). The two efficiencies arrived at in this way obviously cannot be compared.

Gas people may make what comparison they please between one process they use and another they propose to use ; but when someone, in the name of the gas industry, makes a comparison of the so-called thermal efficiency of a gas process with the so-called thermal efficiency of a process in another industry, such as electricity, it behoves him to look to his p's and q's, so that no conclusions are drawn to the detriment of that other industry unless fully substantiated. We were all taught in our early school days that like can only be compared with like.

In my view, the comparison between gas and electricity given by Sir Dugald Clerk in figures of thermal efficiencies in his combination report with Profs. Smithells and Cobb is not only misleading, but entirely without foundation of fact. If Sir Dugald Clerk can show by production of working results that I am wrong in this opinion, he will find me not only willing but anxious to be corrected. I am taking the efficiencies concerned broadly, and I am not quibbling about a per cent. or two in any of them.—I am, &c.,

Nuneaton, June 28. Geo. Helps.

P.S.—I am pleased to notice that Sir Dugald Clerk is not restrained from using the word courteous, and also that he has at last had time to see that the proposed process to which reference is made in the combined report of Profs. Smithells and Cobb and himself in 1918 was mentioned in my specification of 1916.

THE DECISIONS OF NATIONAL JOINT BOARDS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir : Considerable discussion took place at the general meeting of the Incorporated Municipal Electrical Association recently held, with respect to Mr. Alderman Jephcott's resolution regarding the acceptance by Local Authorities of recommendations of the National Joint Boards under the Whitley scheme. There would have been, I think, even more discussion, had not the shortness of time available made it necessary to apply the closure. I venture to think that the mover of the resolution had the unanimous support of the meeting with reference to recommendations of the National Joint Industrial Councils. A difficulty shared by the writer, however, lay with the application of the resolution to the National Joint Board. This was not, I think, due to any objection, generally, to the terms of the resolution applying to a Council, duly appointed and duly recognised, to deal with the matter of staff salaries. It did, however, appear that the resolution as put to the meeting, if passed, could be taken as giving authority to the National Joint Board as now appointed, to continue to make recommendations.

There is a real difficulty in dealing with staff matters of publicly owned commercial Undertakings by means of Joint Councils and the method adopted in the formation of the National Joint Board has placed the managers of many Electricity Undertakings in a most difficult position when discussing matters arising out of its recommendations, with their respective Committees.

It would appear to the writer that when the Incorporated Municipal Electrical Association was invited to provide half the Employers' side of the Board, they should have obtained a mandate from the constituent Authorities, before accepting the invitation. By giving such mandate the various Authorities would have been morally committed to abide by any decision arrived at. There is little doubt in the writer's mind that such authority would have been given, probably unanimously, and it would then have been necessary to have discussed the method of election of the six nominees of the Association. This, I venture to suggest, is not a matter for the Council of the Association, but a matter for the General Meeting. Whilst the Council, as then formed, could have dealt with matters of urgency, as for instance, arbitration cases, their first duty would have been (following the example of the Industrial Councils) to have formed District Councils, and instead of the National Council formulating a scale of salaries applying to the whole country, the matter would have been properly referred to the District Councils and their recommendations subsequently submitted to the National Council for confirmation.

Apparently the nominees of the I.M.E.A. to the Joint Board for this year have yet to be appointed, and it was a matter of very considerable surprise to the writer that no reference whatever was made to the appointment of these gentlemen at the recent Conference of the I.M.E.A.

As the matter stands at the present time it would appear there is likely to be anything but unanimity in accepting the recommendations of the Board by the various Authorities.—I am, &c.,

C. Nelson-Hefford,
City Electrical Engineer
and Manager.

Leeds, June 30.

VALVE AMPLIFIERS AND MEDICAL SCIENCE.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The applications to which the three-electrode vacuum tube has been put are legion. Nevertheless, there is one application which has received no attention in the press at least, although it is so obvious that others must have given the matter more than a mere thought. I refer to the use of low-frequency valve amplifiers in medical science. The extraordinary magnification of microphonic sounds by these devices makes it possible to examine those human functions which have audible manifestations in a manner which has hitherto been impossible.

During the last six months the writer has made some extremely interesting experiments in this direction. The heart, particularly, is capable of the most careful analysis by the use of a microphone stethoscope in conjunction with an amplifier. The faintest murmur of the heart becomes clearly audible. It would appear that early symptoms of irregularities of the heart's action could be detected long before they became sufficiently acute to be heard by means of the ordinary stethoscope. In the case of serious illness, it is conceivable that an attached microphone connected to amplifier near at hand would keep an attendant physician constantly informed of the action of the patient's heart. Another use of such an arrangement would be in the examination of diseases of the lungs.

Very few medical men are in touch with the development of valve amplifiers, and they would hardly look to radio science for something of utility in their profession. Nevertheless, there appears to be a field here for medical research which possibly might prove of great value.—I am, &c.,

London, July 5. John Scott-Taggart.

Electricians' New Demand.

The Trade Unions' side of the National Joint Industrial Council for the Electricity Supply Industry put forward a fresh demand for an advance of 6d. an hour on present rates to all workpeople over 18 and 3d. an hour for those under 18 years of age, and this has been referred to arbitration by the National Council.

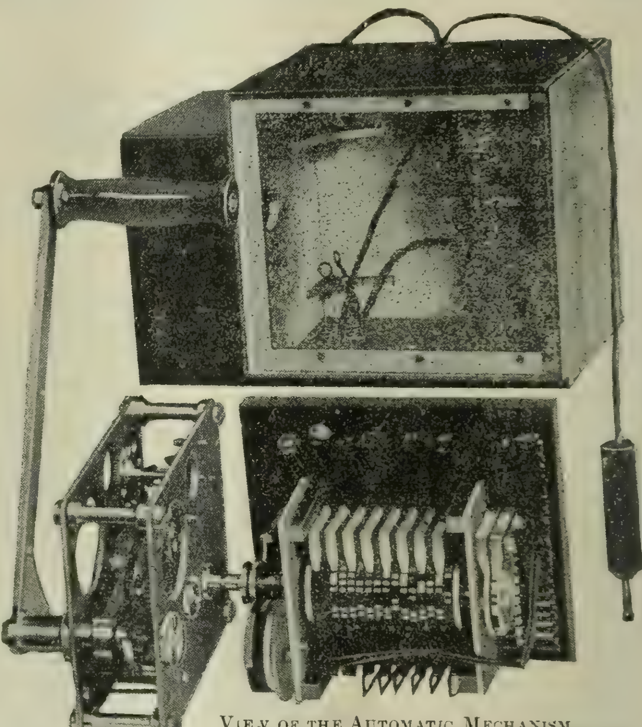
The employers' side of the Home Counties (No. 9 area) Council have passed a resolution strongly deprecating this step, as they think that in such matters action should not be taken without reference to the district councils. The Home Counties' Council has only just fixed rates which the employers' side claim cover all increases applicable or put forward to date, and take into account all grounds for any increases which occurred up to the time of formal approval by the National Council (June 21). Further, the majority of the undertakings in the area cannot even pay these consolidated rates until they have received relief from the Minister of Transport. Therefore, they think it is entirely out of the question even to consider any further increase, and they state that whatever may be the result of the arbitration (to which they refuse to become parties) the employers' side cannot receive same.

The secretary for the employers' side also informs us that official notice has been given to the Ministry of Labour that in view of the special circumstances of the No. 9 Area, the employers' side definitely refuse to become parties to the arbitration, and have asked the Ministry to make this clear in the terms of reference, and to embody in the award a notice that the award does not apply to the Home Counties undertakings.

The Atmospheric Nitrogen Company has started to erect at Solway near Syracuse, N.Y., the first unit of a plant for the FIXATION OF ATMOSPHERIC NITROGEN. According to the "Electrical World," power for the operation of the unit will be taken from the Niagara, Lockport & Ontario Power Company, and if the arrangement proves satisfactory the electrical load will probably be increased to 50 times the initial installation.

New Automatic Telegraph.

An interesting method for automatically transmitting wireless or ordinary telegraph signals is being introduced by the Automatic Telegraph Company, of London. We were given an opportunity of inspecting the apparatus and find that it is designed to take the place of the usual morse key in either wire or wireless telegraph circuits. The adjoining illustration gives some idea of the construction. The apparatus comprises a lever-operated clock mechanism, which drives a spindle carrying a long cylinder with a number of standard contacts and small interchangeable discs, having a group of contacts which are different for each disc. This mechanism is suitably mounted in aluminium boxes, and the front of these boxes is made up with a series of 60 jacks and a single plug. The clock mechanism is designed so that by moving down a lever it is wound, and drives the drum and disc contacts for a definite period; the lever returns to its starting position automatically after being depressed. The interchangeable disc referred to is provided with S.O.S. contacts in each disc, and with contacts which signal a different call letter or number for each machine. No skill is required to operate the apparatus. The plug is inserted, and the lever pushed down to its extreme limit. The apparatus then sends a particular signal corresponding to that on the name plate opposite the jack; the signal is, however, prefaced by the call letter or number of the particular instrument. The designation of each of the jacks can be anything desired without alteration to the apparatus. It is only necessary that the receiving station has a corresponding copy. We understand that the apparatus has been successfully tested between aircraft in the air and the ground, and also between ships at sea and shore stations. It appears to have the merit of dispensing with the need for a skilled operator for such vessels as trawlers, which would, however, find it of considerable commercial value in being able to transmit certain messages to the shore with respect to the "catch." In the case of aircraft, the pilot need have no knowledge of wireless; he can send a message simply by pressing one lever, a fact of great importance in the event of a forced landing. The fact that the sending is mechanical means that the signals are always quite regular, and not dependent on the human element.



View of the Automatic Mechanism.

Business Propaganda and Advertising

"To plan an advertising scheme is no light undertaking, and to plan it without a sound knowledge of the prospective advertiser's facilities is sheer foolishness." In other words, though it is important in these modern days to buy advertising space generously and judiciously, it is equally important to consider carefully how the space can best be filled when it is bought. In a pamphlet which bears the title of this notice, and from which our opening sentence is taken, Mr. A. J. Greenly, managing director of Greenly's, Ltd., and well-known to Batti-Wallahs as a purveyor of good things, shows how this may be done with satisfactory results to the advertiser. He points out that by propaganda the market can not only be exploited but created, and how advertising helps to do both these things. And as example is better than precept, the pamphlet is illustrated by examples of his firm's designs for these purposes. They make a goodly show. Some valuable hints on the advertising campaign, the effective use of space are also given, and, finally, getting the most out of the trade paper is dealt with. We could say something about that ourselves.

The I.M.E.A.—Illustrated.

As the Egyptologist is aware, one of the earliest methods of recording impressions by human beings was by means of pictures. If certain signs are to be believed we are once again only progressing in a circle, and the time may shortly arrive when the relative amount of text and illustrations appearing in our columns will be very different from what it is now. There is this to be said for the picture paper, it leaves something, often a great deal, to the imagination. It makes an instant if sometimes misguided appeal to the impressions. It does so quickly and accurately what the text only does at length and with trouble. This sounds rather like sour grapes, and indeed it is not a little due to the photographs of the scenes at the recent I.M.E.A. Convention, which we publish herewith. These were taken by Mr. C. H. Wordingham, C.B.E., and are reproduced by his kind permission. They indicate in so lifelike a manner the real essentials of the gathering that the lengthy and painstaking account of the proceedings which we gave last week begins to seem a little unnecessary. However, we may feel more optimistic shortly.

1. "Electric Vehicles." 2. "E.D.A." 3. The Indefatigable in Work and Play (the Assistant Secretary). 4. Gentleman in the Foreground: "Shall I have a Drink before we Start?" 5. At Bolton Abbey.

The Telephone Service.

Public protests continue to be made against the inefficient telephone service, trunk line delays, &c., but with little result. In reply to a deputation from the Hull Chamber of Commerce, the Postmaster-General admitted that the service was unsatisfactory and would continue so until the cables were laid underground. Six million pounds were being expended this year on underground cables, but owing to the shortage of material and labour troubles the system could not be completed for about 18 months.

The Select Committee of the House of Commons, which was recently appointed to inquire into the service, the charges made, &c., started to hear evidence on Monday. Sir E. F. Coates presided and the first witness was Sir Evelyn Murray, Secretary to the Post Office, who stated that after the telephones were taken the charge on the undertaking for salaries, &c., was over five millions for 1913-14, but in 1920-21 the figure was 13 millions. The revenue had increased from over 6 millions to £9,730,000, made up partly by normal increase in the use of telephones, and partly through the increased charges imposed in 1915-16. The problem was to ascertain how the £3,980,000 deficit was to be met. About 75 per cent. of the huge increased annual charges was represented by bonuses granted to the staff. If they were to give a better service they would have to provide for a larger staff according to development. There were now the flat rate, the measured service rate, the message rate and others. It was proposed to abolish those and have only one system of charging.

The Chairman said that if this recommendation were adopted it would revolutionise the use of the telephone. Apparently users on the flat rate might be paying £20 a year, and be having, according to the new proposals, £100 worth of telephone use.

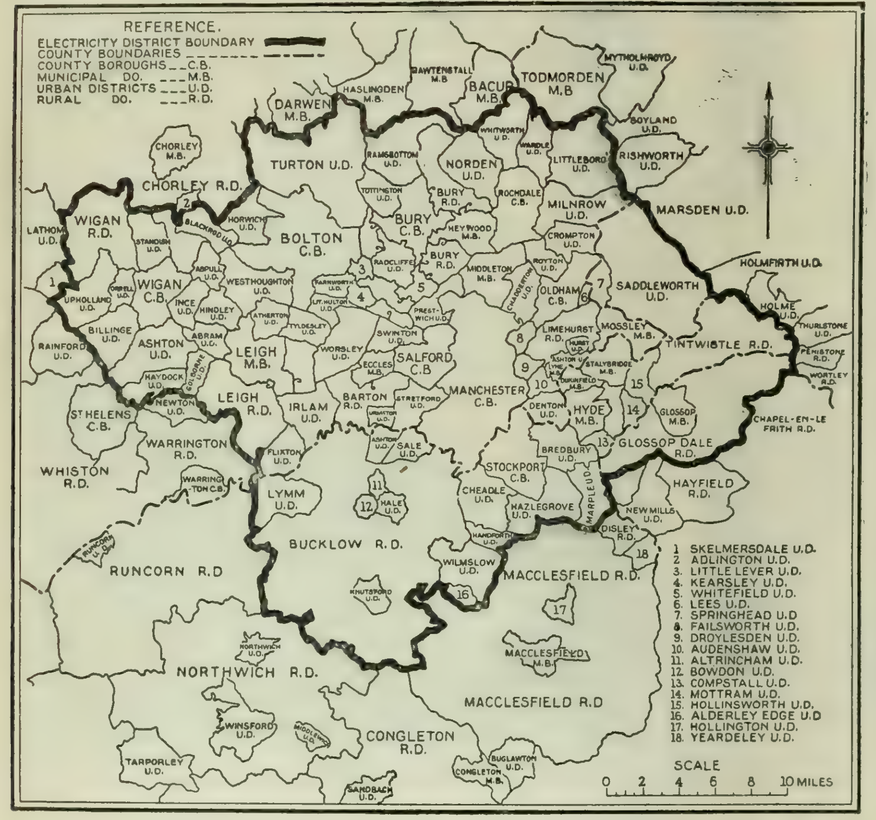
Answering questions regarding the metropolitan area, Sir Evelyn Murray said they proposed to establish an inner circle, within which the calls would only be 1½d., and different charges according to distance. Calls were registered automatically by the operator pressing a button. There was no other check. Dealing with the call offices, Sir Evelyn Murray said it was found that the present charge of 3d. in London and 2d. in the country was not remunerative, but there were so many difficulties in increasing that amount sufficiently to put the system on a paying basis that they recommended the continuance of the present system.

S.E. Lancashire Electricity Area.

The accompanying map shows the area of the proposed South-East Lancashire and North Cheshire electricity district.

The Electricity Commissioners have provisionally determined that the South-East Lancashire Electricity Area shall be as follows:—

County of Lancaster: City and county borough of Manchester; the county boroughs of Bolton, Bury, Oldham, Rochdale, Salford and Wigan; the municipal boroughs of Ashton-under-Lyne, Eccles, Heywood, Leigh, Middleton and Mossley; the urban districts of Abram, Ashton-in-Makerfield, Aspull, Atherton, Audenshaw, Billinge, Blackrod, Chadderton, Crompton, Denton, Droylsden, Failsworth, Farnworth, Golborne, Haydock, Hindley, Horwich, Hurst, Ince-in-Makerfield, Irlam, Kearsley, Lees, Littleborough, Little Hulton, Little Lever, Milnrow, Norden, Orrell, Prestwich, Radcliffe, Ramsbottom, Royton, Standish-with-Langtree, Stretford, Swinton and Pendlebury, Tottington, Turton, Tyldesley-with-Shakerley, Upholland, Urmston, Wardle, Westhoughton, Whitefield, Whitworth and Worsley; and the rural districts of Barton-upon-Irwell, Bury, Leigh, Limehurst and Wigan; and the township of Rixton-with-Glazebrook in the rural district of Warrington.



Map of the S.E. Lancashire Electricity District.

County of Chester: The county of borough of Stockport; the municipal boroughs of Dukinfield, Hyde and Stalybridge; the urban districts of Alderley Edge, Altrincham, Ashton-upon-Mersey, Bowdon, Bredbury and Romiley, Cheadle and Gatley, Hale, Handforth, Hazel Grove and Bramhall, Hollingworth, Knutsford, Lymm, Marple, Mottram-in-Longendale, Sale and Wilmslow; and the rural districts of Bucklow and Tintwistle.

County of Derby: The municipal borough of Glossop and rural district of Glossop Dale.

W. Riding of York: The urban districts of Saddleworth and Springhead.

Objections or representations on account of the inclusion of any area in, or the exclusion of any area from, the district must be made in writing and addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W.1, by Oct. 31 next. The Commissioners intend to hold a local inquiry into the matter, and any authorised undertakers, County Council, local authority, railway company, using or proposing to use electricity for traction, &c., may submit in writing a scheme for effecting improvement in the organisation for the supply of electricity in the area.

The Commonwealth Edison Company, Chicago, which has more than 415,000 customers and is probably the largest electric supply company in the world, recently made an issue of $5,000,000 seven per cent. collateral gold notes. Last year's operating revenue was over $30,000,000 and the expenses $19,500,000. The normal annual increase is between 30,000 and 40,000 consumers.

Parliamentary Intelligence.

L.C.C. OMNIBUS POWERS.

The London County Council have been extremely unfortunate with their legislative proposals for the improvement of their tramway service. In the beginning of the year they prepared a comprehensive scheme of tramway extensions which several of the Borough Councils opposed, and as the House of Commons decided in March not to waive compliance with their Standing Orders, the tramway portions of their Bill had to be dropped. At the time we expressed regret at this decision, because, though many of the projected lines were undesirable in the public interest, there were some useful extensions which might very well have been authorised.

The Council proceeded with the remainder of the Bill, which sought powers to link up the L.C.C. tramways by means of omnibuses, and also to run omnibus services outside the area of the county in connection with their housing schemes. Many local authorities objected to the London County Council encroaching on their areas, but the chief opponents were the London General Omnibus Company.

Much evidence was taken by the Committee, and the hearing lasted seven days. Eventually the chairman (Sir Wm. Howell Davies), in giving the decision of the Committee, said that the opposition of the local authorities in the metropolitan police district outside the Administrative County of London succeeded. So far as the linking up of their trams north and south was concerned, the Committee would grant powers within a circumscribed area, bounded by London Bridge on the east and Westminster Bridge on the west, and a new clause would have to be brought up clearly defining the limited powers. The Committee recognised that the County Council, as the tramway authority, had discharged a great public work with considerable satisfaction to the travelling public, and had done so without any assistance from the State. Had it not been for that fact the Committee would not have granted even the limited powers suggested. They thought that the L.C.C. tramway system, which had to stop at a great many termini within the central part of London, was placed at a considerable disadvantage compared with the London General Omnibus Company. The powers would have to be exercised in the first place with the approval of the Ministry of Transport, and the County Council would have to satisfy that Ministry that the routes which they were proposing to operate were satisfactory routes, and they would also have to satisfy the metropolitan police authorities. The services must be strictly linking-up services, and not general roving services.

This decision is very unsatisfactory and quite illogical. The local authorities, who successfully opposed the London County Council, cannot veto any new services of the London General Omnibus Company. We think the time has come when this local right of veto should either be abolished or greatly modified in the public interest.

LONDON ELECTRIC RAILWAY COMPANIES BILL.

This Bill, which authorises the London Electric Railway Companies to increase their statutory maximum fares for passengers, was read a third time in the House of Commons on Monday.

Mr. J. D. Gilbert moved that the Bill be recommitted, on the ground that the Committee to which it was referred after second reading had not reported on the financial condition and profits of the combined railways in relation to the proposed increases in fares. What London members strongly objected to was the management of the finances of the "combine," and the use of part of their profits, whereby they subsidised a non-statutory undertaking, the General Omnibus Company, which was included in the combine. The revised fares would impose a heavy additional charge on the travelling community. It was proposed that first-class passengers should pay 3d. a mile, with a minimum fare of 4d.; and that third-class passengers should pay 1½d. a mile, with a minimum of 2d. The Bill abolished workmen's fares. It set up a double journey for a single fare for workmen, but it did not say whether that was for all time or only a temporary measure. They ought to have had a report from the Committee on the questions of capital, the rate of interest to which it was suggested shareholders were entitled, and the pooling of profits.

Mr. Grant, chairman of the Committee by whom the Bill was considered, said that the members of that Committee were unanimous in their findings, and recommittal was unnecessary. The Committee were satisfied that the increased charges authorised by the Bill were not more than were necessary to provide from time to time for working expenses, renewals and a reasonable return on capital.

After discussion, the motion was rejected and the Bill read a third time.

On July 2 the Royal Assent to the following Acts of Parliament was read: North Metropolitan Electric Power Supply Act, Mersey Railway Act, Tyneside Tramways and Tramroads Act.

Commercial Topics.

Anglo-German Debts.

The Controller of the British Clearing Office is advised that claims may not have been registered in respect of debts secured by liens or charges in favour of British creditors on securities belonging to German nationals which have been sold or otherwise disposed of by the Custodian of Enemy Property. All claims to be creditors against German nationals should be proved through the Clearing Office before the 12th inst.

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Another Engineering Amalgamation.

Messrs. Guest, Keen & Nettlefolds, Ltd., have made arrangements for acquiring a controlling interest in the well-known engineering firm of Messrs. Bayliss, Jones and Bayliss, of Wolverhampton. Earlier in the year the former company also acquired controlling interests in John Lysaght, Ltd., and in the Melrose Collieries. It is understood that Guest, Keen & Nettlefolds intend to erect on the Ivor site important ranges of coke ovens and also an electric power station for the works and collieries.

* * * *

Electric Heating and Cooking Progress.

A good illustration of the advance in electric heating and the domestic applications of electricity is given in the annual report of the Leeds Corporation Electricity Department. The receipts from the sales of current for heating increased to £12,000 from £6,316 in 1919, the consumers to 2,140 from 1,686, the capacity of the radiators installed to 5,077 kw. from 3,714 kw., and the output to 1,705,666 units from 1,177,527. This progress would have been much greater if it had not been for the fact that many applications for heating supplies had to be refused owing to the fully-loaded state of the mains in certain districts. An increasing number of residential consumers are exercising the option to take supplies of energy for all purposes at the flat rate of a halfpenny per unit, plus a fixed annual charge based on the rateable value.

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Trade Marks.

The important recommendations made in the report of the Merchandise Marks Committee deserve careful consideration by manufacturers and exporters. Inquiry has been made into the need for indications of origin, the utility of collective or national trade marks and the necessity of international action to prevent the use of false marks, &c.

The committee are of opinion that, while they cannot recommend that all imported goods should bear an indication of the country of origin, the special marking of imported goods in certain trades would be useful, especially where British goods are deliberately imitated. They therefore recommend that in such cases, when the advisability of such a course has been established after an official inquiry, the Board of Trade should have powers to order indications of origin. This may, however, lead to undesirable results and to the bureaucratic control of trade.

The existing Act is mainly concerned with the prevention of false or misleading marking, and a false indication, in order to come within the Act, must be in writing. Sections 2, 3 and 5 of the existing Act should, therefore, be amended to include in the broadest possible manner all indications, descriptions, or statements, oral, documentary, or other, whether physically attached to goods or not, including statements in advertisements or catalogues and false indications given by trade names or titles of firms or companies, which are reasonably calculated to lead a purchaser to a false belief as to the origin of the goods. They also recommend that a list should be authoritatively settled of British national emblems the use of which should be forbidden on foreign goods unless specifically authorised or with an adequate qualification. They also suggest that it would facilitate the prevention of false marking if it were made an offence to attempt to do any of the things such as forging a trade mark, and applying a false trade description to goods.

Dealing with the detection of and prosecution for offences against the Act, it is pointed out that the Board of Trade, who are the prosecuting authority under the Merchandise Marks Act, 1891, have no staff of inspectors or detectives, and rely for information as to breaches of the Act upon particulars furnished to them by trade associations and others. On the other hand, the Department of Agriculture and Technical Instruction for Ireland, whose powers to prosecute are given by the Merchandise Marks (Ireland) Act, 1909, have employed a special staff of inspectors. There would be considerable difficulty in setting up machinery under the direct control of central departments in Great Britain, and they recommend that local authorities should be authorised to prosecute.

National Marks and International Action.

Referring to the question of a National or Empire trade mark, the committee state that, in the absence of agreement among the bulk of the traders concerned, there are grave objections to the institution of such a mark, particularly one which is to be under the control and administration of a private association.

The Committee recommend that where a country fails to carry out its obligations under a Convention and representations to the foreign Government concerned have proved ineffectual, the matter might be referred to the League of Nations or to the Permanent Court of International Justice to be set up under the Covenant of the League. International Conventions should provide for any amendments of national laws that may be necessary to enable suitable legal action to be taken. The action should be undertaken at the expense of the State where the abuse aimed at affects interests of a national or far-reaching character, and not merely those of individual traders; but in cases where a particular trader's rights are alone affected the expense should be borne in whole or in part by such trader. If, in addition to the ordinary remedies, an international agreement could be arrived at for protecting the trades of certain towns, such as Sheffield, it might assist the maintenance of the reputation of towns connected with particular industries.

Electricity Supply.

Epsom Urban Council has applied for a loan of £4,000 for services and mains extensions.

Bury Corporation has applied for sanction to borrow £[illegible]5,000 for extensions at the electricity works.

Among the recent connections to the electric supply department of Manchester Corporation are the gas offices, which have been wired for electric lighting.

A supply of electricity is now available in Braintree, Essex, through the efforts of the East Anglian Electricity, Ltd. Current is taken from the generating station of Messrs. Lake & Elliott.

Todmorden Council has applied for sanction to borrow £42,000 for laying supply cables. Arrangements have been made for obtaining a bulk supply of electricity from the Yorkshire Electric Power Company.

Besides deciding to increase the price of electric current and of meter rents by 20 per cent. from July 1, Fleetwood Council has applied for an order to enable the Council to charge a flat rate of 8·5d. per unit, and for permission to borrow £5,000 for new mains and services and £2,000 for meters in connection with their housing proposals.

The total income of the West Bromwich electric supply department for the year ended March was £66,231, compared with £53,888 in 1918-19, an increase of £12,343. The expenditure was £48,876, an increase of £6,787, and the gross profit was £17,354, compared with £11,798. After paying interest and sinking fund instalments the net profit was £6,779.

The Electricity Commissioners will hold an inquiry at Nottingham on the 21st inst. into the applications of the Corporation for consent to erect a generating station on land adjoining Clifton Colliery, and of the Derbyshire & Nottinghamshire Electric Power Company to the erection of a generating station in the parish of Colwick in Basford Rural District.

In a report to Sunderland Electricity Committee, the engineer and general manager (Mr. A. S. Blackman) states that the 6,000 kw. turbo-generator installed in September has not been dependable and has seldom been out of the contractor's hands. The contract for the generator was placed in August, 1917, the Committee hoping to have it in use by the end of 1918, but it was not until September 28 last, that it was first put on load.

The report of the Leeds Corporation Electric Supply Department for the year ended March 31 shows the undertaking to be in a very flourishing condition. Though the consumption of current for power was less, owing to the reduction of hours and the virtual abolition of overtime, this factor was more than counterbalanced by the gain accruing from the more general use of electrical energy in factories and workshops. This tendency, involving an increase in the amount of plant required in proportion to the sales of electricity, will have a material effect in increasing the cost of the supply. The use of electricity for other than industrial purposes is increasing rapidly, and the removal of the restrictions upon lighting and heating resulted in a large increase of output. The tramways department also has purchased from the electricity works a considerably larger quantity of current than before, the increase being mainly due to the fact that during the Yorkshire miners' strike of last summer it was deemed advisable to run the tramway exclusively by energy supplied by the electricity department.

The total number of units sold for all purposes was 63,023,502, an increase of 636,069 (1·02 per cent.); the number of consumers was 19,782, an increase of 2,957 (17·57 per cent.); while the capacity of all the apparatus connected to the mains (exclusive of traction) was 80,938 kw., an increase of 9,095 kw. (12·66 per cent.). Although the number of power consumers increased by 15·36 per cent., and the capacity of the motors installed by 9·78 per cent., the sales of current for power actually diminished from 46,990,861 to 42,485,265 units, a reduction of 9·59 per cent. The number of electric light users increased from 12,136 to14,125 (16·39 per cent.) and the units sold for private lighting from 6,738,624 to 8,366,789 (24·17 per cent.). Street lighting sales increased from 158,680 to 2,349,833 units, but they are only a fraction of those before the war

The continual increase in the cost of materials and labour necessitated further increases in the price of current, the addition to the pre-war scale being now 80 per cent. These increases, combined with the slight increase in output and the greater proportion of current sold for lighting purposes, resulted in an increase of £141,542 (43·2 per cent.) in income. Against the increase in revenue there was an advance of £51,853 in working expenses, and slightly increased interest and redemption fund charges. Allowing for the reduction in war allowances and income tax, the net increase of expenditure was £47,991. Out of the profit for the year (£100,417, compared with £6,866 in 1919), a sum of £56,008 was contributed to the cost of permanent works, leaving the disposable profit at £44,409. Out of this surplus £4,650 has been transferred to the reserve fund, raising that fund to £25,000, the maximum authorised by the City Council, and the balance (£39,758) is available for the relief of rates.

The total works costs were 0·91d. (0·72d.), and the total expenditure was 1·62d. (against 1·26d.) per unit, the average price obtained being 1·79d. (1·26d.). The maximum load was 29,210 kw., against 23,130 kw. Two 6,000 kw. turbo-alternators were delivered during the year, raising the station capacity to 51,000 kw. A further extension of the works has been decided upon, involving additions to the buildings, and the purchase of boilers, turbo-alternators, switchgear, and other accessories, at an estimated cost of £450,000. A contract has been provisionally let for the supply of boilers, &c., and tenders have been invited for other plant, including a 12,000 kw. turbo-alternator. The total loans anctions amount to £2,024,215, and application has been made to the Electricity Commissioners for permission to borrow £612,000.

Electric Traction.

In the report of the Light Railways Commissoners for 1919 particulars are given of 15 new applications for orders to authorise light railways. The need of a uniform policy and of co-ordination in the provision of local transport by rail, road and water is again urged, and the Commissioners anticipate many advantages from the bringing of such means (including light railways) together under the control and the authority of the Minister of Transport. The advantages of the light railway for agricultural development and industrial expansion are pointed out.

The directors of the London & South-Western Railway Company intimate that they have been reluctantly compelled to postpone the electrification of the Cobham and Leatherhead lines to Guildford. This decision is said to be the result of various circumstances which have arisen during the last three or four months, including the abnormal increase in the cost of all material required in connection with the electrical equipment of the permanent way and rolling stock; the refusal of manufacturers to give firm quotations or to guarantee delivery within a reasonable period; and the impossibility of raising fresh capital while the present uncertainty as to the future position of the railways continues.

L.C.C. Tramways.

A report of the Highways Committee on the annual estimates of the tramways undertaking for 1920-21 was presented to the London County Council on Tuesday. The estimated receipts were £4,553,940, and the total working expenses £4,661,890, leaving a deficit of £107,950. Debt charges (£328,222 for repayment of capital and £263,180 for interest on capital expenditure) are £591,402, and income-tax and sundry items £50,090, making a total deficiency of £749,442. The estimates are based on one-half the cost of trackwork renewals being charged to capital account. Assuming that the Treasury consent is obtained to the debt, but not to the renewal proposals, the estimates will show a deficiency of £929,512, and assuming the Treasury consent is not obtained to either proposal, the estimated deficiency will be £1,038,512. The salaries and wages have increased from £1,102,220 from 1913-14 to £3,254,162 for 1920-21. In order to overtake arrears in repairs of rolling stock it will be necessary for several years to incur an annual expenditure of £400,000. The Committee are considering what steps should be taken to deal with the financial situation of the tramways and will report at any early date.

The special committee of inquiry on tramways, in an interim report, pointed out that the increase in wages is estimated to cost £212,000 in the current year. If the deficiency should amount to £1,038,512 it will be equivalent to a special county rate of 6¼d. in the pound. The committee state that it is clearly inequitable that one form of traction only should be called upon to contribute directly to road maintenance, particularly where, as in the case of a tramway, no direct wear and tear to the ordinary road surface is occasioned. No relief from this liability can be obtained without legislation and prospect of relief this year is very remote. The Council is advised that a grant should be procured if possible out of the Road Improvement Fund. As regards the question of road transit undertakings being charged with widenings, the committee think that other competing forms of traffic should be required to share in the charges, according to the benefit they derive from street widenings. The committee think there is unnecessary duplication of travelling facilities, and about 500 omnibuses could be withdrawn from tramway routes. It is pointed out that the Government had assisted competitors. The L.G.O.C. in 1919, contributing nothing to the pool, had drawn out £582,847. The committee proposes a systematic increase in fares. The revised fare would be approximately 1d. for 1·2 mile, instead of the present average of 1·5 mile.

The reports were discussed at considerable length. Dr. Scott Lidgett said the subject was most serious, especially as the housing scheme would need swift and more economical facilities to be provided, so that people could reach quickly the more salubrious parts of the suburbs. The present position of the tramway system was abnormal, and was due in part to the disastrous and subsidised competition of the omnibuses. Before any decision was taken as to the exact way of dealing with the problem, recourse should be had to the Ministry of Transport to clear up the situation of the London traffic problem.

Mr. R. C. Norman said the subsidies were wrong and dangerous, whether they came from the Imperial Exchequer or the Council's rates. He believed the tramways could be made self-supporting, but he wished the Highways Committee to take forthwith any steps required to prevent the undertaking becoming a charge on the rates.

Mr. G. H. Hume said the tramways had not failed to pay through any lack of effort on the part of those who managed them. It was the duty of the Council to go to the Ministry of Transport and say they wanted them to do something to remove restrictions on the development of London traffic.

Mr. H. H. Gordon said the crux of the whole matter lay in the need for co-ordination. They would never be able to keep the tramways off the rates until they eliminated needless competition. The true remedy to meet competition was not to say they would not go on the rates. but to have recourse to the rates in order to relieve the trams from that unfair competition. The policy of increasing fares 100 per cent. had only brought in an increase in revenue of 33 per cent.

Mr. W. J. Squires, chairman of the Committee, stated that if the tramways were to be made to pay the money must come out of the pockets of those who used them.

Ultimately the report was adopted, with the addition of an amendment to the effect that it be an instruction to the committee to take steps forthwith, and from time to time as might be required, to prevent the tramway undertaking from being a charge on the rates.

Institution Notes.

A special meeting of the Rontgen Society will take place on July 15, at 9 p.m., at University College, Gower-street, London, when an address will be delivered by Dr. W. D. Coolidge, of the General Electric Company's Research Laboratory, U.S.A. Members of medical and scientific societies are invited to attend.

In order to celebrate the 26th anniversary of the foundation of the Junior Institution of Engineers, a dinner was given on the 30th ult., Sir E. H. Tennyson d'Eyncourt, president of the Institution, in the chair. It was stated that the membership now exceeded 2,000. The president-elect is Lord Weir.

Among the bequests of the late Dr. Rudolf Messel were the following: £5,000 to the Royal Institution, £1,000 to the Chemical Society, his platinum crucible to the Society of Chemical Industry, and his electric telephone by Reis to the Institution of Electrical Engineers. The residue of the property is to be divided into five parts, four of which are to go to the Royal Society and one to the Society of Chemical Industry, the income to be expended in the furtherance of scientific research and other scientific objects.

At the meeting of the Midland Branch of the National Association of Colliery Managers on Saturday there was a discussion on Prof. McMillan's Paper on miners' safety lamps. Mr. Wm. Maurice, who presided, stated that mining experts realised the advantage of improved mine lighting in so far as it affected the incidence of nystagmus, but the less obvious advantages, such as increased productivity, reduction in the accident rate, the effect on the health of the workers, and so forth, had not yet been made the subject of special investigation. Touching upon flame lamps, Mr. Maurice stated that no one at this time of day could attempt, with any hope of success, to show that flame safety lamps were preferable to electric lamps. As, however, they constituted the only satisfactory means of testing for gas, they could not yet be entirely displaced, and until some new method of approach to that problem was worked out, the probability was that they would fail.

In the report of the past year's work of the North-Western Centre of the Institution of Electrical Engineers it is recorded that subcommittees were set up to deal with (1) Papers, (2) Constitution of Subcentres, and (3) Training of Power Supply Engineers. The membership of this centre numbers 984, an increase of 151 over the previous year.

The following officers have been elected to serve on the committee for the forthcoming session: *Chairman:* Mr. J. Frith; *Vice-Chairmen:* Messrs. W. Walker and A. S. Barnard; *Hon. Sec. and Treasurer:* Mr. A. U. Ellis; *Ordinary Members:* Messrs. B. Welbourn, H. A. Ratcliff and W J. H. Wood.

The Preston Sub-Centre of the North-Western Centre was inaugurated in June, 1919, the membership now being 129. The committee of this sub-centre consists of: *Chairman:* Mr. J. Conner; *Hon. Treasurer:* Mr. J. H. Tonge; and *Hon. Secretary:* J. F. Simpson; *Area Members:* Messrs. J. Gibbs, W. E. Highfield, C. Furness, A. W. Clegg, J. E. Starkie, P. P. Wheelwright, and Lieut.-Col. H. E. O'Brien.

The North-Western Students' Centre has also made great progress during the past session, a great many new members being enrolled.

The Annual Conversazione of the Institution of Electrical Engineers was held on Thursday, July 1, at the Natural History Museum, London, S.W. The guests, who numbered over 1,300, were received by the President and Mrs. Roger Smith and included the Right Hon. E. Shortt, K.C., M.P., Home Secretary, the Hon. Sir J. A. Cockburn, M.D., K.C.M.G., Sir G. K. Elphinstone, K.B.E., Col. Sir T. H. Holdich, R.E., K.C.M.G., Admiral of the Fleet Sir H. B. Jackson, R.N., G.C.B., K.C.V.O., Major-General Sir R. M. Ruck, K.B.E., C.M.G., Col. R. E. Crompton, C.B., Mr. W. M. Mordey, Sir John Snell, Mr. C. H. Wordingham, C.B.E. and Mr. P. F. Rowell (Secretary). A departure from the usual procedure was made in that the demonstration of wireless telegraphy and telephony given in the Shell Gallery was a departure from the usual procedure on these occasions, and was an indication that this was a gathering of a scientific society. In spite, however, of the fact that each demonstration was preceded by a short explanation it was obvious that a good many of those attending hardly realised what was happening. The usual musical programmes were provided by the string band of the Royal Engineers in the Central Hall and by the Allied String Quartette and other artistes in the Reptile Gallery.

The annual conversazione of the Institution of Civil Engineers was held at Great George-street on Tuesday evening last. In addition to the usual musical programmes the visitors were entertained by an inspection of an excellent collection of engineering models and scientific apparatus. Demonstrations were given of the new Marconi calling-up device, which, it will be remembered, enables the alarm signal sent out by a ship to be received by any other ships within range even though the wireless operators are not in actual attendance. The alarm is given by sending out a series of dots at the rate of 180 a minute, the impulses from which gradually build up the oscillations of a relaying device with a corresponding period. As the signals continue contact is made in the relay circuit and a bell begins to ring. The National Physical Laboratory had a large exhibit of measuring apparatus of various kinds, while the Royal Ordnance Factory at Woolwich also sent a number of measuring machines and gauges. Other exhibits were the Faraday-Palmer stress recorder and a model of Sir John Dewrance's adhesion pump in which the oil is sucked up by a spindle, having shallow spiral grooves cut into its surface, which rotates a close fit in an angular chamber.

Miscellaneous.

The employees of the Marconi Wireless Telegraph Company, Chelmsford, have formed a public utility society, with a view to erecting houses for themselves.

Owing to a storm, some overhead electric wires in Cheshire were knocked down, and a farmer lost four dairy cows through their coming into contact with a broken wire.

The Southport electricians who came out on strike last week owing to a dispute as to working conditions, have returned to work, the matters in dispute being the basis of negotiations.

The practice of allowing their workmen a smoking interval of 15 minutes each morning and afternoon without stoppage of work has proved so successful at the Preston works of Messrs. Dick, Kerr & Co., that the innovation is being extended.

M. Krassin, the envoy of the Russian Soviet Government, who is an electrical engineer, last week paid a visit to the Chelmsford Works of Messrs. Crompton & Company, Ltd., and was greatly interested in the modern up-to-date methods of the company.

At the premises of the Office Commercial Français Angleterre (French Commercial Intelligence Dept.), 153, Queen Victoria-street, E.C., there will be an Exhibition of French Manufactures and goods from the 15th to the 31st inst. The exhibits will include electro-medical and surgical apparatus, laboratory accessories, scientific instruments, &c.

We regret to record the death of Lord Downham of Fulham, which occurred at his London residence on Friday last. Deceased, who has held many prominent public appointments, including those of President of the Local Government Board and Financial Secretary to the Treasury, was chairman of the Westminster Electric Supply Corpn., and deputy chairman of the Central Electric Supply Company.

Unreasonable strikes continue to be the order of the day. Owing to the sudden stoppage of work by members of the Electrical Trades Union employed by Messrs. Cammell, Laird & Company, it is probable that the company's Penistone works will close down. The trouble arose over the fact that a member of the electrical staff declined to join the union, and, after vainly trying to get him to join up, the men struck work without giving proper notice.

A dispute over the alleged failure of the Port of London Authority to observe the recent award of the National Conciliation Board regarding wages and hours has arisen, and between 2,000 and 3,000 electricians and builders are on strike. Several hundred electrical workers ceased work to enforce the demand for payment of the district rate of 2s. 3d. an hour. The effect of the stoppage was to cut the supply of electric current from the docks.

The Department of Overseas Trade state that H.M. Trade Commissioner in Toronto (Mr. F. W. Field) has notified that a local firm, who use motors varying from ⅛ h.p. to 5 h.p. for pumping work, is desirous of receiving quotations with particulars of delivery from United Kingdom firms for electric motors of a high starting torque and other characteristics similar to the American "Wagner" and "Century" makes. Particulars from the Department, 35, Old Queen-street, S.W. 1.

The Western Electric Company announce that, owing to the rapid growth of their business at North Woolwich, they have found it necessary to acquire an additional building at 60 and 62, Finsbury-pavement, London, E.C. (Telephone Nos., London Wall 7608 and 7609). The export sales department have removed from Oswaldestre House, and the supply sales department from Norfolk House to the new address, and all sales business will be carried on from Finsbury-pavement in future, where they now have extensive show rooms. The registered offices of the company will continue at Norfolk House.

The 17th annual works outing of the employees of Simplex Conduits, Ltd., took place on the 26th ult., when 300 of the employees journeyed to Bewdley by special train. They were accompanied by most of the management staff, and by a number of the outside managers and representatives, the function being graced by a number of ladies. Sports were held in the morning, previous to a lunch presided over by Mr. L. M. Waterhouse, technical director of the company, who, in response to the toast of "The Firm," congratulated the Committee of the Simplex Social and Welfare Club on the excellent arrangements made for the day's enjoyment. A photograph was taken of the 36 members who had been with the company at the period of the first outing.

A Golf Competition was one of the features of the I.M.E.A. meeting. It was the second of the kind only, the first being held in June, 1914, at the Warmley course during the Birmingham Convention. This produced only a dozen competitors, whereas the Ilkley competition brought 31 (including two ladies) into the field. It might be worth while to arrange the next year's I.M.E.A. Convention programme with a golf competition of a more official kind, as so many are now interested in the game, and there are few business associations that do not have such a competition. Messrs. J. K. Brydges and W. G. Pickvance acted as the organising committee for the present game, and everything passed off smoothly. A silver cup was contributed anonymously, and an optional sweepstake added to the interest of the competition, which was played on the excellent links of the Ilkley Golf Club on either the Wednesday or Thursday afternoons of the Convention week. Mrs. J. K. Brydges presented the prizes to the following: W. A. Brown (Pirelli), 93—17=76, silver cup and first sweepstake prize; Mrs. W. B. Woodhouse, 119—36=83, and H. E. Midgley (English Electric), 91—8=83, between whom the second and third prizes were divided.

Tenders Invited and Accepted.

Manchester Tramways Committee require tenders by July 13 for copper tramway rail bonds. Specification from the General Manager, 55, Piccadilly, Manchester.

Darlington Corporation invite tenders for a 5,000 kw. Turbo-alternator and Surface Condensing Plant. Specifications from the Borough Electrical Engineer, and tenders to the Town Clerk by July 16.

The Victorian Railway Commissioners require tenders by July 28 for a three-phase crane motor for N. Fitzroy sub-station. Specifications from the Commissioners' Offices, Spencer-street, Melbourne.

Brentford guardians invite tenders for electric lighting installations in their offices, infirmary, &c. Tenders by noon, July 13, to the Clerk (Mr. F. E. Harmsworth), Union Offices, Isleworth, Middlesex.

Warrington Electricity and Tramways Committee require tenders for two 6,000-kw. turbo-alternators. Specifications from the Borough Electrical Engineer and tenders to Chairman of Committee by July 13.

Hull Electricity Committee invite tenders for supply and erection of an electrically-operated overhead travelling crane. Specifications from the City Treasurer and tenders to the Chairman of the Electricity Committee, Guildhall, Hull, by noon July 12.

The date for the receipt of tenders by the New Zealand Public Works Department for synchronous condensers, service transformers and three-unit motor generator in connection with the Lake Coleridge hydro-electric undertaking has been extended to July 30.

In connection with the Waikato electric power supply, tenders are required for the supply and delivery c.i.f. Auckland of 2,400 pin insulators suitable for a line operating at 66,000 volts. Tenders to the Secretary, Public Works Tenders Board, Wellington, by July 31.

Grimsby Corporation invite tenders (by August 12) for the supply and erection of two water tube boilers, with economisers, fans, chimney, &c., a 3,000 kw. high pressure turbo-alternator and condenser plant. Specifications from the borough electrical engineer, Lieut.-Col. W. A. Vignoles.

Swansea Corporation has placed an order with the British Thomson-Houston Company for a turbo-alternator and condensing plant at £45,660.

Bolton Electricity Committee has accepted the tender of Worthington-Simpson, Ltd., for condensing plant and that of Stewarts & Lloyds for steel piping.

Worthing Corporation has accepted the tender of the National Fuel Oil Company for the supply of 30 tons of fuel oil, at £11. 15s. per ton, for the electricity department.

Burnley Corporation has accepted the tender of the English Electric Company to carry out the plant extensions at the electricity works at £107,400, subject to the consent of the Electricity Commissioners.

Personal and Appointments.

Prof. Sir John Cadman, D.Sc., Mr. W. B. Hardy and Prof. Sydney Young, D.Sc., F.R.S., have been appointed to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

On the occasion of his leaving the Edinburgh Corporation Tramways, to take up his duties as general manager of the Dundee tramways, Mr Walter T. Young, superintendent of traffic, has been the recipient of a presentation from the officials and staff of the department.

Mr. A. C. Eborall, who has been for many years in charge of Messrs. Brown, Boveri & Company's interests in Great Britain, has recently been appointed an executive director of the Société anon. Brown, Boveri & Cie., of Baden.

The Italian Government have called in Prof. C. F. Scott, of Yale University, and Mr. L. P. Ferris, of the American Telephone & Telegraph Company, to advise them on railway inductive interference problems. It is proposed to extend the telephone network in the North of Italy and to connect Milan, Genoa, Turin and Rome, and big electric railway and hydro-electric schemes are also projected.

Catalogues, Price Lists, &c.

The British Insulated and Helsby Cables, Ltd., Prescot, Lancs., have issued a pamphlet giving particulars and prices of their Prescot fuse wires.

In an eight-page pamphlet, nicely printed in two colours and well illustrated, the General Electric Company, Ltd., give particulars and constructional details of the C.M.I. Magnetos. The Company has also issued a leaflet (K.2331) giving the revised catalogue prices of telephones, telephone switchboards and accessories appearing in Section K. of the 12th Edition of their catalogue.

The Edison Swan Electric Company, Ltd., of Ponders End, Middlesex, have issued a pamphlet which gives some particulars (with prices) of new sizes of low wattage drawn tungsten gas filled lamps. The company have carried out a series of experiments and tests on 40-watt lamps for a standard voltage of 100-130 and on 60-watt lamps for 200-260 volts, and they are now able to recommend them as highly satisfactory in regard to their general construction, reliability and life. In order to cope with the increasing demands of "Royal Ediswan" gas-filled lamps the company have laid down new plant at Ponders End, not only to produce in quantity, but to be able to supply the coming season's demands.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date of which the application was lodged at the Patent Office the former is given in brackets after the title.

1916 Specifications.

120,883 Bolliger. High-tension continuous current dynamo-electric machines. (22/10/17.)
142,141 Skipworth, Madge & Airey. Signalling in wireless telegraphy. (27/9/16. Complete accepted 31/5/17, patent sealed, 31/5/17.)

Two oscillatory circuits are joined across the arc. One of these consists of the aerial system, together with an inductance in series with it, and the other consists of a closed circuit containing an inductance and a condenser. Signals are then made by varying the relative efficiency of the two oscillatory circuits by means of suitable resistances and switches.

1918 Specifications.

142,521 Holslag. Alternating-current welding transformers. (14/1/18.)

1919 Specifications.

123,758 Pestarini. Multiplex telegraphs. (3/4/17.)
125.988 Lubeck. Regenerative braking system for electrically-driven vehicles, cranes and the like. (20/4/18.)
131,294 Nurmberger Metall & Lackierwaaren-Fabrik Vorm. Geb. Bing, Akt.-Ges. Pocket electric lamp. (1/5/15.)
132,500 Scintilla. Means of attaching the handle for varying the point of ignition to the interrupter in electric-ignition dynamos. (13/9/18.)
133,026 Collins. Electric furnaces. (21/9/18.)
133,292 Scintilla. Distributors for the high-voltage current of magneto-electric ignition machines. (1/10/18.)
133.961 Punga & Roos. Bar-windings for electric machines. (4/5/18.)
137,304 Soc. anon. des Etablissements L. Bleriot. Regulating-mechanism for electrical installations. (28/12/19.)
141,008 Herzmark. Method and apparatus allowing a magneto, in a state of rest, to be utilised for starting an explosion engine. (2/4/19.)
142,164 Gray. Electro-magnetic apparatus for use in steering moving vehicles. (19/8/19.)
142.175 Garde & Bennett. Electrical connections. (27/1/19.)
142,177 Turner. Construction of magneto-electric machines. (28/1/19.)
142,187 Hocking & Pearson. Dynamo-battery ignition system. (29/1/19.)
142,190 Attwater & Southern Transport Co. Electrical switches. (29/1/19.)
142,191 Norman & Southern Transport Co. Magnetic chucks and other magnetic holding-on devices. (29/1/19.)
142,199 Gill. Switch-contacts. (31/1/19.)
142,207 B.T.-H. Co. (G.E. Co.) Electron discharge devices. (7/2/19.)
142,211 Walker. Electric step-by-step mechanism. (11/2/19.)
142,214 Anninger. Apparatus for controlling the supply of limited quantities of electric energy. (14/2/19.)
142,215 Forsyth. Attachment to the trolley of overhead electric trams, trains and other electric tractors for facilitating the replacement of the trolley on the wire. (15/2/19.)
142,217 Wallis & Lloyd. Dowel for attaching electric bell covers, box lids and other similar purposes. (17/2/19.)
142,218 Marr. Sound-wave concentrators. (18/2/19.)
142,224 Crabtree. Electric switches. (20/2/19.)
142,225 Crabtree. Electric switches. (20/2/19.)
142,230 Warne. Coverings of conduits for laying electric cables. (27/2/19.)
142,232 Accles & Shelvoke & Steventon. Switches or apparatus for controlling electric batteries. (28/2/19.)
142,255 B.T.-H. Co. (G.E. Co.) Cooling of electric transformers and like apparatus. (31/3/19.)
142,260 Melano. (Borgarello.) Electric switches for electrically-driven compressing-apparatus. (3/4/19.)
142,265 Relay Automatic Telegraph Co., Bygrave & Inman. Telephone systems. (7/4/19.)
142,283 Marks. (Armour Fertiliser Works.) Polyphase electric-heating furnaces. (22/4/19.)
142,292 B.T.-H. Co. (G.E. Co.) Protective devices for electrical distribution systems. (29/4/19.)
142,295 B.T.-H. Co. (G.E. Co.) Insulators. (30/4/19.)

1920 Specifications.

138,072 Slaby. Battery arrangement for small electrically-driven vehicles. (22/1/19.)
142.430 Crabtree. Electric switches. (20/2/19. Divided application on 140,180.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

February 4.

3446 Aktielskabet Jydsk Elektro. Alternating current machines.
3462 Cusens & Paris. Microphones.
3465 Antinoro. Safety fuses.
3471 B. T.-H. Co. (G. E. Co.). Regulating systems for electric circuits.
3491 Deutsche Gasgluhlicht Akt. Ges. Evacuating bulbs of incandescent lamps. (18/5/18, Germany.)
3492 Enrich & Serrano. Current interrupters.
3498 Berry. Transformers.

February 5.

3517 Scammell & Abbott. Driving dynamos.
3524 Cowper-Coles. Electro-deposition of iron.
3555 Cooper. Apparatus for regulating charge and discharge of batteries.
3565 Watson. Electric generators for motor vehicles, &c.
3566 C. L. I. Mfg. Co. & Watson. Automatic switches.
3567 C. L. I. Mfg. Co. & Watson. Electro-generator for motor vehicle lighting, &c.
3568 J. Pintsch Akt. Ges. Electric gas lamp with glow discharge. (26/4/18, Germany.)
3569 J. Pintsch Akt. Ges. Electric gas lamp with glow discharge (18/10/18, Germany.)
3596 Telephone Mfg. Co. (Murray). Telephones.

February 6.

3605 Downs. Lampholders for incandescent lamps.
3606 Eccles. Telegraphic, &c., circuits for ionic tubes or valves.
3610 Campbell & Isherwood, & Berry & Evans. Electric torches or lamps.
3615 Boyd. Brush gear for dynamo electric machines.
3627 Barrows. Terminals for electric cables.
3650 Osborn. Incandescent lamps.
3665 Cannon. Electrical appliances.
3709 B. T.-H. Co. (G. E. Co.). Systems of regulation for electric circuits.
3722 Mellersh Jackson (Newland Patents, Ltd.). Dynamo-electric apparatus.

February 7.

3750 Automatic Telephone Mfg. Co. & Hudd. Railway signalling.
3756 Readett. Shaping steel, &c., articles by electric heating.
3776 Woods. Connecting electric light and power cables with junction boxes, &c.
3783 Dyer. Regulating devices for controlling electrical airheating apparatus.
3790 B. T.-H. Co. & J. Gray. Electron discharge devices.
3797 Bertschinger & Prinzing. Electric coin-freed automatic machines. (16/9/19. Switzerland.)
3803 Henley's Telegraph Works Co. & Nichols. Switch boxes, &c.
3810 Jenkins & Lucas. Electric cables.

Companies' Reports, &c.

British Electric Traction Company, Ltd.

The 24th ordinary general meeting of this company was held on Friday last, the chairman, Mr. Emile Garcke, M.I.E.E., presiding.

In moving the adoption of the report and accounts the chairman said: On previous occasions I have spoken of the restrictive legislative conditions under which the electrical industry in this country has developed. I am glad on this occasion to be able to say that during the past year Parliament has passed two Acts with a view to the amelioration of the adverse conditions. The Electricity Bill, as introduced by Government and passed by the House of Commons last year, was not a suitable prescription for a growing but impeded industry. As a result, however, of the strenuous opposition offered by the industry, aided to some extent by the commercial community, and more especially by the independent judgment of the House of Lords, the Bill was modified by the deletion of all the controversial clauses and was passed in the form which we suggested the Bill should take. As passed, the Act of 1919 has been correctly described as "The Great Charter of Electricity." The Act does not remove all our grievances, but it authorises the appointment of commissioners whose functions, we understand, are to examine the conditions and to legislate for the varying circumstances of particular cases consistently with general policy. That is the form of regulated freedom for which we petitioned. But freedom without security that it will be conserved is no better than a promissory note which it is feared will be dishonoured at maturity. The Government has given us this measure of freedom, but it has made the reservation that it will enact the objectionable clauses which the House of Lords deleted. It is to be hoped that the Government will announce at an early date its abandonment of this policy, for it is undoubtedly true that further uncertainty has a serious deterrent effect on enterprise in this important key industry.

The other Act—the Tramways (Temporary Increase of Charges) Act, 1920—is of importance to the electric tramway industry. It has been passed in consequence of the inability of tramway undertakings to charge such fares as would, having regard to the great increase in the cost of working, enable them to maintain financial equilibrium. It is right that I should bear testimony to the expeditious way in which the Ministry of Transport has dealt with the serious position which was produced in the tramway industry by the general economic conditions of the country. Economically we are all at present in a vicious circle, but the position of the public utility undertakings is unique. We pay more for materials, and we pay higher wages; but we alone were prevented from raising the price of our services. We are in the vicious circle, but we were not allowed to complete the circuit. We were overrun by increased costs, but we were not allowed to keep up with increased prices and charges. The Ministry of Transport has, however, come to our rescue, and I believe, is doing everything it can to enable these undertakings to hold their own. I have heard Labour leaders say that it does not matter if our tramways do not pay, because someone else will acquire the undertakings on a depreciated value which will enable them to be operated on a commercial basis through paying higher wages or, alternatively, that the State or the ratepayers must make good the losses. On the other hand, I have heard employers say that the only escape from the vicious circle is to stop enterprise, cause unemployment, and thus bring down wages. Both views are deplorable; they spell economic disaster and intellectual bankruptcy.

With regard to the results of our operations during the year, taking our public utility undertakings only, and excluding the London companies, the receipts were £2,647,000, an increase of £245,000; the expenses were £1,941,000, an increase of £339,000; the working balance was £706,000, or £94,000 less. We did a larger volume of work, but made less profit. The London undertakings produced even worse results. We have a total investment of over £700,000 in the London group of tramway, omnibus and electricity supply undertakings. During the past two years we have had a net revenue of only about £8,000 per annum on the portion of this capital represented by debentures and some preference stocks. In 1913 we received over £25,000 on about £75,000 smaller investment. In the case of our provincial undertakings the operating profits have increased since 1913. If the London companies had done approximately as well, the revenue account of the Company would be at least £20,000 per annum better than it is. The tramway and omnibus companies of the metropolis have increased their traffic receipts between 1914 and 1919, but their expenses have increased in a much larger ratio and at the beginning of this year they were not earning sufficient to meet their actual expenses. The Ministry of Transport has under the new Act authorised the Metropolitan and the London United Tramway Companies to charge increased fares, but the employees have at the same time obtained a further increase of wages.

Having given a brief analysis of the accounts, the chairman stated that the total revenue was £246,000, compared with £250,000 in 1918. The directors proposed to pay a dividend of 4 per cent. on the ordinary stock, against 3 per cent. in the preceding year, carrying forward £150,000. The net average yield of all their investments was 5·28 per cent., compared with 5·08 per cent. in 1918. They had £230,000 cash, and £204,000 War stock and bonds, besides other assets exceeding £4,000,000, and their ascertained liabilities (apart from debenture stock) was only £156,000, so that they were in a strong financial position. The company had initiated many important services of public utility and necessity, and had built up an exceptional organisation for the promotion, development and operation of such enterprises. Tramway and electric lighting investments were sound propositions, but the political environment of those industries the increasing labour troubles, and the difficulties of making adequate charges to cover the costs of the services were discouraging to new adventures. They had come to the conclusion, therefore, that it would be more profitable to the stockholders in the company to extend the sphere of their operations into other departments of enterprise and to spread their risks still further by holding a smaller amount in each undertaking. In pursuance of that policy they had acquired an interest in a company formed in association with Sir Oswald Stoll to produce kinematograph pictures, an enterprise which was consistent with the technical work for which they were organised. Furthermore, with a view to adding financial strength to the board, they had invited Mr. J. S. Austen to join the board. The gradual realisation by sales to local authorities of some of their undertakings, as the dates of purchase approached and the reinvestment of the capital thus realised, would afford them scope for profitable financial operations in various industrial spheres. In conclusion, the chairman announced that after 25 years of service with the company he was about to retire from the chairmanship, in which he would be succeeded by Mr. Austen. He would, however, be willing to remain a member of the board and to continue to act as President of the British Electrical Federation.

The directors of HADFIELDS, LTD., have declared an interim dividend of 6d. per share on the ordinary shares.

Mr. F. Dudley Docker has resigned the chairmanship of the METROPOLITAN WAGON, CARRIAGE & FINANCE COMPANY, and Sir Ernest Hiley, deputy-chairman, succeeds him.

The directors of the ANGLO-AMERICAN TELEGRAPH COMPANY, LTD., announce an interim dividend for the quarter ended June 30 of 15s. per cent. on the ordinary and £1. 10s. per cent. on the preferred stock.

The directors of the LIMA LIGHT, POWER & TRAMWAYS COMPANY have declared a dividend of 2 per cent., payable as to 1 per cent. in cash and 1 per cent. in ordinary shares, against coupon No. 25, in London, by Grace Bros. & Company, 147, Leadenhall-street, E.C.

The net revenue account of the IMPERIAL TRAMWAYS COMPANY for 1919 shows an available balance of £24,415, and after paying interest on debenture stock and the dividend on the preference capital, a dividend of 4 per cent. on the ordinary capital was declared, carrying forward £965.

DURELCO, LTD., which was recently formed to acquire the share capital of Duram, Ltd., Metal Manufacturers, Ltd., and Cryselco, Ltd., and to extend the manufacturing facilities of those companies, is making an issue of 112,000 shares of £1 each at par, in order to provide additional working capital.

The following were STRUCK OFF THE REGISTER OF JOINT STOCK COMPANIES on July 6: Alexandra Electrical and Engineering Works, Blasberg Engineering Company, Cathodes, Fusion-Welded Metals, Munster Electric Lighting Company, Phœnix Armouring and Cable Company, Strong Light Alloys, William Taylor (Electric Lamp) Company.

Sir H. Mackinder, M.P., who presided over the annual general meeting of the ELECTRO-BLEACH and BY-PRODUCTS, LTD., last week, stated that the exchange of shares with Messrs. Brunner, Mond & Co., had been carried through, and that the owners of only 125 out of the 400,000 issued shares of the Company had refused the offer. He was convinced that the success of the Company was not due to the peculiar circumstances of the war, and he was confident that it would have been just as prosperous had there been no war.

The net profit of EDMUNDSON'S ELECTRICITY CORPN., LTD., for the year ended March 31 (after providing for income tax, mortgage and note interest and debenture stock charges) was £8,099, compared with £13,638 for the previous year. With balance £6,765. 7s. 8d. brought forward, the total profit available is £14,864. 13s. 7d. Of this amount the directors recommend that £4,775 be applied in writing off the discount and issue expenses of the £75,000 6½ per cent. three-year notes, and that the balance of £10,089. 13s. 7d. be carried forward. Owing to the necessity under the present conditions of conserving the company's financial resources, the directors regret that they are unable to recommend payment of the cumulative preference share dividend. To provide for immediate financial requirements the directors have been reluctantly compelled to issue £75,000 6½ per cent. three-year notes, secured on £100,000 5 per cent. prior lien debenture stock. The various undertakings have suffered severely from their inability to adjust prices sufficiently to meet the constantly increasing costs of supply. In the hope of overcoming this difficulty and enabling the company to earn a reasonable return on its capital, the directors promoted a Bill, which was, however, rejected by the committee to which it was referred. It has, however, served to bring home to the authorities the urgent need for relief, and the Electricity Commissioners and the Ministry of Transport are considering by what means relief can be most readily afforded. The total load connected of the 20 subsidiary undertakings of the company was 122,233 kw. at the end of 1919, compared with 112,191 kw. in 1918.

Presiding over the annual meeting of the ANGLO-ARGENTINE TRAMWAYS COMPANY, LTD., last week the chairman (Sir Geo. Touche, Bart.) referred to the changes in the directorate and to the abnormal conditions which had affected the financial results of the year's operations. They had carried a record number (370,734,985) of passengers, an increase of 6·14 per cent. The company's system consisted of 395½ miles of single track (compared with a route-mileage of 348 in the London metropolitan area), of which 8½ miles of single track were underground. Last year they carried 937,383 passengers per mile of route, and the average fare paid was 2·01d. per passenger, seven passengers being carried per mile run. Owing to the increasing costs of all materials and the heavier wages bill, operating expenses reached the high level of 78 per cent. of the gross receipts. The total expenditure was £2,573,742, or 8·35 per cent. over 1918. There was a decrease of £24,934 in the cost of electric current. In 1918 coal cost nearly £10 a ton, compared with 30s. in pre-war days. On maintenance, £276,882 had been spent, principally on rolling stock, against £243,408 in 1918. There were now in service 1,684 motor and 869 trailer cars. Owing to the delays and difficulties in obtaining deliveries of new rolling stock from Europe, the manager was now constructing cars in their own workshops from native woods. During the first six months of 1920, however, they had been able to ship 26 subway cars, and these would be put into service on arrival. The holders of the first preference shares had not received any dividend since June 30, 1917, the arrears being £440,000 gross. The directors recommended the payment of a dividend on those shares in satisfaction of the arrears to June 30, 1918, absorbing £123,200. On the 2nd preference shares no dividend had been paid since Dec. 31, 1915 (the arrears amounting to £550,000).

Sir John Denison-Pender, G.B.E., K.C.M.G., presided over the 47th ordinary general meeting of the GLOBE TELEGRAPH & TRUST COMPANY, LTD., last week, and in moving the adoption of the report he said that the total receipts for the year ended May 31 last, after deducting working expenses, amounted to £263,950, or an increase of £36,527, and with the balance brought forward the total of £265,579 was a record figure. The balance available for distribution was £258,579. The directors recommended a final dividend of 3s. per share on the preference shares, making 6 per cent. (less tax) for the year, and of 14s. on the ordinary shares, making a total dividend on those shares of 10 per cent., tax free. The three great telegraph companies, the Eastern, the Eastern Extension and the Western had increased the dividends on their ordinary stocks and shares from 8 per cent. to 10 per cent. per annum, and, as the Globe Company's holdings in those companies were very large, they were therefore able to increase the dividend on their ordinary shares. During the year the Eastern, the Eastern Extension and the Western Companies issued new capital, which they offered at par to their existing stock and shareholders, and the proportion of new shares offered to the Globe Company represented nearly £700,000. The profit on the sale of their holding in the Central & South American Telegraph Company was more than £115,000. As the three great companies in which the Globe Company was interested had now announced their intention of paying their dividends in future by equal quarterly instalments, that policy might enable the board to equalise more nearly than had hitherto been possible the quarterly dividends on the ordinary shares of the company. When the present transitional period was past, and the cable companies were paying their full year's dividends on the new shares, the dividends the Globe Company would receive on the new shares allotted to them would amount to a little over £70,000, while the dividends the Globe Company were paying on the new shares would only cost them a little over £60,000 per annum, so that, so far as they could humanly foresee, the prospects of the company were exceedingly good.

The directors' report of the GENERAL ELECTRIC COMPANY, LTD., for the year ended March 31 states that the net profit was £630,143, and with £141,503 brought forward the total was £771,646. After deducting debenture stock interest (£8,000), depreciation (£85,329), grants to dependants of men on active service and contribution to pension fund (£6,766), the dividend at rate of 6½ per cent. per annum on the "A" preference shares for the year (£107,626) and the amount transferred to reserve (£150,000), the available balance is £413,923. The directors recommend payment of a dividend at the rate of 10 per cent. per annum (tax free) on the ordinary share capital for the year (£122,500), and the appropriation of £40,000 as a further grant to superannuation trust fund, leaving to be carried forward (subject to excess profits duty) £251,423.

In the opinion of the directors, the results are most satisfactory, especially as they have been obtained during a year of reconstruction. A good deal of development work was carried out during the year, and a considerable proportion of the capital expended is not yet productive, mainly on account of the slow progress of essential building operations. The latter include erection of large telephone and ebonite works at Coventry, extension of engineering shops and new buildings for switchgear works at Witton, new administration buildings and club buildings at Witton, extensions to the Lemington Glass works, Osram lamp works, and to the turbo works at Erith and the completion of the company's building in Kingsway. The last is becoming daily the more necessary, as the company, in consequence of its growth, is at present compelled to carry on its administration in London in 28 different buildings. The company's works are fully employed, and, to judge by orders in hand, they are likely to remain so throughout the coming financial year. Independently of its factories, the company has now established in the United Kingdom 31 sales branches and depots; the overseas branches and depots number 15. The employees exceed 15,000, but a considerable addition is anticipated as soon as the works in process of building are completed. The pension scheme came into effect on January 1 last, and has met with a gratifying response from the employees. The annual cost of the scheme to the company will approximate £20,000. The directors propose to allocate a further sum of £40,000 to the trust fund, which was created in 1918 for the superannuation, pensioning off and benefit of the long service employees of the company. Almost all the company's allied and subsidiary enterprises continue to be satisfactory, the notable exceptions being some small supply companies, such as Madeira, Frinton and Macclesfield, which have all suffered through conditions created by the war. Mr. H. P. Wells, having accepted a position of greater responsibility with the company, the assistant secretary, Mr. L. C. Gamage, has been appointed secretary.

New Companies.

CASTLETON ELECTRIC COMPANY, LTD. (168,622).—Reg. June 28. Capital £125,000 in £1 shares (50,000 6 per cent. cumulative preference) to carry on the business of electricians, electric adn mechanical engineers, dealers in electricity, switchgear makers, &c., to acquire all the isshed shares of Whipp & Bourne (Ltd.), and to adopt an agreement with S. Whipp, C. W. D. Bourne, F. Whipp, R. Walker, E. Tweedale and L. Tweedale. First directors are: S. Whipp, C. W. D. Bourne, F. Whipp, R. Walker, E.Tweedale and L. Tweedale.

FRED. H. PICKERING, LTD. (168,438).—Private company. Reg. June 21, capital £10,000 in £1 shares, to take over the business of an electrical engineer carried on by Fred. H. Pickering. First directors are: F. H. Pickering (managing director), S. Preston and J. Preston. Reg. office: 6, Stanley-street, Bury.

FRED PRICE & COMPANY (1920), LTD. (168,229).—Private company. Reg. June 12, capital £50,000 in £1 shares, to carry on the business of electrical engineers and contractors, mechanical engineers, &c. First directors are:—Sir Edward Nicholl, Sir Wm. Diamond, R. Lane and C. W. King. Secretary, T. C. Evans. Reg. office: Institute-lane, Park-place, Cardiff.

GARNER, HOLT & COMPANY, LTD. (168,355).—Private company. Reg. June 17, capital £5,000 in £1 shares, to take over the business of an electrical engineer and constructor carried on by G. Garner at 2, Grange-terrace, Rusholme, Manchester, as "Garner, Voyce & Company." Permanent directors are:—G. Garner and A. O. Holt.

GREENLING ELECTRIC SUPPLIES, LTD. (168,255).—Private company. Reg. June 14, capital £5,000 in £1 shares (4,000 participating preferred), to carry on the business of electrical, mechanical, motor and general engineers, manufacturers of and dealers in transformers, dynamos, motors, &c. First directors are:—W. H. Roslington (governing director) and others to be appointed by him. Solicitor, E. J. B. Hobrow, 9, Ironmonger-lane, E.C.

H. W. SMITH & COMPANY (1920), LTD. (168,161).—Private company. Reg. June 10, capital £60,000 in £1 shares (50,000 cumulative preference), to take over the business of electrical wire and cable manufacturers carried on by H. W. Smith & Company, Ltd. Reg. office: Lydbrook, Glos.

WELDED CONSTRUCTION, LTD. (168,425).—Private company. Reg. June 19, capital £10,000 in £1 shares, to take over business carried on by Industrials, Ltd., as the Welded Construction Company, to carry on the business of builders, contractors, electrical engineers, suppliers of electricity, &c., and to enter into an agreement with the said company and the Alloy Welding Processes, Ltd. First directors are: W. A. Hunter, D. G. Boissevain, E. H. Jones and J. Caldwell, M.I.C.E., M.I.E.E. Reg. office: 14-16, Cockspur-street, S.W.

YORKSHIRE & DISTRICT ELECTRIC LAMP REPAIRING COMPANY, LTD. (168,647).—Reg. June 28. Capital £30,000 in £1 shares, to take over a certain licence granted or to be granted by the Allies Electric Lamp Repairing Co., Ltd., to C. G. Gordon-Young, and to carry on the business of manufacturers, importers, exporters and repairers of and dealers in electric lamps, engineers, &c. First directors are: H. J. M. Cockayne, A. S. Lee, A. C. Davy, C. G. Gordon-Young, D. W. Hogan and A. W. C. Bower. Reg. office: 70, Queen-street, Sheffield.

Prices of Metals, Chemicals, &c.

Tuesday, July 6.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£104 0 0	£3 0 0	—
Electro Wirebars...	,,	£109 0 0	£4 0 0	—
H.C. wire basis......	per lb.	1s. 3⅛d.	$\frac{7}{16}$d.	—
Sheet	,,	1s. 5d.	—	
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. 8⅛d.	$\frac{7}{16}$d.	—
Brass 60/40—				
Rod, basis	,,	0s. 10¾d.	¼d.	—
Sheet, basis	,,	1s. 3½d.	—	—
Wire, basis	,,	1s. 3½d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£36 10 0	£2 0 0	—
Foreign or colonial	,,	35 10 0	3 10 0	—
Tin—Ingot	,,	250 15 0	5 15 0	—
Wire, basis	per lb.	0 3 3¼	¼d.	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Per ton £19.

,, (Roll Brimstone).—Per ton £19.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £43.

Boric Acid (Crystals).—Per ton £74.

Carbon Bisulphide.—Per ton £60

Sodium Bichromate.—Per lb. 1s. 11d.

Sodium Chlorate—Per lb. 5½d

Rubber.—Para fine, 2s.; plantation 1st. latex, 1s. 11¾d. to 2s. 0¼d. per lb.

Shellac.—T.N. Orange, 670s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Forty Years Ago.

(The Electrician, July 10, 1880.)

South Australia—A Telephonic Feat.—A remarkable instance of telephony is exciting considerable interest throughout the colony, and amongst the scientific world in particular. By means of an improved telephone the Adelaide Post Office chimes have been clearly heard at Port Augusta, a distance of 240 miles.

The Sydney Exhibition.—We find the following among the Awards made at this Exhibition: Group (scientific and philisophical instruments and methods, classes 307-312). Great Britain: Sax Julius, London, electric bells, telephones, presses, pulls, first award. Telegraphic Construction and Maintenance Company, London, specimens of electric submarine cables, special award. J. Taylor & Sons, London, inferential meter, second award. New South Wales: F. M. Bladen, Sydney, telephones, second award. Victoria: John Edward Edwards, Melbourne, microphone transmitters, first award. John Edward Edwards, Melbourne, telegraphic apparatus and electric bells, &c., third award.

News from Australia in Five Hours.—The telegram conveying the first news of the capture of the Kelly gang of bushrangers was despatched from Sydney at 12.30 p.m. (Sydney time) on the 28th ult., and reached London at 7.33 a.m. (Greenwich time) on the same day, and was published in the second edition of *The Times* on that day. Allowing for the difference of time between Sydney and London—Sydney being 10 hours and 5 minutes in advance of Greenwich time—the actual time occupied in transmission was 5 hours and 8 minutes; thus enabling events at the Antipodes to be published in the London morning papers on the day of their occurrence. This speaks well for the organisation of the Eastern and Eastern Extension Cable Companies.

The Edison Lamp.—The following results of the experiments made by Professor Henry Morton and Messrs. A. M. Mayer and B. T. Thomas on Edison's "cardboard" lamp are of considerable practical importance: The resistance of the horse-shoe shaped carbon whilst in its incandescent condition was 75·5 ohms; when cold its resistance was as high as 114 ohms. The current traversing the carbon was 1·079 webers per second, its mechanical value being ·116 horse-power for each lamp. The maximum luminous effect under these conditions was 20·6 standard candles; the mean value being 14·26 candles. Allowing a loss of 40 per cent. in the conversion of mechanical into electrical energy, one horse-power would maintain in action five lamps, each having a mean illuminating power of 14·26 candles, or a total of about ·70 candles. These figures alone are sufficient to condemn the Edison lamp; for the worst of regulator lamps would give twenty times the illuminating power (in one focus) for an equal expenditure of power; and even the Regnier, or Werdermann lamps, under the most unfavourable conditions, would afford six or eight times as much light as the Edison lamp under the best conditions. The defective result is sufficiently accounted for by the combination of two conditions which are most detrimental from an economical paint of view, viz.: A comparatively low temperature and large radiating surface.

The Cuba Submarine Telegraph Company, Limited.—The number of messages passing over the lines of this company during the month of June was 2,653, estimated to produce £2,700, against 2,104 messages, producing £2,425 in the corresponding month of last year. The traffic receipts for the month of April, estimated at £3,100, realised £3,139.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics" (First Aero Show Number):—Dinner to the Pioneers; "Our Air Mail Policy Adopted"; and "Aerial Navigation."

"The Cabinet Maker":—"Cabinet Work at the L.C.C. Hammersmith School of Arts and Crafts"; "The Empire Timber Exhibition"; and The Future of the Royal College of Art.

"The Fruit-Grower":—"The Exhibition of Roses"; "Trade Exhibits at the Royal"; and "Fruit Industry and Control."

"The Hardware Trade Journal":—"The Enamelling of Steel Sheet"; "Steel Wire and Wire Drawing (II.)"; and "Labour Saving in the Foundry (XII.)."

"Ways and Means":—"The World Crisis: A Suggested Remedy," by Sir George Paish; "Letters by Air," by Major P. L. Holmes; and "Women Workers and an Eight-hour Day," by Miss Violet Ralph.

"The Chemical Age":—"Society of Chemical Industry"; Notes on the Newcastle Meeting; and "The Chemical Engineer."

"Gas World":—Analyses of the Accounts of Fifteen Metropolitan Gas Companies; The Gas Regulation Bill.

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Notes.

The Miners Again.

THE miners have broken out again with fresh demands, and, if Mr. SMILLIE is correctly reported, would like to ensure a modification of LINCOLN's aphorism, and bring about government of the people by the miners for the miners in order that something might prevail, though what is not quite certain. The country has indicated quite clearly that they are opposed to any nationalisation of the mines, and as a result the Mines Bill has been introduced by the Government in the attempt to produce a compromise that will please both sides. Like most compromises, however, it pleases neither side; but, while the mine owners are at least consistent in their opposition to its provisions, the miners are neither consistent nor logical. For, on the one hand, they demand the removal of the 14s. 2d. per ton increase on domestic coal, and on the other they ask for an advance of 2s. per day in wages, with a reduced working week, and, further, that the whole control of the industry shall be placed in their hands. With such a policy the industry would quickly qualify for a Government dole or be in the bankruptcy court. In this way the miners would obtain what they want with the chance that they would not be blamed for having brought ruin to the country.

The Ultimate Aim.

THE best that can be said of this fresh attitude is that it strips the ultimate aim of all this agitation of the camouflage which has up to now surrounded it. It exposes the fact that these constantly recurring demands are based on no economic foundation, not even that flimsy one of the increased cost of living; but simply rest on a desire to bring about such chaos in one of our essential industries that trade and commerce will alike become impossible. Then State Socialism or some other quack panacea will be brought in to revive a moribund industry. And no one who has thought about the matter can be optimistic of the success of that! It is time that thees insidious manœuvrings of a small body of extremists were checked, and we are glad to see in other labour quarters the more moderate men are becoming vocal, and are protesting against these constant attempts to stir up strife. We hope they will continue to do so. In the meantime, these new demands should be stedfastly resisted, if this attempt to cripple the country's industry is to be defeated.

Indiscipline in the Gas Industry.

IT was said of the BOURBONS that they forgot nothing and learnt nothing. It would almost seem that the same is true of a good many trade unionists. For if the recent trouble in the tramway industry showed one thing more clearly than another it was that sectional strikes simply reduce negotiations to a farce and bring about a state of affairs which does nobody any good. Yet in spite of this the gas workers in Manchester, Salford, Oldham, Bury, Huddersfield, Bristol and in the Potteries have come out on strike against the advice of their leaders, thus causing great dislocation of trade, wide unemployment and a maximum of inconvenience to the inhabitants of those towns. The strike is ostensibly due to dissatisfaction with the national award, which gave them an increase of 6s. per week instead of the 10s. demanded, though the award was made on a national basis, which was one of the principles at stake in the tramway dispute. In reality, it has probably been engineered by extremists, who, whatever they may ultimately desire, at least have no wish for agreements or anything like peace and quietness. It is time that trade unionists not only realised this, but fought against a policy which these ideas bring in their train; otherwise the life of their institutions is likely to be a short one.

The I.E.E. Summer Meeting.

DURING the past week the first summer meeting of the Institution of Electrical Engineers to be held since the war has been taking place at Cardiff, Newport, Bristol and Swansea, with headquarters in the first named city. The decision to have no formal meetings, and to devote the whole time to purely social functions is so wise that it seems a pity that not more members and their ladies were able to be present. The meagreness of the gathering is only accentuated by the statement that of the 160 or so who attended there were several ladies and a considerable proportion even of the members of the various classes of the Institution belonged to the Western

Centre, and must therefore be classed rather as hosts than guests. This is not a very good showing for an Institution which boasts the largest membership of any engineering body, and the only thing that can be said for this lack of support is that it has probably relieved the organisers of considerable embarrassment in arranging accommodation in these days of crowded hotels and overflowing boarding houses.

The Young Engineer's Opportunity.

This small attendance is the more deplorable, for it shows lack of realisation of the important part functions of this kind should play in the life of the engineer, and especially in the life of the young engineer. They enable friendships to be inaugurated, and nothing is finer than friendship. They enable acquaintances to be made by the young man with those high in the profession on a plane of social equality, which is not possible in the office, laboratory or workshop. They give opportunities for informal discussions on engineering and cognate matters which should be of the very greatest benefit to all concerned. We do not know whether the Council or the Committee of the Western Centre are disappointed at the result of their first post-war attempt to resuscitate the summer meeting. If they are, we hope that they will not let this natural feeling deter them from organising a similar meeting next year. Indeed, we should like to see such a meeting organised on a rather more generous scale, and a meeting place somewhere outside this country selected. Unfortunately, the time has not yet come when we can expect either the French or the Belgians to be our hosts, but we suggest that arrangements might possibly be made to visit either Sweden, Norway or Denmark, where objects of both engineering and general interest are numerous and sufficiently different from those in this country to be highly attractive.

Telephone Charges.

The report of the Departmental Committee on telephone rates recommends, as was expected, some changes in the present tariff, and equally expectedly recommends that the charges should be increased. That relatively pampered person, the flat-rate subscriber, is to disappear, and the charge in future will take the form of a fixed annual rental plus a small sum for each call initiated. Quite rightly, the Committee recommend that this call fee should be the same throughout the country, thus equalising the more favourable position in which London stands in relation to the rest of the country. The local fee would cover calls to exchanges within five miles of the initiating exchange, and for calls beyond this distance there will be an additional charge on a uniform mileage scale. This is a tendency towards simplification which is all to the good. The annual installation rentals will be £8. 10s. in the London area (within 10 miles of Oxford Circus), £8 in Birmingham, Glasgow, Liverpool and Manchester, and £7. 10s. elsewhere. This cuts down the present London area considerably, and differentiates subscribers in large districts from those in small.

The Need for Development.

It should be noted that these increased charges are not dictated solely, or even principally, by the need for raising more revenue, but are necessary to counteract the increased cost of installation and operation. At present, it is stated, it costs £7·5 in London and £8·23 in the provinces to instal a telephone, while each call costs 1·65d. and 1·38d. in London and in the provinces respectively. Since 1914 expenditure has risen from £6,000,000 to £13,700,000 in 1920, of which increase wages accounted for £5,700,000, or nearly as much as the total expenditure in the earlier period. Another possible source of revenue is indicated by the recommendation that lines whose number of "engaged" calls exceeds 25 per cent. of the number of effective incoming calls should be refused services if they do not agree to rent additional lines. This is drastic, if not salutary, and incidentally will be difficult to carry out at the present time when subscribers are clamouring for instruments and an illegitimate traffic is being conducted in premiums for vacant lines. Further efficiency is aimed at by the discontinuance of party lines, except in the case of farmers' lines. This last is a service we should like to see extended. Although there are some useful recommendations as to other charges and some interesting figures as to the cost of erecting exchanges, the Committee tactfully skirt the question of further capital expenditure. This, however, is a matter which should receive the closest consideration. Efficient communication is essential to the well-being of the country, and though we do not agree with some of the strictures that are made upon the present system it cannot be denied that there is great room for improvement. But that improvement will not be obtained without judicious expenditure on a well-conceived scheme.

West of England Electricity Authority Scheme.

Mr. Faraday Proctor is to be congratulated on the skilful way in which he managed the meeting held at Bristol last week. Another definite step has been taken, and the draft scheme is now to be put before the Electricity Commissioners. It is, of course, open to anyone interested to attend next week's local inquiry and put forward their views as to where and how the scheme can be amended. The Commissioners and everyone connected with electricity supply know only too fully the difficulties which stand in the way of reorganisation in any district. Every scheme, by its very nature, must contain much that is experimental. Merely to dilate on the possible risks involved in this or that provision of a scheme contributes nothing useful, and it is to be hoped that the Commissoners will cut short lugubrious orations. If, on the other hand, anyone can show how a difficulty can be got over in a better way than that provided in the scheme, he can be sure of being met with open arms. At the Bristol meeting there appears to have been a plentiful supply of destructive criticism, while there seems to have been a dearth of any constructive alternative proposals.

Destructive Criticism.

One of the main criticisms of the scheme has arisen over what is evidently a misunderstanding of the whole position. The draft scheme consists mainly of provisions covering the constitution of the joint authority and the wherewithal by which the authority when constituted, can fulfil its duties. On the other hand, it does not embody comprehensive engineering proposals, for obvious and very good grounds. The reorganisation in this area must be a long and difficult process of co-ordinating the existing supply stations and distributing networks, of making the best of everything available, and adding to the system whatever is necessary as demands arise. A thing of this kind cannot be set down on paper by a few engineers met in conference, uncertain even as to the exact elements with which they have to deal. Obviously, it is a continuous work for a responsible and properly equipped body, and it is precisely such an authority that is needed before anything can be done. The West of England scheme is working in this logical order, and taking as its first step the constituting of a responsible authority representative of all the interests concerned. In a word, the whole idea of a voluntary authority is that under this authority the existing undertakings shall co-operatively evolve their engineering reformations, not that they shall have any ready-made engineering scheme imposed on them from the outside. But curiously this is what was wanted by some of the West of England critics. However, these appear to represent only a minority of those interested, and we hope that after the local inquiry has been held all parties will be satisfied.

Patents in 1919.

The Annual Report of the Comptroller-General of Patents is not a very exciting or luminous publication. It might be made more useful if we were given some information as to the trend of invention and an analysis of the number of applications for patents in the different branches of industry. Instead, we are only treated to bald columns of the aggregate number of applications for the grant of Letters Patent and for the registration of trade marks and designs, particulars of the fees received, list of staff, with salaries and other uninteresting details of the work of the Department. For instance, we are told there were 306 applications for patents by women, against 286 in 1918. We have heard so much about women in engineering of late that it would be interesting to know how many of these applications related to engineering. In pre-war days the Comptroller's Report was more informative, and, even though there is a paper shortage, we hope that on the next occasion he will be able to revert to the old practice.

Increase in Applications.

As might be expected in the year following the greatest war in history, there were records in several branches of the Department, and the total number of patent applications increased to 32,853 from 21,839 in 1918. There were also large increases in the number of designs and trade marks registered, and a corresponding advance in the fees paid. We notice that the Patent Office is one of the few Government departments which have a substantial surplus on the year's working. The total receipts from fees and from the sale of publications were £404,474, and there was a surplus of £54,324 after meeting all expenditure. This would seem to indicate that the fees are too high, and, as the poor inventor deserves well of the State, and should receive every encouragement, we hope that it may be possible to reduce some of the charges made by the Department. Substantial progress has been made with the new classification of the books in the Library, which is now open to the public until 8 p.m. In view of the importance of its extensive list of technical works, and of the need for giving everyone interested in invention, including working engineers, an opportunity of consulting the publications in the Library, we hope that the Department will soon be able to reintroduce the old rule of keeping open until 10 p.m.

Closing Finsbury College.

Our readers, and particularly those who received their training at the City and Guilds Technical College, Finsbury, will be sorry to learn that it has been decided to close down this useful Institution in July, 1921. In the early days of electric lighting many engineers took an electrical engineering course at the College, and many more took advantage of its evening lectures. It will come as a shock to these, as well as to all who take an intelligent interest in engineering education, that, owing to changed conditions, it has been found necessary to terminate the career of an institution which has done such excellent and such useful work in the past. In the course of the statement issued by the Council of the City and Guilds of London Institute it is pointed out that, both from the educational and financial point of view, the work of the College has received prolonged consideration. The Institute has also had under consideration the position of the College in relation both to its original scheme and purpose and to the altered circumstances under which all technical work has since its foundation come into more or less direct relationship with the educational authority of the metropolis.

Changed Conditions

When the College was established, no local educational authorities existed beyond school boards, whose functions and funds were limited by Act of Parliament to elementary education. And although other authorities have since been established, with funds and duties covering the whole field of education, the Finsbury College has continued an independent existence without direct relationship with those other bodies, beyond the admission of their scholarship holders. The position has, however, been fundamentally changed by the Education Act, 1918. The Institute is advised that the London County Council propose to make the Northampton Polytechnic (which is within a mile of Finsbury College) a thoroughly good engineering school, and therefore it is questionable whether there is need in such close proximity for two engineering colleges, both attempting to cover the same ground. Consequently it is proposed that the engineering school at Finsbury should be discontinued.

Reasons for Closing.

The Institute had been advised that if the College were to devote the whole of its energy to industrial chemistry it would enter upon a new career of usefulness. It has given these representations careful consideration, but it has been reluctantly forced to recognise that to continue a work, necessarily involving largely increased expenditure, in which it could not look to the Education Authority for any encouragement. The Institute has already established its university work at Kensington, and if the work of the College were to be continued and due provision made for its adequate development, an increased annual expenditure of at least £13,000 over that of the pre-war year 1913 would be required. As there is no prospect of raising this additional income, and under all the circumstances the Institute has reluctantly come to the decision that it has no alternative but to close the College as soon as arrangements can be made for completing the education of the present students. No new students will, therefore, be admitted to the college, which will be closed at the end of the session in July, 1921. The closing of the College will enable the Institute to devote further funds towards carrying on and developing in other work This is, indeed, a very great pity, and we hope that, for every reason, it is not too late for the decision to be reconsidered..

The Manchester College of Technology.

Manchester City Council having endorsed the recommendations of their Education Committee as to the future of the College of Technology, involving the reversal of the policy hitherto pursued, the natural sequel has now come in the form of the resignation of the Principal. Though we regret the course events have taken, we cannot see that Mr. Maxwell Garnett could have taken any other step consistent with his dignity and his responsibilities. As he points out in his letter to the Lord Mayor tendering his resignation, "instead of extending the highest work of the College, the Council has decided to reduce it, and for the first time to admit as whole-time students senior technical schoolboys who are not qualified to pursue the whole-time courses of study hitherto provided." Apparently another result of the Committee's policy will be an endeavour to use the laboratories and classrooms, when vacant, for the instruction of the schoolboys, thus involving the use of these rooms at scheduled times. This attempt to run the university work on the shift system, as well as the reversal of the present policy, will do serious injury to the good work and reputation of the College. The parochial idea seems to have actuated the members of the Committee, and their action makes us doubt the wisdom of placing the control of higher education in the hands of local authorities.

An Opportunity Missed.

Those who observe the goings hither and thither of men and inform us what is happening, tell us that London is each year becoming more and more of a holiday resort. And however correct this may be in a general way it is certainly true this year when for the first time for practically six years it has been possible for Americans, French and other friendly invaders to visit our shores. It was therefore a happy thought to organise an exhibition at a place so easy of access as the Crystal Palace, where visitors might not only enjoy the amenities of beautiful surroundings but go away with some idea of what our manufacturers were doing towards reconstructing the industries of the world. Unfortunately the execution of this idea has not been as happy as the thought itself. The number of exhibits is small and it is regrettable to have to state that the electrical section is the poorest of all in this respect. But few of our great firms seem to be showing, and the visitor will obtain an entirely erroneous idea of British electrical progress if he depends only upon the impressions he can draw at the Crystal Palace. It would seem that here was a great opportunity, and somehow or other it has been missed.

Taxation and Industry.

The clauses in the Finance Bill legalising the Excess Profits Duty at the rate of 60 per cent. during the coming year were passed by the House of Commons on Monday. This was the only result that could be expected, in spite of the extremely able opposition organised by the Federation of British Industries and the National Union of Manufacturers. The views of these bodies were officially put forward respectively by a deputation to the Chancellor of the Exchequer and by Mr. George Terrell in the House, but nevertheless they failed to obtain a rescission of the duty or even its maintenance at last year's figures. Promises were given, and were reiterated by the Chancellor in the House, that some improvement will be made next year, but unfortunately no great reliance can be placed on that. Considering the great importance of impressing upon the Government how those concerned in the industry of the country regard this crippling impost, it seems a pity that these two bodies did not join forces. It might not have made any difference, but on the other hand it might just have turned the scale. Really, however, there was never much hope. Commercial interests were outgeneralled by the Treasury from the beginning in the discussion over the relative merits of the Capital Levy, the Corporation Tax, the Excess Profits Duty, and since then they have fought a losing battle.

Economy in the Abstract.

Strong as the opposition in the country generally was, and is, to the Excess Profits Duty, that strength was not evident in the attacks made on the Government in the House itself. This is not altogether surprising. Fond as the average Member of Parliament is of economy in the abstract, in particular he has generally some scheme for spending more public money either to forward some pet ideal or to benefit his own constituents. So that when the pruning knife is actually about to be applied he is more anxious to ensure that his own scheme survives, whatever else is sacrificed, than to agree to ruthless and essential economies. At the present time this attitude gives an air of unreality to all debates on financial questions.

Organised Opposition.

In spite, however, of the lack of success on this occasion, we hope that those who represent the trade and finance of the country will not cease their opposition both to the Excess Profits Duty itself and to the use the Government is making of the money they are receiving from the almost overwhelming taxation which is now imposed upon us. This opposition must, however, be carefully organised, and the essential badness of this duty must be considered in future from rather a different point of view than that which has quite naturally been adopted by the Federation of British Industries and other similar bodies, in order that the demand for the abolition of this tax may have the widest possible support.

Stated in the broadest possible way our present national commitments are due to two interconnected causes—the enormous expenditure occasioned by the war and the inflated ideas of Government Departments on the subject of finance—ideas which are concretely exhibited in Labour Exchanges, housing schemes, and in grants, subsidies and doles for this, that and the other thing.

Pre-War Inflation.

It is important to note that this inflation is not entirely due to the war. Its causes were already in evidence in 1914, but there was only a comparatively small expansion of normal administrative activities. The war swelled these activities to an unprecedented extent, and if the present state of things is to continue this swelling will remain a permanent feature on the body politic. As an indication of this we may mention that while in October last the Chancellor of the Exchequer estimated the revenue in a " normal " year to be £806,000,000, with an expenditure of £808,000,000 during the coming year, both expenditure and revenue are estimated at £1,029,000,000, inclusive of a debt redemption of £148,000,000, while no less than £305,000,000 is for Civil Service requirements, only a comparatively low proportion of which is allocated for salaries. This shows how greatly the activities of Government departments are being diverted from purely administrative duties into side shows which do little else than spend money.

Ruthless Economy Essential.

But quite apart then from opposition to any particular tax or taxes (and it must not be forgotten that a very large revenue has to be raised by some means or other), it is evident that strenuous propaganda must be initiated to relieve not only manufacturers but everyone, employers and employed alike, from this intolerable burden, and to insist that ruthless economy must be the guiding principle of Government expenditure.

In the past too much attention has been called to the effect the duty is likely to have on one small portion of the community. This is a mistake. For it is highly important that its effect and the effect of the Income Tax and the Corporation Tax on the country as a whole should be stressed.

A Financial Council.

We are glad to see that this fact is realised by the Federation of British Industries, though we cannot altogether agree with the methods they propose for bringing the desired end about. They suggest in effect that a Financial Council of independent men should be set up under the chairmanship of the Chancellor of the Exchequer to advise the Cabinet upon the financial aspects of all proposed legislation involving expenditure, to criticise the estimates and generally to supervise expenditure. In other words, that a small body of experts should assume the duties and responsibilities which are generally presumed to be the prerogative of Members of Parliament. In these democratic days such a proposal will be rightly subjected to the fiercest criticism, and we fear that a body set up in this way, and composed as suggested, would have no success at all in doing what it is desired it should do.

In our opinion the only way of dealing with this problem is by bringing Members of Parliament to see that the whole opinion of the country is in favour of the most rigorous economy, the strictest curtailment of expenditure, the postponing of new schemes involving expenditure and the inauguration of methods which will bring this country back to its old financial stability. This can be done if the help not only of the trading interests, but of the people generally is enlisted. And it must be done if disaster is to be averted. As Mr. G. H. Roberts justly said the other day, "An uncertain future means a stagnant present." Yet this is what we are experiencing at present, nor will matters be better until the finances of the country are placed on a sounder basis.

Workmen's Compensation.

Even before the war there were demands for an amendment of the Workmen's Compensation Act of 1906, and recent industrial and economic changes have only accentuated the need for revision of the law relating to compensation to injured workmen and their dependents. In May, 1919, the Home Secretary appointed a Committee to inquire into the existing system of compensation, and after hearing many witnesses from all parties—employers, workers and insurance companies—the Committee has now issued its report, which makes far-reaching recommendations as to the amounts to be paid for compensation and the procedure to be adopted for carrying out their suggestions. It is estimated that over 15,000,000 workers are covered by the existing Act, and as it is proposed to include other classes and to increase the amount of compensation, the recommendations of the Committee deserve most careful consideration.

No State Insurance.

No doubt there is a prejudice among workers against insurance companies, for they are credited with a good deal of unnecessary litigation in the past. Consequently, the Committee considered whether a system of State Assurance was desirable, and we are relieved to find that it does not advocate such a scheme. However, it is proposed that there should be State supervision of the rates of premium charged by insurance companies, with a view to the restriction of their expenses and profits. With this object, it has been agreed upon the heads of a working agreement with the Accident Offices' Association (representing the insurance companies), whereby not more than 30 per cent. of the premium income is to be expended in profits, management and commission. The maximum rates of premium are to be approved or fixed by a new Government official, termed a "Commissioner." Mutual associations are to be placed under the same obligations as to setting aside funds to meet liabilities and furnishing returns as insurance companies.

Compulsory Insurance Extended.

It is proposed that every employer, other than the Crown, a local or public authority, a statutory company, or a householder in respect of servants not employed by him for trade or business, should be required to insure against workmen's compensation risk. Employers, with an annual wage roll exceeding £20,000 can, however, claim exemption from compulsory insurance upon certain conditions. Many new classes of persons are to be brought within the scope of the proposed scheme, including persons employed otherwise than by way of manual labour whose remuneration does not exceed £350 a year (instead of £250), and also certain cases of casual employment, taxi-cab drivers, &c.

Increased Compensation.

An increased scale of compensation rates is advocated. In a fatal case, where there is only a widow, the amount is to be £250; but where there are children a weekly allowance of 10s for the first, 7s. 6d. for the second and 6s. for every other child is to be paid. The allowances are to be provided by the payment by the employer into a central fund of £500 in the case of a workman dying and leaving a child or children under 15 years. The maximum liability for compensation for a workman's death would thus be £800, compared with £300 at present. There is a new and, we think, necessary provision for investing money for children. To partial dependents the compensation suggested is a sum representing the value of the workmen's contributions to the support of those partially dependent, with a maximum of £250.

Total and Partial Incapacity.

Under the 1906 Act the maximum benefit payable in cases of total incapacity was £1 a week, but this was raised to 35s. in January last. It is now proposed that the total payment shall be 66⅔ per cent. of the average weekly earnings, with a maximum of £3. In the event of partial incapacity payment is to be on the basis of two-thirds of the difference between the average weekly earnings before the accident and the average the workman is earning, or is able to earn, in some suitable employment after the accident. At present no compensation is payable for incapacity lasting one week or less; when incapacity lasts more than one but less than two weeks, compensation is payable from the beginning of incapacity. It is now proposed that there should be a waiting period of only three days, with no dating back.

Miscellaneous Benefits.

Medical and surgical aid necessary, in addition to the medical treatment already available under the National Health Insurance Acts, is to be provided for the injured workman at the cost of the employer under a scheme to be worked out by the proposed Government Commissioner, in co-operation with the Ministry of Health. Various other recommendations are made in order to assist workmen in ascertaining and maintaining their rights. It is proposed that County Court Registrars should undertake to give information (free of cost) to injured workmen or their dependents, and advise them as to the necessary procedure to protect their rights; and also to act as mediators between employers and injured workmen or their dependents. There are also some recommendations for reducing solicitors' costs, court fees, &c.

Prevention of Accidents.

An interesting part of the Report is that devoted to suggestions for the prevention of accidents. It is proposed that the Government Commissioner should be empowered to institute inquiries into the practicability of a system of discounts from normal rates of premium in consideration of the adoption of approved safety devices or provisions, and by agreement with insurance companies and mutual associations to prescribe schemes. A Government official is to be appointed to supervise insurance companies, mutual associations and self-insurers in certain matters and for the discharge of duties in relation to workmen's compensation which are performed by any Government Department. This Commissioner would undertake the collection of returns as to compensation and the preparation of an annual report to Parliament, which would give a resumé of the development of workmen's compensation during the year in other countries and also contain recommendations for the amendment of the Act or for improvements in its working. The Committee also recommends that priority be given to the full amount of a compensation claim in the distribution of the assets of a bankrupt employer. Taken as a whole, the recommendations are conceived in a liberal spirit, but certain of them, especially those relating to the amount of compensation wil require a searching examination.

An Electrical Device for Checking the Oil Temperature of Medium-Sized Turbo-Generators.

By GEO. J. DUCKETT.

During the period of the War many electro-mechanical devices were brought into being to counteract the depletion in staff, or to safeguard machinery owing to the poor quality of the human element available.

Privately-owned power stations were particularly hard hit from this point of view, and in the case of a power house coming under my control in which small turbines of upwards of 750 kw. capacity are used, in which all my original staff were called up for military service, I had to keep the plant going by introducing devices of an automatic nature which more or less safeguarded the apparatus, at the same time allowing me to keep an eye on the efficient working of the plant although my office was situated some considerable distance away from the Power House.

The device I propose to describe is used in connection with the oiling system, and engineers who have steam turbines to deal with will realise the importance of the oiling system of these machines, the slightest failure of the oil supply being most disastrous, as the rotor bearings are quickly overheated owing to the high peripheral speed of their journals. Therefore I introduced the automatic tell-tale arrangement as shown in the following sketches. Figs. 1 and 2 show part sections of the device; Fig. 3 the wiring diagram; and Fig. 4 a chart taken from the recorder, showing the effectiveness of the device.

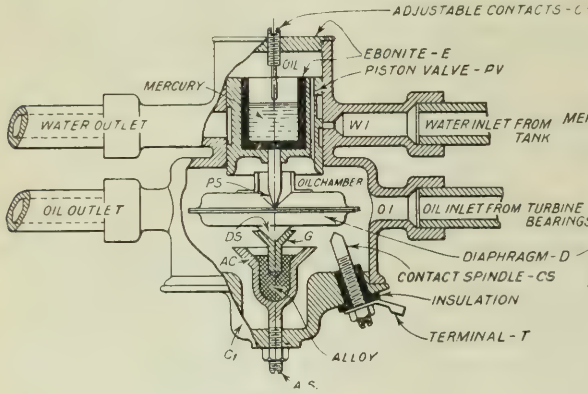

Fig. 1.

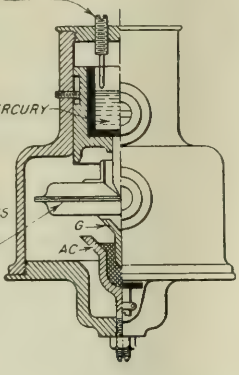

Fig. 2.

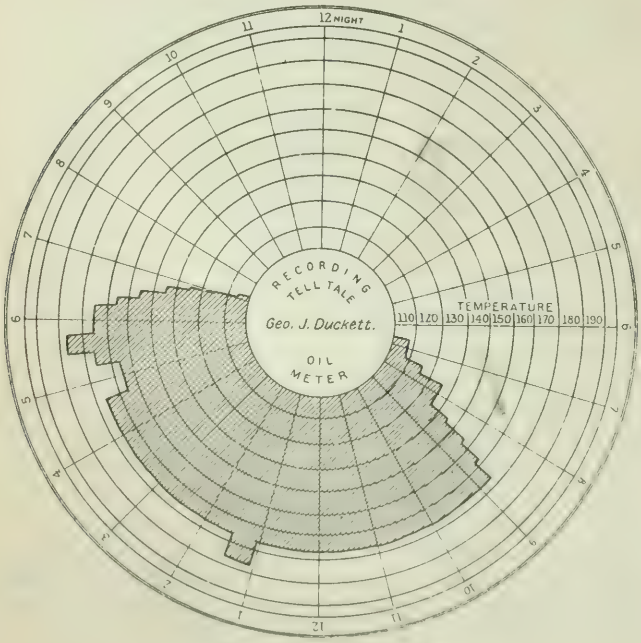

Fig. 4.—Recorder Chart.

The Object of the Scheme.

The object of the scheme is to record at a distance exactly the state of affairs through which the lubricating oil is passing at any time, and also the controller (Figs. 1 and 2) automatically adjusts the quantity of water passing through the oil cooler; therefore, when the temperature of the oil becomes abnormal the water supply is opened and the oil is subjected to a greater cooling surface, which, of course, reduces its temperature. When the water is reduced to a minimum, therefore, there is no unnecessary water passing through the cooler.

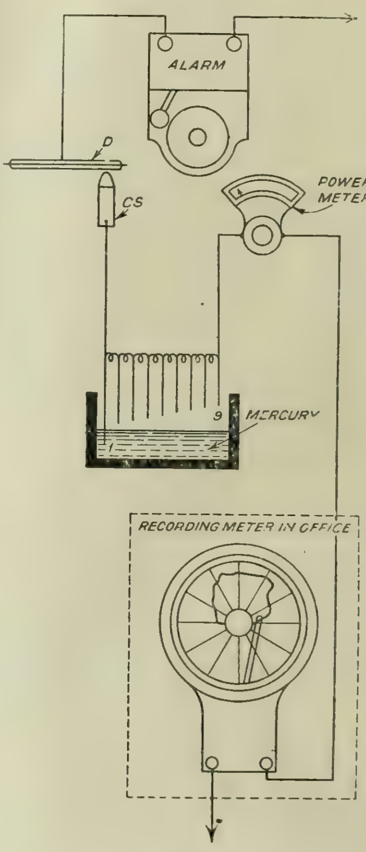

Fig. 3.

On referring to Figs. 1 and 2 it will be seen that the oil after passing through the turbine bearings flows into the lower cavity of the controller and surrounds the diaphragm "D" which forms the regulator. This consists of two flanged discs soldered together on the flanges so as to form a box. Inside the box there is a liquid consisting of ether or methylated spirits (a cheap mixture I have found suitable consists of 1 lb. resin to 1 lb. methylated spirits).

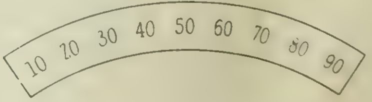

Fig. 4a.—Scale of P.H.M.

The diaphragm "D" is supported on an adjustable spindle "A.C.," the bottom portion of which forms a cup in which there is a metal alloy, of composition formed of lead 25 per cent., tin 12·5 per cent., bismuth 50 per cent., and cadium 12·5 per cent. The action of this alloy will be explained later.

The Action of the Valve.

Resting on the top of the diaphragm there is a spindle which floats a piston-valve, " P.V.," which opens and closes the water supply to the cooler in accordance with the movement of the diaphragm, which, of course, expands owing to the increased temperature of the oil flowing around it. The piston valve " P.V." is balanced, as there is an equal pressure on both top and bottom, and as it is well lubricated there is little or no friction. The inside of the piston valve is machined out to take an ebonite cylinder, which contains mercury.

As the surfaces of the mercury rises and falls, due to the fluctuating temperature of the oil, it necessarily follows that if electrical contacts are fixed so that they are in close proximity to the surface of the mercury, then when the diaphragm expands and raises the piston, the contacts touch the mercury and complete the circuit.

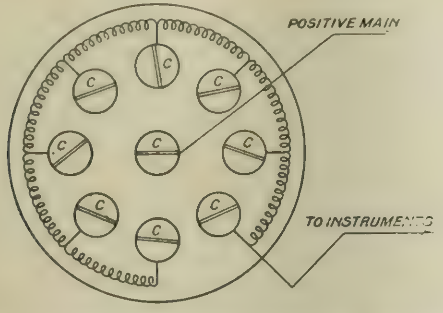

Fig. 5.—Arrangement of Adjustable Contacts.

The contacts are so arranged as to form steps, between which certain resistances are interposed (Fig. 5). Therefore, if the supply of current to the contacts is at a constant voltage, it is an easy matter to calibrate an instrument (see Fig. 3 "P.A.M.") to indicate the temperature of the oil flowing. (An enlarged view of the meter scale is shown in Fig. 4a).

The Obtaining of Permanent Records.

In order to obtain a permanent record of the operation of the regulator a recording voltmeter is fixed in the same circuit as the meter " P.A.M.," and the effectiveness of this recording meter is shown on consulting an enlarged view of the chart (Fig. 4). As the mercury makes contact with the contacts " C " the recording pen marks the revolving chart in the form of steps, the quicker the temperature rises the less the width of the tread of the steps; also, as previously mentioned, the higher the temperature the greater the flow of cooling water. As the recording meter can be fixed in any position the Chief Engineer can locate it so that it can be more or less under his personal supervision, and the daily charts can be filed away for future reference.

If by any chance the oil supply becomes dangerously overheated the small spindle cup containing the alloy, which is in the direct flow of the overheated oil, also becomes overheated, and the alloy softens. The spindle supporting the diaphragm sinks into the molten metal, and in so doing allows the diaphragm to drop on the electrical contact C.S., which supplies current to an audible alarm signal. This, of course, attracts the attendant, and at the same time the piston valve is dropped so that abnormally large ports in the piston register with the water inlets, and thus a heavy flow of water will pass through the oil cooler tending to keep the temperature of the oil within bounds.

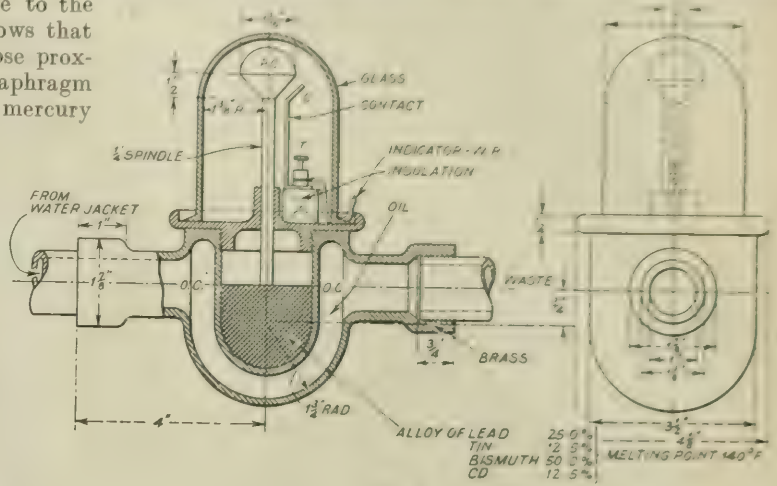

Fig. 6.

Apart from the value of the Regulator as a safety device, I find that a considerable saving accrues from its adoption, inasmuch as the consumption of water in small plants, such as 500-750 kw. capacity, is reduced by many hundreds of gallons per day; in fact, the saving approximates *one-third* of the total supply.

Although the oil used by turbo-generators is almost a negligible quantity in comparison with reciprocating plants, still I find that the regulator also has a tendency to further reduce the oil consumption. Fig. 6 shows the arrangement I have fitted in the water-cooling circuit of air-pumps or compressors, &c., but in this case it does not regulate the water but gives an alarm if the water becomes over-heated.

Alabaster Fittings.

The present popularity of alabaster as an illuminating medium is fully justified by its extraordinary beauty. In comparison with white glass there is a certain loss of efficiency varying in proportion to the amount of veining; in the case of pure white alabaster the efficiency is practically as high as that of Veluria or Druid Glassware. A number of installations employing B.T.-H. semi-indirect fittings equipped with alabaster bowls and Mazda half-watt lamps have been carried out. Many of these installations are in private houses, but alabaster is equally suitable in theatres and in certain business premises where the conditions warrant decorative treatment, and the question of first cost is not a matter of urgency. Private offices afford an appropriate milieu for the employment of alabaster, which, at a relatively small cost, will assist in producing that atmosphere of refined luxury so desirable as an indication of business prosperity. One interesting example is the installation in the private offices of Messrs. Angus Watson, Ltd., of Newcastle-on-Tyne. In the managing director's office two fittings equipped with Mazda half-watt lamps are used. The alabaster bowls are well matched in respect of colour and veining, although, owing to halation, the farther one looks almost pure white. The lighting effect is in every way excellent, while the exquisite tone and texture of the illuminated alabaster have an extraordinary decorative value, enhancing the appearance of the room in a most amazing fashion. The other private offices are similarly equipped, including the office of Lord Leverhulme, who has acquired a controlling interest in Messrs. Angus Watson. In the general offices and corridors, semi-indirect fittings with white glass reflector bowls are employed. Alabaster bowls of various sizes, shapes and colours and degrees of veining are stocked by the British Thomson-Houston Company at 77, Upper Thames-street, E.C. 4, where appropriate fittings may also be obtained.

Managing Director's Office.

Three Magnetically-Coupled Circuits.

By E. BELLINI.

The case of three magnetically-coupled circuits, as shown in Fig. 1, is important for the art of wireless telegraphy, as this device is widely used, though its properties are not exactly known. In this article the problem of these circuits will be treated in an elementary manner, assuming that resistances of the three circuits are nil, and that their frequencies are the same.

Referring to Fig. 1, we can write the differential equations of the three circuits as follows :—

$$L_1\frac{d^2i_1}{dt^2}+M_{12}\frac{d^2i_2}{dt^2}+\frac{i_1}{C_1}=0 \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

$$L_2\frac{d^2i_2}{dt^2}+M_{12}\frac{d^2i_1}{dt^2}+M_{23}\frac{d^2i_3}{dt^2}+\frac{i_2}{C_2}=0 \quad . \; . \; . \quad (2)$$

$$L_3\frac{d^2i_3}{dt^2}+M_{23}\frac{d^2i_2}{dt^2}+\frac{i_3}{C_3}=0 \quad . \; . \; . \; . \; . \; . \; . \; . \quad (3)$$

Differentiating these equations twice, we obtain

$$L_1\frac{d^4i_1}{dt^4}+M_{12}\frac{d^4i_2}{dt^4}+\frac{1}{C_1}\,\frac{d^2i_1}{dt^2}=0 \quad . \; . \; . \; . \; . \; . \quad (4)$$

$$L_2\frac{d^4i_2}{dt^4}+M_{12}\frac{d^4i_1}{dt^4}+M_{23}\frac{d^4i_3}{dt^4}+\frac{1}{C_2}\,\frac{d^2i_2}{dt^2}=0 \quad . \; . \quad (5)$$

$$L_3\frac{d^4i_3}{dt^4}+M_{23}\frac{d^4i_2}{dt^4}+\frac{1}{C_3}\,\frac{d^2i_3}{dt^2}=0. \quad . \; . \; . \; . \; . \; . \quad (6)$$

Eliminating $\frac{d^4i_1}{dt^4}$ between (4) and (5) and $\frac{d^4i_3}{dt^4}$ between the resultant equation and (6), and taking into account that $L_1C_1=L_2C_2=L_3C_3$, we obtain

$$(1-k^2{}_{12}-k^2{}_{23})\frac{d^4i_2}{dt^4}+\frac{1}{L_1C_1}\,\frac{d^2i_2}{dt^2}-\frac{1}{L_1L_2C_1}\left(M_{12}\frac{d^2i_1}{dt^2}+M_{23}\frac{d^2i_3}{dt^2}\right)=0,$$

where $k_{12}=\frac{M_{12}}{\sqrt{L_1L_2}}$ and $k_{23}=\frac{M_{23}}{\sqrt{L_2L_3}}$.

Eliminating $M_{12}\frac{d^2i_1}{dt^2}+M_{23}\frac{d^2i_3}{dt^2}$ between the last equation and (2), we obtain

$$(1-k^2{}_{12}-k^2{}_{23})\,\frac{d^4i_2}{dt^4}+\frac{2}{L_1C_1}\,\frac{d^2i_2}{dt^2}+\frac{1}{L_1{}^2C_1{}^2}\,i_2=0.$$

This equation shows that the intermediate circuit possesses two periodicities,

$$m_1=\frac{1}{\sqrt{L_1C_1(1+\sqrt{k^2{}_{12}+k^2{}_{23}})}}\text{ and }m_2=\frac{1}{\sqrt{L_1C_1(1-\sqrt{k^2{}_{12}+k^2{}_{23}})}}$$

It is not possible to obtain from the equations (1) to (6) a differential equation either in i_1 or in i_3. To obtain these differential equations it is necessary to add three more equations by differentiating twice the equations (4), (5) and (6).

$$L_1\frac{d^6i_1}{dt^6}+M_{12}\frac{d^6i_2}{dt^6}+\frac{1}{C_1}\,\frac{d^4i_1}{dt^4}=0 \quad . \; . \; . \; . \; . \; . \quad (7)$$

$$L_2\frac{d^6i_2}{dt^6}+M_{12}\frac{d^6i_1}{dt^6}+M_{23}\frac{d^6i_3}{dt^6}+\frac{1}{C_2}\,\frac{d^4i_2}{dt^4}=0 \quad . \; . \quad (8)$$

$$L_3\frac{d^6i_3}{dt^6}+M_{23}\frac{d^6i_2}{dt^6}+\frac{1}{C_3}\,\frac{d^4i_3}{dt^4}=0. \quad . \; . \; . \; . \; . \; . \quad (9)$$

Eliminating $\frac{d^6i_3}{dt^6}$ between (8) and (9) and $\frac{d^6i_2}{dt^6}$ between the resultant equation and (7), we obtain

$$(1-k^2{}_{12}-k^2{}_{23})\,\frac{d^6i_1}{dt^6}+\frac{1-k^2{}_{23}}{L_1C_1}\,\frac{d^4i_1}{dt^4}-\frac{M_{12}}{L_1{}^2C_1}\,\frac{d^4i_2}{dt^4}+\frac{M_{12}M_{23}}{L_1L_2L_3C_3}\,\frac{d^4i_3}{dt^4}=0.$$

Eliminating $\frac{d^4i_3}{dt^4}$ between this equation and (5), $\frac{d^4i_2}{dt^4}$ between the resultant equation and (4), and, finally, $\frac{d^2i_2}{dt^2}$ between the new resultant equation and (1), we obtain

$$(1-k^2{}_{12}-k^2{}_{23})\,\frac{d^6i_1}{dt^6}+\frac{1}{L_1C_1}\,(3-k^2{}_{12}-k^2{}_{23})\,\frac{d^4i_1}{dt^4}+\frac{3}{L_1{}^2C_1{}^2}\,\frac{d^2i_1}{dt^2}+\frac{1}{L_1{}^3C_1{}^3}\,i_1=0.$$

It is extremely complicated to solve this equation; but, really, we do not want to solve it, as we can verify by substitution that the periodicities m_1 and m_2 already found and the periodicity $m=\frac{1}{\sqrt{L_1C_1}}$, common to the circuits before their coupling, satisfy this equation.

The circuit 3 furnishes the same result as the circuit 1.

So we obtain the very interesting results that the extreme circuits are always tuned to the common periodicity m, however close the two couplings may be, and that two coupling periodicities exist in the three circuits.

Experiments made to verify the results of the theory were conducted in the following manner :—

First of all, the three circuits were tuned to the same frequency by separately exciting each of them with a buzzer wavemeter and varying the capacities of their condensers till a detector and a telephone connected in series and derived from the condenser armatures gave the loudest sound.

Afterwards the three circuits were magnetically coupled, as shown in Fig. 1, and varying the condenser capacity of the buzzer wavemeter, the resonance frequencies for each circuit were found by successively connecting the detector telephone to the condenser armatures of the three circuits. The results of these experiments agree with those given by the theory.

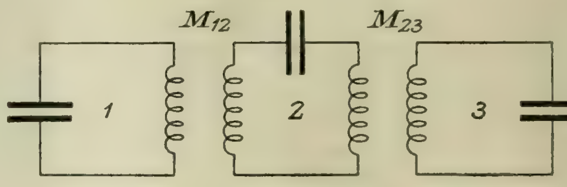

FIG. 1.

The following gives details of one of the experiments : The three circuits were separately tuned to the frequency corresponding to the division 95 of the condenser scale of the buzzer wavemeter. After their coupling it was found that

The circuit 1 was resonant at the divisions 58—95—134
,, 2 ,, ,, ,, 58———135
,, 3 ,, ,, ,, 58—95—132

It is interesting to consider the case of the intermediate circuit containing no condenser. The calculations in this case are easier than in the general case, as the equations (1) to (6) are sufficient to furnish the differential equations in i_1, i_2 and i_3.

The result is the following : The circuits 1 and 3 possess two periodicities,

$$m=\frac{1}{\sqrt{L_1C_1}}\text{ and }m_1=\frac{1}{\sqrt{L_1C_1(1-k^2{}_{12}-k^2{}_{23})}}.$$

whilst in the intermediate circuit only currents of the periodicity m_1 are generated.

Electric Railway Contact Systems.*

By Sir PHILIP DAWSON.

(*Concluded from p.* 59.)

Conductor Rails.

Owing to the large mileage installed in this country much information is available on conductor rails. At the present moment there are three types of conductor rails in general use :—

Over-running, where the shoe rests on the top portion of the rail, being kept there by means of gravity or springs, as is the case on various British railways.

Under-running, where the current is collected from the lower surface of the rail, the rail being supported from the top and the contact being pressed upwards by means of springs against the conductor rail. This system is not in use in this country, although it is largely installed in the United States and on the Continent.

Side-running, such as was designed and installed by Sir John Aspinall on the Manchester-Bury section of the Lancashire and Yorkshire Railway, where the current is collected from the side of the conductor rail by means of a collector pressed laterally against the conductor rail by means of springs.

Conductor rails have to be interrupted at crossings and at complicated portions of the track, and in order to enable trains to leave and again make contact with the conductor rail at high speed either vertical or lateral ramps have to be installed to bring the collector shoe into gradual touch with the conductor rail. Jumper cables have to be provided in order to connect electrically the different sections of the conductor-rail system. Where possible these should be laid either above ground or on the surface, so as to be easily accessible. The shape of the conductor rail varies very much and no standard exists for this at present.

As regards gaps, with pressures up to 1,300 volts no great troubles with over-pressures have so far been encountered owing to contact shoes making and breaking contact. It is, therefore, possible to coast over lengthy gaps where multiple-unit trains are used. This, however, becomes difficult if not impossible where electric locomotives are used to haul heavy loads and where a gap would mean a complete interruption of energy to the train. In order to overcome this difficulty an overhead construction to carry an overhead conductor rail may be necessary. With conductor rails operating at 600 volts under normal conditions no protection is required or advisable. The number of fatal accidents due to persons coming into contact with the conductor rail is very small, and such accidents have more generally occurred in the case of trespassers than of employees. Where, however, a pressure of 1,200 or 1,500 volts is in use, the conductor rail must be protected. A suitable form of protection of Jarrah wood for a side contact has been adopted by the Lancashire and Yorkshire Railway on their Manchester-Bury section.

The only serious delays so far caused in this country on conductor-rail systems have been due to the rail becoming covered with a thin layer of ice. This difficulty appears to be overcome either by under-running or by side-running. The loss of rail due to wear and tear and corrosion in open air is about 1 lb. per yard per annum, half due to wear and half to corrosion.

There are two definite systems of conductor rail in operation and a third has been proposed. The Metropolitan and the Metropolitan District Railways, owing to the fear of the drop in the return circuit being limited to such a figure by the Board of Trade as to make it difficult to realise with an ordinary track rail return, have adopted double conductor rails, the track rails not being utilised as a part of the return circuit. This arrangement has drawbacks in connection with insulation of the apparatus on the trains, and increases capital and maintenance costs. The other system, adopted by the North-Eastern, the Lancashire & Yorkshire, and the London & South-Western Railways, uses only one insulated conductor rail, the track rails being utilised for the return circuit either with or without a supplementary bonded rail or return conductor.

With a view to employing 3,000 volts, but avoiding motors wound for a higher pressure than 1,500 volts, and in order to eliminate large return currents through the track rails, Mr. Raworth proposes the use of two insulated conductor rails per track, the track rails serving as a neutral. A similar system has been running for some years on the Nord-Sud line in Paris.

Voltage Drops in Earth-return Circuits.

At the present time there have been considerable departures from the original Board of Trade standard for maximum voltage drop in rails of electric tramways where direct-current systems are concerned. The maximum allowance of 7 volts imposed on tramways has compelled railways electrified under parliamentary powers to install insulated return-current conductor rails. Other railways not so situated are operated with rail drops perhaps exceeding for short periods 20 times that figure. Either, therefore, the Board of Trade limit, as imposed on tramways, is unduly severe if applied to railways, or damage in the form of electrolysis must sooner or later involve considerable trouble. Since sub-station distance, and therefore the economic operation of direct and alternating-current systems, are directly affected by rail drop, some step should be taken to remove this anomaly.

It was formerly considered that alternating current had no harmful electrolytic effect, and in any case this effect is very small, and the Board of Trade allow a higher pressure drop. The first regulation laid down was 200 volt-minutes for a period not exceeding 10 minutes, which means that for short periods the drop may be twice as much. The question of cost is very largely governed by the number of substations, and this in its turn is governed by the maximum drop allowed in the track return. Inductive effects have not proved by any means so troublesome as had been prophesied, the effects of rail impedance being largely counterbalanced by the comparatively small current transmitted in the alternating-current system.

Conclusion.

It is not proposed to make any comparison between the merits of conductor rails and the overhead system. But the presence of a charged rail near the track must increase the cost of maintaining the permanent way, and men working on track with a charged rail have been authorised to receive special extra pay at the rate of 2s. per week. By using overhead conductors, this difficulty is removed except for an appreciable but unimportant increase in the cost of painting of the valances of the roofs at stations near which the live conductor passes.

DISCUSSION.

The President (Mr. Roger T. Smith) said that overhead wires were essential for direct current when any pressure above 1,500 volts was used; that being so, Sir Philip Dawson's description of the details of the overhead construction of the Brighton Railway was very useful. Where steam traction during the war did not play havoc with the corrodible parts, the cost of maintenance of this overhead construction compared very favourably with any third rail system. The important part of the Paper was the full information given as to the essential clearances between electrified metal and earthed metal, and the principles laid down fairly summarised the standard up to 11,000 volts. The curves showing the percentage variation in maintenance with time were also important.

Mr. J. Dalziel (Midland Railway Company) believed it was universally agreed that for main-line electrification 600 volts was too low. He doubted whether 1,500 volts was high enough to satisfy technical conditions, but he was sure it was too high for use on a conductor rail under British main-line conditions. He agreed that the presence of conductor rails materially increased the cost of maintenance of the permanent way, while the constant breaks in continuity made high-speed working problematical. Gaps in conducting rails could be bridged over by bows, but at high speed a good many of the bows would be wrecked, because of drivers forgetting to lower them in time. The overhead system throughout presented a much simpler problem. It did not interfere with track maintenance, and the overhead equipment need not be costly. The clearances on the Midland single-phase line at Heysham were very similar to those on the Brighton line. With regard to the limitation in current imposed by overhead conductors, on the Chicago, Milwaukee and St. Paul line, currents were collected up to 2,000 amperes with a single bow with a double shoe from a double trolley wire. On this basis, at 1,500 volts, 750 kw. seemed to be the maximum for a single shoe on a single wire. He thought, however, that present-day requirements pointed to a higher voltage than 1,500 being used—say 3,000 direct current. This might have to be paid for in, say, 10 per cent. increased cost of locomotive equipment, and there might also be an increase in maintenance costs. Compensation for these increased costs could be obtained in reduction of sub-station expenses. It was desirable to increase the contact line voltage to widen spacing and to increase the load factor. The regulation as to return rail drop, however, imposed a distinct limit to this, which could only be relieved by providing feeders or boosting. On a main line, electrolysis troubles should be non-existent. A rail drop in excess of the standard 7 volts was, therefore, permissible, and a suitable value would be such as to be reasonably safe for a man to receive, say, 100 volts.

Sir James Ball (L.B. & S.C. Railway) said, as permanent way engineer, he could speak as to the advantages from the point of view of ease and convenience of maintenance of the use of overhead wires. The use of electric power in any form on railways, especially in tunnels, enabled electric lighting to be used, so that the work could be done much more quickly and comfortably.

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* Abstract of Paper read before the Institution of Electrical Engineers.

Mr. H. E. O'Brien (Lancashire & Yorkshire Railway) thought that, from the railwayman's point of view, both the overhead and contact system of electric traction had serious disadvantages. The overhead system had the disadvantage of the difficulty of finding places for the supporting structure. It was more difficult to be able to estimate the cost of overhead construction than contact rail construction. The surface rail construction was a nuisance to the ground staff. He would like to know to what extent the overhead construction on the Brighton line involved alterations to the signalling, and what such rearrangement cost. It appeared from the curves in the Paper that the wear on the trolley wires of an overhead construction at 1,500 volts would be very serious indeed, because this voltage involved heavy currents. Electrolysis was not caused by electric railways, and he hoped that railways would be given a free hand in the matter of voltage drop in the future.

Mr. H. W. Firth (Great Eastern Railway) thought it would be a difficult thing at the moment to agree as to the best voltage for main-line working. With regard to the third-rail system, the only satisfactory one was the inverted under-running type used on the New York Central. The construction clearances in this country, however, precluded the use of such rails. It was desirable to have the question of voltage drop settled definitely. Either 7 volts was right, and should be insisted upon, or it was wrong and should be replaced. He would like to know if the author thought pull offs and their complication was necessary. In any comparison of the cost, the cost of the job from beginning to end must be taken, and not merely the cost of the overhead or contact equipment. He could not conceive how big shunting yards were going to be dealt with on the contact rail system.

Mr. G. L. Drury (North Eastern Railway) exhibited some contact strips which had been in use on the N.E.R. with heavy electrical locomotives, to illustrate the amount of punishment which such strips got with currents up to 1,000 amperes per locomotive. One type was the Continental bow, of which there were four per locomotive, the usual accelerating current being 900 amperes, or 225 amperes per contact. There were two overhead wires, and there was a considerable amount of burning with the bow used on the Milwaukee, Chicago & St. Paul Railway. There were copper contact strips, and four points of contact for each pair, there being two pairs for each locomotive, so that there was approximately 250 amperes per contact. The Continental type of bow had to be scrapped after 7,000 miles, and the American after 8,500 miles, and the cost of replacing the strips, after allowing for the scrap brass and aluminium, was from £3 10s. to £4. He would like to know if the author had had any trouble from lightning.

Mr. H. M. Sayers said it seemed to him that the overhead equipment on the Brighton line was unnecessarily heavy, and the factors of safety were unnecessarily high. Economic considerations would force us to use higher pressures for railway electrification in the future, quite independently of system. He did not think the wear of bows need be regarded as serious, and it was better to sacrifice the bow than the wire, because it was cheaper to replace. Had the author any information with regard to inductive interference with wires in the vicinity? There was little information published on this subject, although a good deal of confidential information existed. The use of the overhead or contact system resolved itself into a question of the total economy of the whole system, and with regard to the use of the fourth rail with the contact system, he believed there was some doubt about track circuiting if the track rails were used as return, and that was one reason why the fourth rail was used. That difficulty, however, could be got over by using alternating current for track signalling circuits.

Mr. G. W. Partridge wondered whether lightning had been the cause of the failure of some of the insulators. The double insulators, being in series, there was nothing to show if one had broken down. It might be better to have a fuse or spark-gap which gave an indication when one of the insulators had failed.

Sir Philip Dawson, in reply, said there was no experience extending over any considerable period of lines having a very heavy service, so that it was difficult to say what the wear and tear might mean on overhead construction with low pressures where heavy currents had to be collected. He agreed with Mr. Dalziel as to the possibility of damage to the collector when passing from third rail to overhead on high-speed lines. He could not give Mr. O'Brien definite figures of the proportion of cost of the overhead construction, but it was a comparatively easy thing in laying out an overhead system to fix the price beforehand to within 5 or 6 per cent. Mr. H. M. Sayers was quite right in saying that the overhead construction was heavy. The fact was that no chances of failure of any kind were run when the line was put up. The experience gained with it had enabled a very much simpler construction to be got out. Except in very few instances, the signalling had not been interfered with at all by the overhead construction. He would hesitate to use anything more than 1,500 volts with a contact rail system, and even 600 volts on a contact system had to be treated with great respect. The question of the proper voltage for main-line work, raised by Mr. Firth, was an extremely difficult and thorny problem. It would be very much nicer if they could use a very low voltage, but in order to collect the currents necessary with main-line operation it was essential to go to higher voltages, and he was convinced that it would be necessary to go to pressures which would involve the use of overhead construction for the purpose. The normal current collected by one bow strip on the Brighton Railway when running at full speed was between 30 and 40 amperes, and the maximum current collected at starting was 120 amperes. Bow wear on the Brighton line was extremely small, and there had been no trouble from lightning.

Good Lighting in a Boiler Works.

The productive value of good industrial lighting has been so often discussed during the last few years that any factory owner still unconvinced of the advantages of improved illumination must be numbered amongst those determined doubters whose faith always depends upon practical example. Fortunately there is no lack of concrete evidence as to the beneficial effects of scientific lighting. The British Thomson-Houston Company, Ltd., who have made a particular study of the requirements of industrial lighting, and have designed many hundreds of installations employing Mazdalux metal reflectors and Mazda lamps, are in possession of much testimony on this point. Factory owners and managers who have tried the Mazdalux system of lighting are agreed that improved illumination means improved production, both quantitatively and qualitatively, while it also has an important bearing on the visual comfort and well-being of the workers.

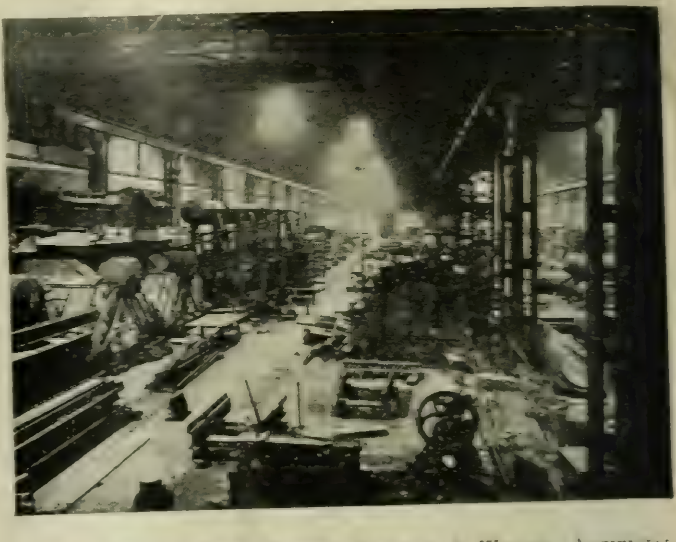

Fig. 1.—Marine Shop, Messrs. Babcock & Wilcox. Artificial Lighting with Half-watt Type Lamps in Mazdalux Reflectors.

A new catalogue of Mazdalux reflectors recently issued by the British Thomson-Houston Company, Ltd., illustrates a number of typical successful installations. Since the publication of this catalogue, particulars of other installations have become available, the most notable of which is at the Renfrew works of Messrs. Babcock & Wilcox. Photographs, of which we give examples herewith, taken by artificial light in the marine shop, indicate the remarkable effectiveness of the illumination. But for the slight halation round the lighting units, they might easily be mistaken for daylight pictures. On the floor level the illumination is of high intensity and comparative uniformity and, what is of equal importance in a works where there are large castings and other light obstructors, the high suspension and scientific equipment of the units, and the good diffusion thereby secured, tend to reduce the shadow effect.

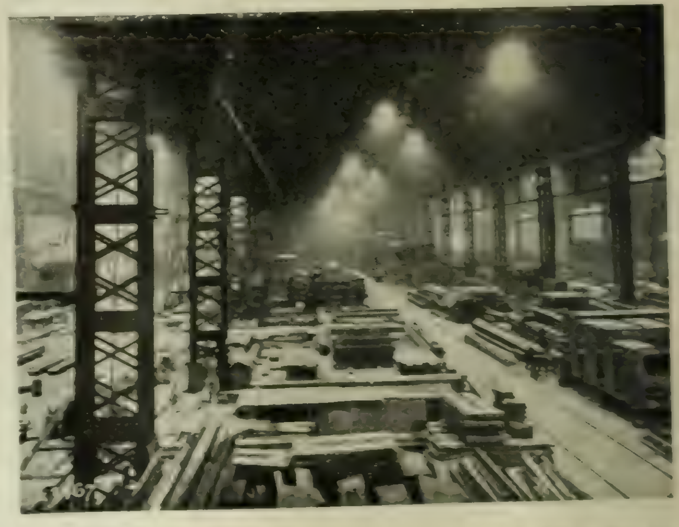

Fig. 2.—Another View of Marine Shop in the Boiler Works of Messrs. Babcock & Wilcox. Note the High Intensity and Uniform Illumination of the Mazdalux Illumination.

"Tricity" Cooking Apparatus.

The British Electric Transformer Company, Ltd., are experiencing a brisk and an increasing demand for their electric cooking and heating apparatus. Among some of their standard specialities may be mentioned the following :—Waxed Oak Combined Hot Cupboard and Hotplate, which is made by the company, is fitted with two compartments having drop doors, nickel-plated handles, nickel-plated top as warming plate, lined with aluminium and lagged with asbestos. The over-all dimensions are 2 ft. 3 in. wide by 1 ft. 6 in. deep by 2 ft. 10 in. high, the dimensions of each compartment being 1 ft. 11 in. wide by 1 ft. 1½ in. deep by 1 ft. high. The maximum loading is approximately 1 kw., the loading being equally divided. The hot-plate and cabinet are separately controlled. The interior of each compartment can be fitted with removable plate racks each holding 22 plates, or without the racks joints, vegetables, &c., may be kept warm. The cabinet may be made in various selections of wood to suit existing forms of decoration. One of these hot cupboards, which are extremely useful for the dining rooms of large private houses, hotels, &c., was installed some time ago in the directors' dining room at Paddington Station, and since then many similar cupboards have been supplied for town and country houses.

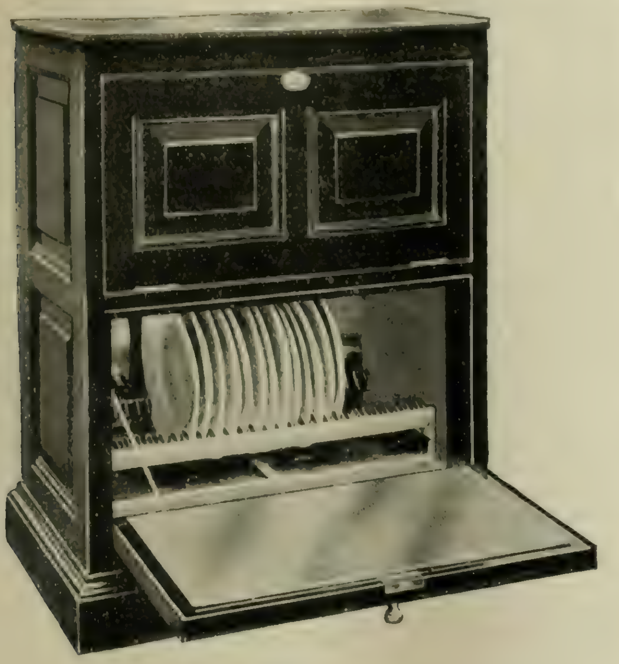

Fig. 1.

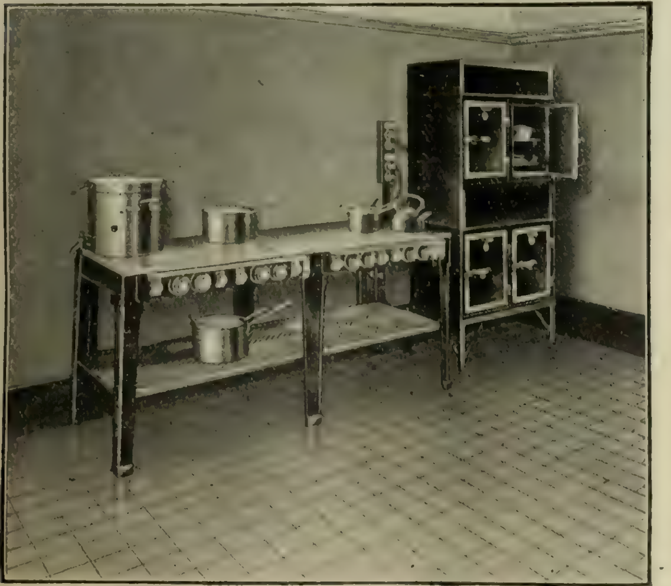

Fig. 2.

The company's boiling table measures 6 ft. 2 in. by 2 ft. and has eight hot spots. The top is cast iron with ground top and is in three sections with cast legs and skirting containing shelf underneath for plates, &c. The four hot spots in front are each loaded 1 kw. and the four at the back are 1.5 kw. each. Each hot spot is controlled by a three-heat switch and Zed fuse mounted on the front skirting. These tables are excellent for large hotels and restaurants. Two smaller sizes are also supplied one with four and one with six hot spots. The loading and arrangement of the hot plates on the smaller tables are exactly similar to those for the larger tables.

Each band of the two tier "Tricity" oven consists of four No. 593 or 593*a* standard type ovens arranged in two tiers (2 and 2) with hot shelves between the tiers and at top. The total maximum loading of a 593 oven is 1,500 watts and the switching arrangements are as follows:— The "on" and "off" switch in centre of panel controls the two top elements (total 500 watts); the lower switch controls the four bottom elements as follows: at "full" all elements (1,000 watts), at "medium" the two lower ones (500 watts) and at "low" two upper and two lower in series (250 watts). The 593*a* oven has an additional 100 watts at the top, giving a total maximum loading of 600 watts.

The National Physical Laboratory.

The annual report of the Executive Committee of the National Physical Laboratory for 1919, which has just been published, opens with a reference to the loss incurred by the Institution through the deaths of Lord Rayleigh and of Sir John Brunner.

Attention is also called to the retirement of the first Director of the Laboratory, Sir Richard Glazebrook, after holding the directorship for close upon 20 years. Of his services in that connection the Committee feel it is impossible to speak too highly. He raised the Laboratory, which commenced work on a small scale, to a great national institution of first rate importance and secured for it a commanding position among the great standardising laboratories of the world. The Committee desire to express their appreciation of the strenuous service he has rendered in the application of science to industry in this country. In this they will be joined by all engineers and scientists the world over.

New Development.

The past year has been marked by the further development of working the Laboratory under the financial control of the Treasury as a branch of the Department of Scientific and Industrial Research. The new aeronautics building to which reference was made in the last report is now nearing completion and will shortly be occupied. A portion of these buildings is to be used for clinical thermometer testing, the work on which has greatly increased owing to the order that all clinical thermometers sold in this country must have passed the laboratory test. The Advisory Council has now approved further buildings for the engineering, metallurgy, tank and electrotechnical departments, and for a staff canteen, though authority to proceed with the work in connection with these has not yet been received from the Treasury.

A scheme of salaries prepared by the Executive Committee in October 1917 has now been approved by the Treasury and an establishment has been fixed for the Laboratory. The conditions of service have generally been revised to bring them into line with those obtaining in the Civil Service.

Extensions of Commercial Test Work.

In 1918 proposals were submitted to the Committee for extensions in various directions of the test work undertaken by the Laboratory. These proposals included a scheme for a British electrical proving house brought forward by the Institution of Electrical Engineers, the establishment of a local station for testing gauges and other products at Birmingham, and for the testing of chemical glassware for volumetric measurements. These matters raised the general question of the relation of Government to the testing of ordinary commercial products and after careful consideration the Advisory Council of the Research Department reported "that the routine testing of ordinary commercial products is not and ought not to be within the functions either of the National Physical Laboratory or of this Department." This view is also, it is understood, held by the Government and proposals for State action for the promotion of standardisation are now under consideration. Temporarily the Committee continue to undertake some of the work referred to at Teddington pending the making of other arrangements.

The Electrical Department.

In May last the Board of Trade Electrical Standards Laboratory was moved to Teddington. During the war several of the members of the staffs of the electricity department have been very much occupied with special war problems, a full account of a number of which is given in the Report. They include the development of wireless directional apparatus, which early in the war was carried to a high degree of efficiency, the perfection of amplifying valves for various special purposes, improvements in compass magnets and the investigation of sound ranging and sound receiving apparatus. Much time was spent during the war on height finding apparatus and electrical transmission gear for use in aircraft work and in supervising the use of such installations in this country and in France.

Researches were also carried out for the Ordnance Committee on the velocity of gun projectiles and gun recoil, the results of which are of great interest. Since the armistice the fundamental work of electrical standardisation has been resumed and this will receive much attention during the coming year. Research on buried cables has made good progress and valuable work has been done in the investigation of resistance materials. A considerable amount of work has also been done in an advisory capacity in connection with the design of gauges from standard specification issued by the British Engineering Standards Association.

An investigation has been carried out with the Lubrication Committee of the Research Department on the lubricating efficiency of a series of animal, vegetable and mineral oils. This has furnished results of importance. In connection with this work apparatus was designed and constructed in the department for the determination of the viscosity of oils at high pressures. The problem was one of considerable difficulty and the method employed presents novel and interesting features. The experiments are of importance in connection with the cooling of aero engines.

The Victory Exhibition.

Whilst the Imperial War Museum at the Crystal Palace provides infinite interest for the adult and delight for the youngster, it is impossible to enthuse greatly over the "Great Victory Exhibition" which is attached to it. Frankly it is disappointing as an exhibition, not on account of the quality of the exhibits, but of the small number, and it requires a little stretch of the imagination to appreciate the grandiose title given to it.

The exhibition, apart from the War Museum, has been divided into four sections: Electrical, oil, gas and engineering, and the electrical section is the poorest of the lot. In all there are seventeen stands in the electrical portion, but one or two are, presumably, included, because of the lack of any other suitable place for them. The engineering section has 29 stands; but 10 of them belong to one firm and its associated undertakings, and are really one large stand. The oil section has 10 stands and the gas section 13 stands. It will thus be seen that from the point of view of numbers, if the exhibits are to be regarded as the Great Victory Exhibition, and the remainder the War Museum, a somewhat less pretentious title would have been more in keeping with the actual fact.

The only exhibit of anything approaching large apparatus in the electrical section is that of W. Geipel & Co., of Vulcan Works, St. Thomas-street, London, S.E. The outstanding feature of this is a contactor type panel for the automatic control of direct-current motors for air compressors, pumps, &c., which has recently been placed on the market, and is, we are assured, proving very successful. The panel consists of a single pole contactor type main switch, operating in the main circuit between magnetic blow-outs and a master rheostat of novel construction, being a series of contact fingers corresponding to the number of rheostat contactors. All the contactor-operating coils are arranged in series in a common circuit, and are short-circuited when the master controller is in the off position. The operation of the master solenoid brings these into operation one after another, until the whole of the resistance is cut out. The exhibit also comprises hand starters for direct-current motors, shunt regulators, combined starters and speed regulators, both for shunt and series operation, rotor starters, star delta and series parallel drum type starters; also the well-known Ward-Leonard theatre dimmers, shunt regulators and vitreous resister units. There are, in addition, sections of various sizes and qualities of vulcanised rubber insulated wires and cables, which are manufactured throughout at the firm's works at Wembley, Middlesex, in accordance with the B.E.S.A. standards. Geipel's patent steam traps are to be seen on this stand, as well as Okonite & Manson insulating and protective tapes, which are the principal tapes used throughout the U.S.A.

Messrs. F. L. Mitchell & Co., of 188, Rye Lane, London, S.E., have a well-stocked exhibit of wireless telegraphic and telephonic apparatus, this firm undertaking a great deal of apparatus manufacture for experimental work. Some captured German wireless apparatus is also staged, but the firm is anxious for it to be made known that this is not imported German apparatus for sale. Messrs. Mitchell & Co. are British to the backbone. The main exhibit is the "world wide" receiving set, which is the firm's latest production, and covers all ranges of wave lengths from 150 to 25,000. The inductors are wound by a special process to eliminate capacity effects as far as is practically possible. The combination of selection switches render very fine adjustment possible. Four valves are used with this set, two for high-frequency amplifiers, and two for low-frequency, with separate high-tension batteries for each pair of valves. The outfit is contained in a cabinet about 3 ft. square. The claim made for this apparatus is that it will receive messages from any average power station in the world. Another exhibit is a new type three-valve amplifier, by means of which an almost unlimited variety of circuits can be arranged by connecting or disconnecting to the terminals mounted on the amplifier. These latter intercommunicate with plate and grid connections inside the instrument.

A large selection of various wires and cables is shown by the London Electric Wire Company and Smiths (Ltd.), of London and Salford, especially silk cotton and enamel-covered wires, high-resistance wires, telephone cords and lighting flexibles, bell wires, fuse wires, &c., all of which are manufactured in London. The Salford branch of the firm manufactures bare copper wires, strips and bronze wires, &c.

Three firms show ebonite insulating material, viz.: The British Ebonite Company, Ltd., of Hanwell, London; Ebonestos Insulators, Ltd., of Old Kent Road, London; and Messrs. Attwater & Sons, of Preston.

Domestic electrical appliances have the largest number of exhibitors. Suction carpet sweepers are shown by The Hoover Suction Sweeper Company, Ltd., of Regent Street, London; and Magic Appliances, Ltd., of Westminster Bridge Road, London. Both are now well known, but it may be mentioned that the special claim is made for the former that it is the only carpet sweeper which raises the carpet from the floor and beats the embedded dirt out of the texture. Then we have the Thor Electric Washing Machine shown by Messrs. Chas. Beck & Company, Ltd., of New Bond Street, London, together with the Thor Electric Ironer, and the Thor Vacuum Cleaner. The washing machine is said to consume but a pennyworth of electricity per hour. The ironer is only partly electrical inasmuch as the "shoe" has to be heated by gas or petrol.

There is no need to give a minute description of the "Rawlplug" shown by the Rawlplug Company, Ltd., of Lenthall Place, Gloucester Road, London, nor of the electric clocks of the Synchronome Company, Ltd., of Clerkenwell Road. The patent fibre plug—"Rawlplug"—is finding a tremendous clientèle by reason of the manner in which it can be used without damaging walls. The Synchronome Company provide the time-keeping service throughout the electrical and engineering sections of the Exhibition, the various clocks being operated from one self-wound controlling pendulum or master clock exhibited in the electrical section.

X-Ray apparatus is shown by Messrs. A. Winston & Company, Ltd., of 32, Regent Street, London.

The Engineering Section.

Electrical engineers will find much to interest them in the engineering section, but as it is of a general character, and not specially electrical, it can hardly find detailed reference here. The same applies to the oil section. Whether the line of development will be in the direction of burning oil fuel under boilers in electricity works we would not care to prophesy. There are many who hold the view that it is a sinful waste to burn oil under boilers at all, having regard to the possibility of a shortage of petroleum oils in the not far distant future. However, that may be, there are several types of apparatus for burning oil under steam boilers, although up to now the greatest application of these has been for marine purposes. At the same time, the high price, poor quality and uncertain deliveries of coal are directing the thoughts of engineers more and more into the direction of using oil fuel, despite the recent pleading of the Director of Fuel Research, Sir George Beilby, for greater development in the economical use of solid fuel. There are several Diesel engines, including that historic engine, the first ever made in England, viz., in 1897, which is still in working order.

So far as the War Museum is concerned, the North East Gallery of the Crystal Palace is given up to "Signals," and here may be seen telegraphs, telephones, Fullerphones, cables, air-line stores, wireless apparatus, &c. Elsewhere may be seen relics from captured and surrendered German submarines, including electric frying pans, kettles and cookers; captured cable wagons, and wireless sets, &c,

Heating and Cooking Notes.

NEW APPARATUS.—A "CREDA" KETTLE.

The most recent addition to the range of domestic appliances manufactured by Messrs. CREDENDA CONDUITS COMPANY, LTD., is a kettle especially designed for table use. Its pleasing design on the lines of high-class silverware make it a most suitable ornament for an artistically laid tea table, and it should therefore appeal to buyers looking for a utility present. It is heavily nickel plated, and the loading is 600 watts, so that in the majority of cases it could be used off a lampholder. The capacity of the kettle is 2½ pints, which content can be raised to boiling point in 15 minutes, the cost when used off a lighting circuit with electricity at 8d. per unit being approximately 1⅓d. Suitable legs are provided to permit the kettle being used on a polished table without risk of damaging the polish with heat, and the plug pin connections are protected by a sheet metal guard.

"SMOOVIT" ELECTRIC IRON.

The ENTERPRISE MANUFACTURING COMPANY, LTD., have placed on the market an electric iron of two sizes, 5 lb. and 6 lb. in weight respectively. The iron is provided with a wire attachment fixed to the back end, which allows the iron to be stood on end when not in use, and a lengthy spiral wire guard protects the flex from the point where it leaves the connector. It is claimed that a special feature of the "Smoovit" iron is its capacity for maintaining adequate heat at the point of the iron.

AN UP-TO-DATE "TRICITY" LIST.

The BRITISH ELECTRIC TRANSFORMER COMPANY, LTD., have recently issued a complete catalogue of their well-known "Tricity" heating and cooking appliances. This list is quite comprehensive, and as all prices are quoted in a separate sheet the difficulty of continually altering prices in the list or making calculations on the Government Bonus system is avoided. New price sheets will be issued when the prices are revised. In addition to the catalogue a series of publicity cards, each dealing with a separate article, have also been produced, and should form a welcome selling aid to those dealing in this class of apparatus.

CARRON APPARATUS AT MAUDE'S RESTAURANT, OXFORD STREET.

An interesting commercial electric cooking equipment was completed at the above restaurant in the early part of this year, the contractors being the WESTMINSTER ELECTRICITY SUPPLY CORPN. The apparatus employed consists of a double-oven roasting range, a griller, fish fryer and a three-tier pastry oven, the total load being some 35 kw. The apparatus is of Carron manufacture, and this concern's lengthy experience in designing commercial cooking apparatus leaves little room for doubt that the installation will prove successful. In addition to the above-mentioned cooking appliances, Belling fires are employed for heating the dining hall.

THE NEW "HOTPOINT" ELEMENT.

Some time back the HOTPOINT COMPANY OF AMERICA produced a new type of element with a view to overcoming difficulties experienced in cooking apparatus due to food boiling over and to uneven temperature gradients on leading in and connection portions of the element. Briefly the method now employed consists of placing a resistance alloy along the centre of a seamless steel tube and filling in the space between the alloy and the steel tube with insulating material. The tube is then passed through a series of rolling operations until it is reduced to a quite small diameter, the resulting product being an insulated alloy wire which is mechanically protected by a steel housing. Special means are taken in the rolling process, so that the ends of the alloy wire which are allowed to protrude for connection purposes are left larger in diameter than the portion of the alloy wire which is contained in the metal tube. Thus perfectly cool and satisfactory terminal connections can be made. "Hotpoint" cookers, containing elements made on this principle, can now be seen at the showrooms of Messrs. Duncan, Watson & Company, who are now acting as the selling agents for the Hotpoint range of domestic cooking appliances. There are many features of interest about Hotpoint cookers other than the elements. The hob and oven are mounted at waist level, thus facilitating the housewife's task in lifting utensils. The doors of the oven open similarly to a ship's galley, so that the oven door acts as a shelf. The oven elements are mounted top and bottom, and can be removed just as easily and completely as a shelf, a method which greatly facilitates cleaning. The oven is divided into two portions, one above the other, with separate doors, and a hot closet is arranged above the upper oven. The hob is roomy, and all switches are mounted just below the hob to the left of the oven. The convenience of the cook seems to have been carefully studied in every detail, but, of course, sidemounting for the hob means that the cooker occupies more linear space than the vertical type of cooker does. This is a factor of some importance in small houses or flats where space is limited.

THE SCOPE FOR DOMESTIC APPLIANCES.

An interesting survey was recently made by our contemporary, the "Electrical World of New York," with a view to ascertaining what demand existed for domestic appliances outside the U.S.A. Figures were compiled from census reports, handbooks, consular notes, &c., and a set of statistics arrived at showing the percentage population of various countries that lived in houses wired with electric light. So far as British possessions were concerned, the figures arrived at were as follows:—

Country.	Population.	Per cent. of population living in electrically lighted houses.
Australia	5,792,000	11·2
Bermudas	23,000	14·0
Egypt	11,207,000	0·2
New Zealand	1,099,500	14·3
Union of South Africa	6,000,000	3·3
United Kingdom	46,089,000	16·5

Taking the United Kingdom and assuming that an average of four persons live in each electrically lighted house then the number of such houses is approximately 1,900,000. Each of these houses is a possible resting place for an iron, kettle, toaster, if not for a cooker and radiator. There is, therefore, considerable opportunity for developing the use of domestic appliances, provided adequate selling efforts are made co-operatively by all parties concerned.

Patents and Designs in 1919.

The Comptroller-General of Patents reports that in 1919 there were 173 applications under the Trading with the Enemy Amendment Acts, 1916 and 1918, for the grant of licences and 152 were granted. One application for the avoidance of the registration of a trade mark was received and refused. 725 notifications of the deposit of documents relating to foreign patents, designs and trade marks were deposited during the year.

The receipts from patent fees were £364,381, and from designs fees £7,477, increases of £49,950 and £1,710 over the respective amounts for 1918. The total receipts were £404,475, an increase of £59,070. The surplus of receipts over expenditure was £54,324. The total number of persons in the employment of the office at the end of the year was 658. The number of readers who made use of the Library was 98,618, against 65,076 in 1918. The number of volumes added was 4,147. The number of works in the Library at the end of the year was 58,112.

PATENT FEES AND RENEWALS.

The amount received from renewal fees again exceeded the previous best, the figures being £247,408, against £232,629. There was a remarkable recovery in the work of the office, the number of applications and specifications filed being the highest on record. Applications numbered 32,853, or 1,901 more than in any previous year, and an increase of 11,014 over 1918. There was an equally notable increase in the complete specifications filed, which numbered 18,922, an increase of 5,659, or 42·7 per cent. The applications received from women inventors numbered 306 against 286 in 1918. The applications made by way of communication from abroad numbered 1,320 compared with 787. Under the provisions of the International Convention for the Protection of Industrial Property 2,661 applications were made, an increase of 699. The number of applications post-dated in consequence of disconformity between the complete and provisional specification was 220, and the number of applications for patents of addition 531, compared with 175 and 428 respectively. The number of cases in which complete specifications were filed in respect of cognate provisional specifications was 503, against 355. The number of new patents sealed in 1919 was 12,301.

RESTORATION AND REVOCATION OF PATENTS.

The number of applications for the restoration of lapsed patents was 25, of which 3 are still pending, and in the remaining 22 cases the patent was restored. There were seven applications for revocation of patents within two years from the date of the patent. One of these was withdrawn, one returned as being out of time, and two cases are still pending. Of the remaining three cases one was dismissed, one patent was revoked, and in third case an order was made requiring an amendment of the specification. Four petitions for extension of term, one relating to a patent of the year 1905, and three to patents of 1906, were lodged. The first mentioned case has not yet been decided, whilst, as regards the three patents of 1906, consideration of the petitions has in two instances been adjourned *sine die* by the Court in view of the terms of Sect. 6 (2) of the Patents and Designs Act, 1919. There are now five patents in force which have been prolonged beyond the normal period of 14 years.

DESIGNS AND TRADE MARKS.

The number of applications to register designs was 14,094, including 335 sets, compared with 10,019 (194 sets) in 1918. The number of designs of which the copyright was extended for a second period of five years was 3,141, and the number of which the copyright was extended for a third period of five years was 886.

The number of applications for the registration of trade marks (including 235 applications made to the Cutlers' Company of Sheffield) was 12,479, compared with 6,968. Of the Trade Marks registered in 1905, registration was renewed for a second period of 14 years in 2,800 cases, of those registered in 1891, for a third period of 14 years in 1,824 cases, and of those registered in 1877, for a fourth period in 1,648 cases. During the year 5,991 trade marks were advertised and 4,837 registered.

A New Method of Producing High-Tension Direct Current.*

By M. SCHENKEL.

For many scientific and practical purposes, small high-tension direct currents are required. Sometimes a few milliamperes are all that is necessary. Generally, accumulators in series have been used, but they are very inconvenient, so that high-tension machinery has sometimes been employed, or even electrostatic devices, in which a condenser is always used. The condenser is certainly simple and cheap, but its voltage rapidly falls off. In order to keep up the voltage, some method of charging it continually must be used. Among these plans may be mentioned those employing rotating contact pieces, which connect the condenser intermittently with the poles of an alternating-current source of power, those employing valve cells, and lastly the so-called vacuum valve tubes. Delon's device, which has already been described by Lichtenstein, is among those which employ rotating contact pieces. Greinacher has used valve cells to produce direct-current voltages up to 10,000; but both these plans have the disadvantage that an external source of power of relatively high voltage must be provided, for a single condenser can at most be charged to a voltage which is equal to $\sqrt{2}$ time, the effective voltage of the external source. With Delon's and Greinacher's methods, the former of which employs two condensers and two valve cells, the maximum voltage that can be reached is 2·83 times that of the source of alternate-current power. In order to produce 100,000 volts on direct current it is necessary to have an alternate voltage at least of 40,000 volts; this requires a good deal of space and many accessories.

In the present article a new plan is described which also employs condensers, but the necessary alternate-current voltage is much less than before. Let us suppose an alternate-current source of power represented by the winding *W* in Fig. 1. Let it be joined in series with the condenser *C* and the valve tube *V*; then, as the current passes in the one direction in the winding, the condenser is charged to the maximum value of that voltage, and let us suppose this maximum value to be .$\sqrt{2}$. While in this first half cycle—*i.e.*, during the charging of the condenser—the voltage of the winding is opposed to that of the condenser, in the other half they will both be in the same direction, so that the winding, together with the condenser, will have a maximum voltage of $2\sqrt{2}$. The arrows in Fig. 1 are intended to show this. The new arrangement consists in adding another condenser and valve tube, so that the second condenser becomes charged when this maximum voltage of $2\sqrt{2}$ occurs. This second condenser, then, becomes charged with the maximum voltage of $2\sqrt{2}$, and the charge cannot be lost in consequence of the valve tube. At the next reversal of direction a third condenser can be charged to $3\sqrt{2}$, and, if the process is further continued, the voltage can be still further magnified. Thus, if there are five condensers, and an original alternate-current voltage of 15,000, the fifth condenser will be charged to a voltage of 106,000 volts. If we suppose the winding *W* to be disconnected, then the condensers will endeavour to discharge through the valve tubes. In Fig. 1 there are five valve tubes in series, and the voltage is distributed between them. The discharge voltage through each is, therefore, comparatively low. If current is taken from the last of the condensers, it is immediately re-charged by the winding *W*, and this takes place through the agency of the other condenser; thus the sizes of the condensers vary, and the ones with the highest voltage are the smallest, and the one next the winding will be the largest. In Fig. 1 it is assumed that high-voltage valve tubes are used with cathodes which are heated with current from an external source. The heating terminals are shown at *a* and *b*. The anodes are shown at *A*. Of course, any other kind of electric valve can be used, if it is capable of withstanding the voltage, or even mechanical commutators. In the latter case we should have a number of rotating contact pieces, mounted on one spindle. This would become somewhat similar to Delon's method, though it would be simpler, and would not require such a high alternate-current voltage.

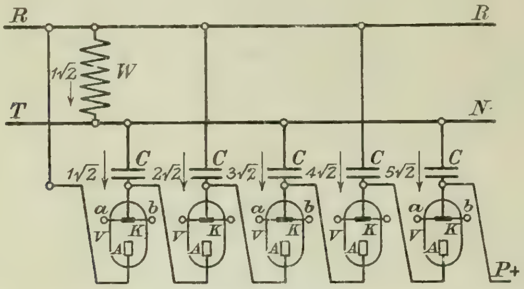

Diagram showing the Connections for Producing High-tension Direct Current by Means of Condensers and Valve Tubes.

The advantage of the new system lies specially in the low cost of the apparatus. If a small amount of current is required, the condensers can be small and cheap. Leyden jars are quite sufficient. The valve tubes are not very expensive. The low voltage of the alternate current is a great convenience. Under suitable conditions, ordinary transformers can be used. The accumulators that are necessary for heating the cathodes are the only external accessory. By adjusting the original alternate-current voltage any desired voltage on direct current can be produced, or if the voltage is taken from different condensers, then, again, different voltages with direct current are possible. The high-tension valve tubes protect the arrangement against overloads, as they do not allow more current to pass than that which corresponds to their saturation point. When not in use it can be safely handled. The maximum voltage is not developed in the winding, but in one of the condensers; this is an advantage, inasmuch as a breakdown in the winding might be difficult to repair under many conditions, whereas a condenser or valve tube might conceivably be repaired without great difficulty. In any case, the cheapness of condensers and valve tubes makes it possible to keep a few in stock. The condensers are very easily and quickly charged, so that the direct-current voltage is at once available, and remains substantially constant. Its constancy depends on that of the alternate-current supply.

The defects of the system are, in the first place, that it gives very little current. If a large current is necessary, the capacities must be great, and the apparatus becomes expensive; but this case is not common. Usually a small current suffices. A further disadvantage is the high tension to which the valve tubes and condensers are continuously exposed. The insulation must, therefore, be very carefully designed. Insulation of this sort is not impossible in the present state of our knowledge, but there are, obviously, limitations due to radiation into the air. The device is described in the German patent No. 310,356, which is the property of the Siemens Schuckert works.

Correspondence.

MR. GEORGE HELPS AND THERMAL EFFICIENCY

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Mr. George Helps, in his letter published in your last issue, obviously fails to understand or to answer my letter dated June 25. He defends the use of methods of calculating and comparison found in his patent specification of 1917 (No. 111,495), which I have not attacked, and then passes on to an extremely irrelevant and fallacious attack on the conclusions of the Clerk-Smithells-and-Cobb Report of April 14, 1919.

To assist Mr. Helps to a comprehension of the true position it is desirable to state the facts very briefly. For some years past Mr. Helps has been endeavouring to improve the methods of coal gas manufacture, and on August 26, 1916, he applied for provisional protection for an invention for which he filed the Complete Specification on March 26, 1917. In the Complete Specification he makes detailed calculations of the course and results of "Present Gas Works Practice," "Carbonising Coal—Coke Making," at page 5 of the specification. At pages 6 and 7 he makes similar calculations for what he calls "Practice according to this invention" Gasifying Coal—Gas Making.

In both cases he calculates out the efficiency of the gas-making process, for the first case as 56 per cent. and for the second case, 83 per cent. The first case dealt with what Mr. Helps considered as ordinary gas works practice in 1917, and the second case with complete gasification of coal by processes which are not specifically described but from indications given may have been modifications of the ordinary long-established water-gas plant. The efficiency given for complete gasification is obviously an efficiency hoped for but not yet obtained in water-gas plant. The efficiency given by Mr. Helps on page 5 for "Present Gas Works Practice" is obviously the result of actual tests within Mr. Helps' personal knowledge.

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* Abstract of an article in the "Elektrotechnische Zeitschrift," No. 28, 1919.

So far as ordinary gas making by carbonising was concerned, it is important to note that Mr. Helps had calculated the thermal efficiency as 56 per cent. in the year 1917. At that time he could no doubt have said that if all gas works of the country were as efficient as those he tested, the efficiency of gas making or generation was 56 per cent.

In the latter half of 1918, Messrs. Clerk, Smithells and Cobb were asked by the then President of the Institution of Gas Engineers, Mr. Samuel Glover, to consider among other things the thermal efficiency of gas production or generation as practised in the United Kingdom at the whole of the gas works of the country, and arrive if possible at the average efficiency for a year's working. This was a difficult problem, but they ultimately obtained sufficient data of the ordinary practical operations to come to a general conclusion. The thermal efficiencies of a year's gas making at the Gas Light & Coke Company and the South Metropolitan Gas Company were determined respectively as 47·8 and 46·3 per cent. That of a separate test of horizontal retort carbonising by Mr. Ferguson Bell was found to be 57·4 per cent. The three values, 47·8, 46·3 and 57·4 per cent. of Clerk, Smithells and Cobb in 1918 thus agree well with the 56 per cent. found by Mr. Helps about a year earlier. The methods of calculation used in 1917 by Helps and by Clerk, Smithells and Cobb in 1918 were identical, and they were made independently of each other.

It is difficult to see where Mr. Helps differs from me now; we were certainly agreed both as to results and methods of calculation, comparing with Mr. Helps of 1917. But Mr. Helps of 1917 appears to be a very different man from Mr. Helps of 1920.

He now contends that the method used by himself and by Clerk, Smithells and Cobb was erroneous, as "only 50 parts are gasified, as roundly 50 parts of coke are left over and allowed for at 100 per cent. efficiency."

Here he needlessly accuses himself and me of serious error, and he does this because he misuses the term "efficiency." There is no question of thermal efficiency involved here. The coke can readily evolve 50 per cent. of the original heat of the coal and as economically apply that heat to useful purposes as the original coal; consequently the whole of its heat must be considered as still available for use. No question of thermal efficiency of coke production arises in that connection; consequently no error has been made by Mr. Helps of 1917 or by me in 1919.

Mr. Helps further boldly states that the thermal efficiencies of gas making cannot be compared with the thermal efficiencies of electricity generation, and that such comparisons "are entirely without foundation in fact."

It is indeed surprising that a man of Mr. George Helps' technical experience should be so ignorant of fundamental principles as to be capable of making and believing such statements.

Mr. Helps is anxious to be corrected; he is quite wrong in his opinion, and he may take comfort in the fact that I now correct him and direct his attention to the fact that all the efficiency calculations in the Clerk, Smithells and Cobb Report are based on working results with gas and electricity, both on the very largest scale.

With regard to Mr. Helps' postscript, he is quite wrong here also; he proposes no particular gas making apparatus or process in his specification and does not in any way indicate the use of a "continuous vertical gas retort" in combination with a water gas plant.

With reference to the editorial in "Gas," referred to in my letter of June 25, Mr. Helps' editor is as absurdly fallacious as Mr. Helps himself. The editorial contains many fallacies, including the following:—

(1) The efficiency of electro dynamic transformation in an electric motor is compared with the efficiency of thermodynamic transformation on a gas engine.

(2) The proportion of heat in gas produced from coal is taken as the thermal efficiency of gas production.

(3) The efficiencies of gas and electricity generation are confused with efficiencies of use of both in cooking and heating.

It may be worth while to write an article clearing up these matters later, but meantime it will prove a profitable exercise for Mr. Helps of the 1917 specification to reason with Mr. Helps of 1920 and his editor, so as to come back to an attitude of sanity with regard to the treatment of thermal and other efficiencies.—I am, &c.

London, W.C., July 10. DUGALD CLERK.

THE RAIL DROP QUESTION.

TO THE EDITOR OF THE ELECTRICIAN

SIR: The Editorial Note in your issue of July 9 and something said in the discussion on Sir Philip Dawson's Paper give the impression that the Board of Trade has by regulation limited the rail drop on electrical railways to 7 volts, as in the case of tramways. Sir Philip did not say that, but only that railways which have electrified under Parliamentary powers were *compelled* to use insulated return-current conductor rails by the *fear* of similar regulations. Some of the speakers in the discussion, including the President, gave a so much more positive turn to this statement that I thought there must be such a regulation extant, though it had escaped my notice, and in my own contribution to the debate I did not care to challenge what was so positively affirmed. I have since made enquiries and am assured by those who ought to know, that the Board of Trade has in no case prescribed any maximum voltage drop in track rails used as return conductors. There is a regulation, No. 8 in the 1905 reprint of the model regulations, providing that in metal tube lines, such rail returns must *either* be metallically connected to the metal tube at 100 yards intervals *or* that if insulated from the tube they shall be so connected, &c., that the P.D. between them and the metal tube shall not exceed 10 volts.

These general regulations clearly refer to continuous current lines. Sir Philip Dawson states that in the case of the Brighton alternating-current system a regulation was laid down that the rail drop should not exceed 200 volt minutes for a period not exceeding 10 minutes. It is not stated whether this was a Board of Trade regulation or a Post Office condition, but it is clearly a very different thing to the tramway 7 volts; and I think it will be found that the Board of Trade has on no occasion imposed or shown any desire to impose the tramway regulation or anything like it on the entirely different conditions of railways.—I am, &c.,

Streatham, July 12. HENRY M. SAYERS.

[We are glad to have Mr. Sayers' exposition of this very important question.—ED.]

Books Received.

[Copies of the undermentioned works can be had from THE ELECTRICIAN Offices, on eceipt of published price, plus postage.]

"Proceedings" of the Rugby Engineering Society. Vol. XIII. (Rugby: Engineering Society.) Pp. xxvi. + 94.

"Common Commodities and Industries: Aluminium." By G. Mortimer. (London: Sir Isaac Pitman & Sons.) Pp. viii. + 152. 2s. 6d. net.

"Steam Boiler Construction." By E. G. Hiller, B.Sc. (Manchester: National Boiler and General Insurance Company, Ltd.) Pp. 203. 3s. 6d.

"Electric Oscillations and Electric Waves." By G. W. Pierce, Ph.D. (London: Hill Publishing Company.) Pp. ix. + 517. 30s. net.

"Year Book of Wireless Telegraphy and Telephony." 1920. (London: Marconi Wireless Telegraph Company.) Pp. 1148.

"Rotary Converters. Their Design, Construction and Use." By C. Sylvester. (London: S. Rentell & Co.) Pp. 57. 2s. net.

"Controllers for Electric Motors." By H. D. James, B.Sc. (London: Crosby, Lockwood & Son.) Pp. xiv. + 354.

"Year-Book of the American Institute of Electrical Engineers." 1920. (New York: American Institute of Electrical Engineers.) Pp. 528.

"Armature Winding and Motor Repair." By D. H. Braymer. (London: Hill Publishing Co.) Pp. xxi. + 515. 18s. net.

"Armature Winding." By C. Sylvester. (London: S. Rentell & Co.) Pp. xiii. + 165. 7s. 6d. net.

"Problems in Physical Chemistry." By E. B. R. Prideaux. (London: Constable & Co.) Second edition. Pp. xii. + 294. 18s. net.

Reviews.

Piece Rate, Premium and Bonus. By J. E. PROSSER. (London: Williams & Norgate.) Pp. vii. +122. 6s. net.

In every phase of industry the problem of production is intimately associated with incentives to effort on the part of the workers engaged therein. Even, for instance, in a highly organised machine shop, in which the machinery factor is probably at its highest, the effort and attitude of the individual workman is a determining feature. It is while paying regard to this fundamental principle underlying all manufacturing processes that elaborate wage systems have been devised. It is realised that in general increased output must be preceded by the desire on the part of each worker to furnish the increased quantity. In order to achieve this end some definitive incentive to improve individual output must be provided, hence as one contribution in this direction the elaborate wage systems—an examination of the more important of which, is the object of Mr. Prosser's book.

After outlining the chief characteristics of ordinary time wages and straight piece wages, and dwelling upon their deficiencies when greatly improved output is required, the author analyses the Halsey, the Rowan and Cost premium systems, the Differential Piece Rate, which is inseparably associated with the name of F. W. Taylor, and finally the Emerson efficiency bonus. While marked originality cannot be claimed for the information put forward in this analysis, the subject is treated in a concise and lucid manner enabling the reader to understand easily the salient features of each system together with its advantages and disadvantages. In all cases attention is paid to the ultimate criterion of any wage system, that is the effect on the labour cost per unit of output.

The chapter on "Scientific Management" merits real commendation. The author has in the small compass of a dozen pages made a creditable attempt to answer the question, "What is Scientific Management?" and has carefully analysed its advantages and defects. The term scientific management is to-day so frequently heard, and so commonly used by people who have most ill-defined ideas respecting its character, and the desire of the factory worker to have some elementary information respecting the subject is so great that the concise exposition of Mr. Prosser is most welcome.

The author concludes his book with a chapter on "Profit Sharing." While, as he explains, the subject in part falls within the domain of systems of remuneration, and it is of such an extensive character and the field covered contains so many contentious points, that we feel the author would have been well advised to have abstained from including this subject. Three appendices are included, the first in which various wage systems are compared being of the greatest merit. The others relate to Lever Brothers' Co-Parternership Scheme and to an analysis of profit sharing in the United States.

The book should certainly be a valuable help to all who desire to know something of current systems of wage payment, and who wish to avoid the trouble of searching through technical magazines for the original papers on the various systems.

Mr. Prosser has rendered a service in so far as he has collected and collated information relating to the fundamental principles underlying modern wage systems.

A. P. M. F

The Propagation of Electric Current in Telephone and Telegraph Conductors. By J. A. FLEMING, M.A., D.Sc., F.R.S. (3rd edition.) (London: Constable & Co.) Pp. xiv.+370. 21s. net.

We welcome a new, revised and considerably extended edition of this well-known and valuable work.

Chapter II., on the propagation of electro magnetic waves along wires is of particular value to the student, and deals with the subject both mathematically and physically in a lucid manner. The work of Pupin, Kennelly, Campbell, &c., is made full use of in ensuing chapters on propagation in cables, and there are ample references to these and other authorities. In Chapter VI. the theory of transmission of high-frequency currents along wires is entered into, and this is becoming a matter of considerable importance in view of the possibilities of "wired wireless" telephonic and telegraphic transmission. The chapter on measurements of the constants of cables describes most of the methods in general use. No reference is made to the Larson compensation method as modified by Dr. Kennelly in his new alternating-current potentiometer for telephonic measurements which promises to be of considerable value. Probably Dr. Kennelly's Papers were of too recent publication for inclusion in this work. The data on loaded lines will be found of considerable interest, and to have been much amplified, and the physical and mathematical treatment of reflection losses at cable junctions should be of great assistance to the student.

The book is one which should find a place on the shelves of all interested in telephonic and telegraphic transmission.

B. S. C.

Electricity Supply Districts.

Four electricity supply districts have now been provisionally determined by the Electricity Commissioners and particulars of these districts, with maps of the areas, have been published in THE ELECTRICIAN. The delimitation of the Lower Severn District was notified on the 30th April, the Mid-Lancashire on the 27th May and the South-East Lancashire and the West Riding (Aire and Calder) districts on the 18th June. Local inquiries will be held in each case and the Commissioners notify that any person wishing to make any objection or representation in regard to the inclusion of any area in, or the exclusion of any area from, the district so provisionally determined, should do so in writing within the time specified, and should state:—

(*a*) The area or part of the area in respect of which the objection or representation is made, described in terms of the Local Government Boundaries, and shown on an ordnance map on a scale of one inch to the mile; (*b*) The specific grounds for inclusion or exclusion; (*c*) The omission, addition, or modification desired; and, in the case of any area proposed to be excluded, should specify any alternative proposal for an improvement in the organisation of the supply of electricity in such area.

Anyone desiring to submit to the Commissioners a scheme for effecting an improvement in the organisation of electricity supply can obtain from the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, a Memorandum as to the heads under which any such scheme should be prepared and of the particulars (administrative, technical and financial) which should be forwarded to the Commissioners in support thereof, together with information as to steps to be taken in connection with the submission of the scheme.

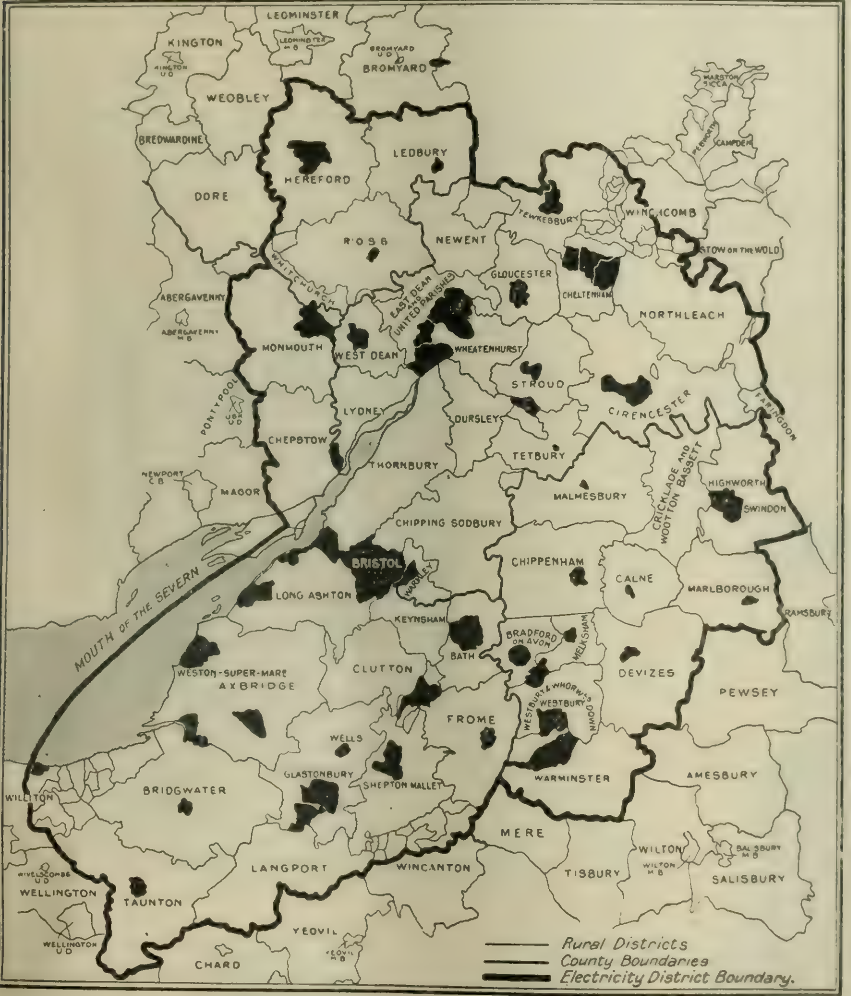
A meeting of authorised undertakers, representatives of County Councils, &c., concerned in the scheme of the supply of electricity was held at Bristol on the 6th inst.

Mr. H. FARADAY PROCTOR, engineer and manager of the Bristol Corporation electricity department, presided, and stated that they were met to consider the submission of a draft scheme to the Electricity Commissioners for the establishment of a joint electricity authority in the west of England. The Organising Committee, which was appointed in January last, had put forward a draft scheme, which was not a project for effecting or securing any financial advantages from any particular alteration in the area. Sec. 5 of the 1919 Act required a scheme for the improvement of the existing organisation for the supply of electricity, but from letters he had received there was some misapprehension on that point. Some appeared to have expected an engineering scheme which dealt with what generating stations it was proposed to construct or abolish. That was altogether outside the scheme, and it would be almost an absurdity to have attempted that in the preliminary stages. The authority had to be appointed; when that was done they could get to work and formulate their scheme. Herefordshire was included at the request of the Commissioners, and not by the Organising Committee. The financial clauses excluded from the 1920 Act by the House of Lords would be reintroduced in the Bill to come before Parliament this session, and the financial clauses of the proposed scheme were modelled on those proposed in the new Bill. It was essential to have power to raise money, and to have facilities to raise it as cheaply as possible. The scheme dealt with the levying of a deficiency rate. The chief reason for putting that into the scheme was not because the Organising Committee considered that the undertaking would not be self-supporting, but to provide a better security for lenders of money. The scheme was not binding; it would have to go before the Commissioners, who might make amendments, and it would come back to them for further consideration. To facilitate discussion, he suggested the consideration of the scheme in sections, and moved that pages 1 to 15, together with schedule 2, be adopted.

Col. RUSSELL KERR (Gloucester County Council) seconded, and stated that his Council were favourably disposed. They were well inclined not only to come in, but to come in with financial responsibility if they couid be assured on one or two minor points.

Sir HARRY HATT (chairman, Bath Electrical Committee) considered the first duty of the Organising Committee was to devise a scheme which would conduce to greater efficiency and economy in the generation and distribution of electricity. The Committee had misunderstood the reference made to them when they were appointed. Part of their duty was to define an area, and he would like to know why the proposed area included such undertakings as Bristol, Bath, Weston-super-Mare, Swindon, Beachley, Forest of Dean, &c. They would like to know whether it was the intention to go forward with that scheme. They had a project before them for providing the money necessary to run a scheme which was not before them. It seemed to be taken for granted that they were necessarily going to effect very considerable economies if they generated and distributed from large power stations. He thought he was right in saying that designers of steam turbines were increasing the efficiency of smaller units, with the result that at present there was so small a margin of efficiency between the 2,000 kw. and the 10,000 kw. sets which was more than wiped out by the heavy transmission losses. He suggested that the proper course for the conference was to adjourn, and to instruct the Organising Committee to prepare an engineering scheme, and ask the Commissioners to postpone the inquiry. He moved an amendment to that effect, and Ald. G. **Stevens** (Swindon) seconded.

The **Town Clerk of Swindon** said his Council had given careful consideration to the proposals in the draft scheme, and they desired to contribute in every possible way to the carrying out of the policy laid down in the Act of 1919; but that did not say that a public representative body, with its responsibilities to its constituents, should not examine very carefully any proposals that were made which committed them to financial liabilities. His Council would take strong exception to the powers sought for the levying of a deficiency rate.



Map of Severn Electricity District.

Mr. F. **Wardle** (town clerk, Bath) stated that he expected to receive some information of a special nature to enable them to arrive at a conclusion as to whether the scheme was practicable. Boundaries of areas had been defined without any regard to the engineering possibilities of those areas.

Mr. R. **Owen Seacombe** (town clerk, Cheltenham) stated that the area which was included in the scheme was not the area selected by the Organising Committee. It was selected by the Commissioners. The idea of the Act was to widen the area of electricity supply so as to do away with a large number of smaller undertakings all working on different lines, and to get one area under one control to develop electricity in a more efficient manner.

Mr. J. H. **Edwards** (representing a number of smaller undertakings in the area) said it would be much the better plan if speakers had given their attention to items of the scheme. Until the joint electricity authority was formed nothing could be done. He strongly advocated the passing of the scheme reserving objections until the inquiry of the Commissioners.

Mr. A. J. **Howard** (Taunton) said that Taunton were undecided as to coming into the west of England scheme. A joint authority was in process of formation at Exeter, which was nearer Taunton than Bristol, although they were not keen on coming into either.

Mr. E. T. **Gardom** (Gloucester County Council) complimented Mr. Proctor on the production of the present scheme. It had been submitted to the Parliamentary draftsman, who had approved it. The Commissioners could alter the scheme if they thought fit.

Mr. H. **Faraday Proctor**, in replying to the discussion, said that the responsibility incurred was in proportion to saving power obtained. Personally, he thought it would be absolute folly for such a small Committee as had been set up, assisted by a very few engineers, to endeavour to give a report upon what should be done within the area during the next 5, 10 or 15 years. This was the only scheme. He ought to make it quite clear regarding Beachley and the Forest of Dean. No action has been taken by the Organising Committee directly. True, the Commissioners had asked him to take action on their behalf, but what has been done has been done under clause 18 of the Act. It was the Commissioners who had the matter in hand. The time was not opportune to consider the points raised by Sir Harry Hart, but they had not been lost sight of. If Taunton thought it better not to be included, the Organising Committee would raise no objection to the line being drawn on the near side to Bristol. If Hereford, Worcester and Swindon desired to remain outside, the Committee would not oppose them. The area as submitted was that of the Commissioners, and not of the Organising Committee.

The amendment was lost by 2 votes to 16, 19 not voting. The chairman's resolution resulted in 20 voting for and 5 against. The remaining portions of the scheme were carried by a substantial majority in each case.

Mr. F. W. B. **Cripps** (Gloucestershire County Council) urged the necessity of proceeding immediately with the transmission lines from Beachley to the Forest of Dean coalfields, and a resolution making representations to the Commissioners to that effect was carried unanimously.

Sheffield's Electricity Undertaking.

The controversy as to electricity supply charges in **Sheffield** is still exciting much interest in local municipal and industrial circles. In a fresh report to the Council, the Electric Supply Committee state that they have given careful consideration to the position arising out of the decision not to sanction the Committee's recommended increased charges, and directing that the charges for lighting be upon the same basis as for power. The Committee point out that it has been the settled policy to develop the supply of current for the benefit of local industries. The experience of other countries has shown the great advantages which accrue from its adoption, and rendered it necessary, if Sheffield was to maintain its position in the industrial world. Among the advantages resulting from the electric drive were the economy and flexibility of working, as well as the improved conditions in which the workers carry on their operations and the diminution of the smoke and sulphur nuisance. It has only been due to the adoption of the most improved types of generators and methods of working that the supply of current at reasonable prices has been possible. The electric furnace has been largely introduced into the manufacture of steel, with the greatest advantage to the trade of the city. The question of price is all-important; a small fraction turns the scale one way or the other. It is the universal experience that the supply for lighting is more costly than that for power. For these reasons it is the invariable practice to make higher charges for lighting than for power and heat. The lighting supply is unremunerative, and could not be given at the present rate but for the support received from the power and heat supply. Having regard to the greatly improved types of lamps now obtainable, compared with those formerly in use, the actual charge for the light supplied is insignificant. In these circumstances, the Committee respectfully request the Council to reconsider the question and to rescind their resolution so far as it declines to sanction the proposed increase in the charges for lighting, and directs that the charges for lighting be upon the same basis as for power.

The general manager of the department (Mr. S. E. Fedden) has also issued a lengthy report on the matter, and points out that over four years the total costs per unit for lighting are approximately four times the cost per unit for power. For the year ending March 25, 1919, the total income was £671,263. The demand for lighting was 11,950 kw. and the demand for power was 47,596 kw. The load factor for lighting itself varies in considerable degree with various classes of consumers, and practically the whole benefit of the proposed reduction will apply to the least desirable consumers from a commercial point of view, as consumers with a reasonable load factor are already provided for by the different rates charges for lighting. There are 8,820 lighting consumers, 2,862 of whom are already charged at 2d. per unit or under; 5,771 consumers are charged at the maximum rate of 4d. per unit. The average number of units used per annum per consumer at the maximum rate of 4d. per unit is 600, against an average of 1,963 units for the remaining consumers. £43,227 of the £51,211 estimated losses due to the proposed reduction will accrue on the particular units supplied at over 2d. per unit, or, in other words, six-sevenths of the total reduction will apply to only one-third of the units supplied for lighting. There is no precedent and no economic justification beyond that of load factor for charging the same price for light as for power. There is no question that the lighting charges in Sheffield, even when the proposed increases are added, will be low either when compared with the rates prevailing in other towns or when considered according to the actual costs involved in production.

In a statement by Mr. Graves it is maintained that the policy of the municipalisation of public utility undertakings involves the principle of equal service on equal terms to all citizens, and relies upon the working of the law of average to enable this principle to be carried out. The electricity supply department does not supply light or heat or power as separate, distinct commodities; it supplies so many units of electricity as and when required by each of its 9,246 consumers. The cost of generating every unit of current at any given moment is the same to each consumer, and has no relation whatever to the use to which the current is put when supplied. The adoption of a uniform basis of charge to all consumers, with a sliding scale in favour of large customers, as far as this can be shown to be commercially sound, is a just and equitable apportionment of the working costs and capital charges of a municipal electricity undertaking.

High-Tension Switchgear.

The new edition of the General Electric Company's catalogue devoted to high tension switchgear contains illustrations and full descriptions of the design, construction and operation of switchgear suitable for all ordinary requirements, but for special schemes the company will supply specifications on request. Among the features of G. E. C. oil break switches are the substantial design of the contacts, complete absence of burning, the long double break and simplicity of design. Lists and prices are given of various types of non-automatic, overload, and of overload and no-volt patterns of three-phase switches for various circuits up to 11,000 volts and also standard types of remote control switches with c.i. trip control for circuits varying from 3,300 to 11,000 volts, 22,000 and 45,000 volts. The catalogue also contains particulars of the company's tension limiters and lightning arresters, limiting resistances, earth-plates, choking coils, isolating links, relays, plug fittings, switch boxes, static leakage detectors, fuses and accessories. The publication appears to have undergone careful revision and is undoubtedly a comprehensive list af all apparatus coming under the heads of h.t. switch-gear. Dimensional drawings and a good index increase the value of the catalogue to engineers and contractors.

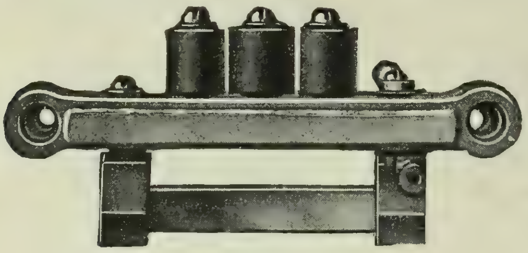


Fig. 1.—Tension Limiter.

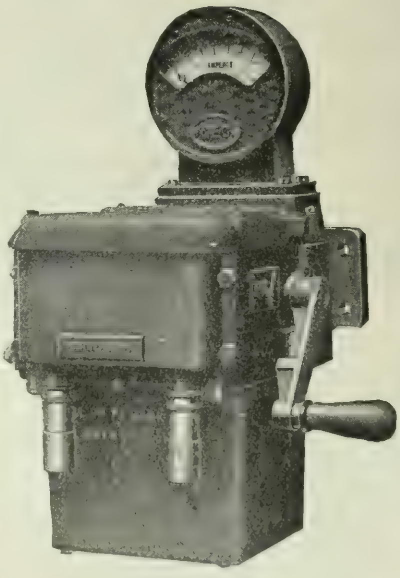


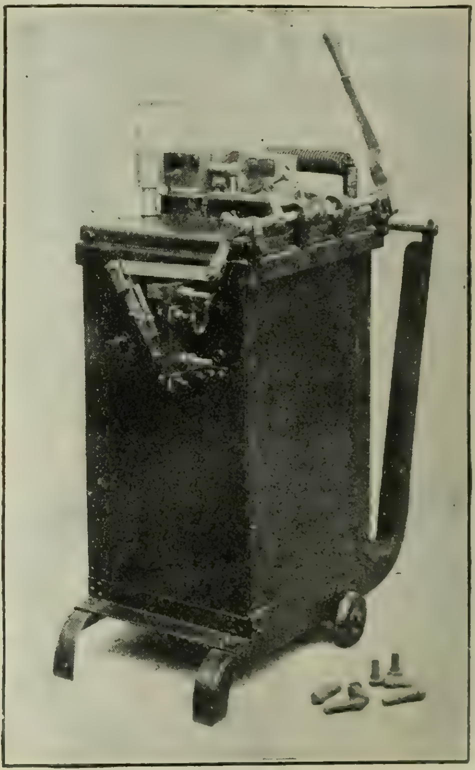
Fig. 2.—Wall Switch.

Exigencies of space only permit us to give two illustrations of the Company's apparatus. The second shows an oil break switch for wall mounting with ammeter attachment. This switch is suitable for three phase circuits up to 600 volts and for currents up to 60 amperes; it is fitted with two overload releases with time lags and with free handle. The first illustration shows a tension limiter and one of these units should be installed for each 1,000 volts line tension. The non-indicative resistance shown on the lower side of the porcelain piece in the illustration limits the current flow to about 5 amperes. These tension boilers are suitable for a.c. circuits up to 10,000 volts.

Electric Heating of Rivets.

During the war the question of output was closely studied by the engineering industry, and matters affecting shipbuilding received particular attention. The speed of rivetting attracted a good deal of public attention and it was with the idea of doing away with the disadvantage of the rivet heating forge and attendant labour that the Westminster Engineering Company in 1917 built their first electric rivet heating machine. The chief advantages claimed for this apparatus are: (1) Economy in fuel (since there are no stand-by losses); (2) the heat is produced inside the body of the rivet, so that the exterior is the coolest portion, thereby reducing "scaling" to a minimum; (3) uniformity of temperature; (4) the machine being portable, can be brought right up to the work, thereby reducing labour; (5) cleanliness, due to absence of fumes.

Briefly, the rivet is held between spring-adjusted copper jaws, forming the secondary circuit of a transformer and the passage of the current through the body of the rivet, which necessarily has a high internal resistance, evolves heat exactly where required.



View of Rivet Heater.

The aim has been to make the machine as simple as possible, and since the necessary operations are all performed by the single lever seen in the front of the machine, it would seem this desirable feature has been attained.

As our illustration shows, between the copper jaws there is a small steel cradle with fingers to support the rivets. On moving the lever forward one jaw advances and grips the rivet endwise. Still advancing the lever the cradle sinks out of the way, and at the same time a switch makes the electric circuit to the primary winding of the transformer. The rivet immediately gets hot and the desired temperature is attained in 10 seconds. The lever is then reversed, so that the primary circuit is broken, and the cradle is raised to support the heated rivet. A further movement of the lever to the original position releases the pressure between the jaws and the rivet, now lying free on the cradle fingers, can be removed by tongs.

The transformer windings are absolutely protected by enclosure in the iron base of the machine, and the copper jaws consisting of copper rod held in clamps, are capable of adjustment for rivets of various lengths (in the machine illustrated from ½ in. up to 5 in.).

With regard to speed, a rivet ¾ in. diameter by 2¼ in. long requires 23 k.v.a. to bring it to rivetting heat in 10 seconds. Nineteen of these rivets can be heated for 1 B.Th.U., which at 1d. per unit gives a cost of 5¼d. per 100 rivets of this size. Looked at in another way, approximately 5½ lb. of rivets can be heated at a cost of 1d., assuming the charge for electricity is 1d. per unit.

The Telephone Service.

The House of Commons Committee on Telephone Charges has continued to hear evidence. Major T. F. Purves, Assistant Engineer-in-chief to the P.O., said the cost of labour and material for the construction of underground lines had gone up 236 per cent., and the over-all increase for plant installed had gone up by 204 per cent. The administration and operative expenses had increased from £1,500,000 in 1913-14 to £4,710,000 in 1920-21. In reply to a question as to whether, in installing new lines, a point was reached where the addition of further lines involved an addition to the average cost per line, witness said that the costs kept pretty well level as the system increased. If the telephone were installed in every house in London the cost would probably decrease. In regard to safeguarding subscribers that the correct number of calls was being registered, witness said that when each telephone was replaced two lights indicated the fact to the operator, who then pressed a button which registered the call against the subscriber. The call was not registered against a subscriber when he was cut off or in the event of a wrong number being given. Asked if there was any likelihood of an early improvement of the service, witness said that the department were prepared to spend a great deal of money in consolidating the service, but it was difficult indeed to get plant—ducts, cables, &c., which were coming in very slowly. It was the policy to continue underground cabling whenever possible.

In regard to charges, Major Purves said that a larger number of calls involved more work for the operator, so that the extra income was absorbed by operating expenses. He promised to supply a statement setting out the annual cost of an automatic exchange and a manual exchange. The object had always been to try to get new devices which would cut down the cost of operating. If they could rely entirely upon automatic, they would save an immense cost, but they could not dispense entirely with the service of operators. They were extending the system of automatic exchanges and they had a good many schemes on hand. So far as London was concerned, the Post Office scheme would give the messages at a little less than cost price, and would put a little more on to installation.

Mr. Kidner, assistant secretary to the department, gave evidence as to the rate of remuneration before the war and at present in force.

In a White Paper issued on Monday it is stated that in 1924, on the assumption that the present level of prices is maintained, the cost of installation will be £7·5 in London and £8·23 in the provinces, the message costs being 1·65d. and 1·38d. respectively. It is thought that the message fee should be uniform throughout the country and a charge of 1½d. a call is recommended. The installation rental should be £8 10s. in London (within 10 miles of Oxford-circus); £8 in Birmingham, Glasgow, Liverpool and Manchester; and £7 10s. elsewhere. The Committee point out that between 1913-14, when the telephone service showed a fair margin of profit, and 1920-21, the expenditure had risen from slightly under £6,000,000 to £13,700,000. Of this increase salaries and wages accounted for £5,700,000, of which £4,210,000, or 74 per cent., was due to war bonus. Depreciation was higher by £840,000, the charge for pension liability by £340,000, and interest by £330,000. In the same period the revenue had risen from £6,200,000 to £9,700,000, and there was therefore an estimated deficit of nearly £4,000,000.

NEED OF INCREASED REVENUE.

The need for growing revenue to meet the increased cost per unit is pointed out, and the distribution of that cost among those who use the telephone service should be fixed in proportion to the cost of giving each class of subscriber the service required. The flat or unlimited service rate gives an undue preference to the large as against the small user, encourages the overloading of lines and in other ways tends to restrict development. The "measured rate" is also open to the objections of undue preference, though in a less degree. The message rate—namely, a fixed annual charge for the installation and a uniform charge for each effective local call, is the most equitable, and at the same time the most convenient method of charge. The cost of supplying the telephone service to private residences and to business premises is the same, and the same rate should therefore apply. The local fee should cover communication with any exchange within five miles of the originating exchange. For calls in excess of this distance the junction and trunk fees should be merged in a uniform mileage scale. To meet the special position of London, the area within a five-mile radius from Oxford-circus should be treated as a single point for calculating the fees for calls (*a*) between two London exchanges and (*b*) between London exchanges and exchanges not more than 30 miles from the centre of London. Similarly in Birmingham, Glasgow, Liverpool and Manchester, the area within a two-mile radius from the centre should be treated as a point for this purpose.

NEW CIRCUITS FOR EXTRA CALLS.

With a view to reducing the number of "engaged" calls due to overloaded lines, the Committee recommend that the Postmaster-General should take power to refuse service to any subscriber on whose lines the number of "engaged" calls exceed 25 per cent. of the number of effective calls, if he refuses to rent an additional circuit. In order to encourage the renting of relief circuits, the charge for an auxiliary line should be £1 per annum less than the charge for the original circuit. The minimum charge at present imposed for calls, whether made or not, should be discontinued. The continuance of the present call office fee of 3d. is recommended for both London and the provinces. It is recommended that subscribers should be given the facility of settling their accounts quarterly in future, instead of being required to pay annually in advance as at present.

It is estimated that on the foregoing basis the telephone accounts would show a surplus of £800,000 in 1921-22, of £240,000 in 1922-23, and of £200,000 in 1923-24, but a deficit of £500,000 in 1924-25. It is pointed out that there is a substantial increase in the cost as exchanges develop in size. They give the following figures:—for 200 subscribers, £7 per line; for 1,000 subscribers, £10 per line; for 5,000 subscribers, £11 2s. per line; and for 10,000 subscribers, £12 5s. per line. Where there are several large exchanges, which involve an elaborate system of junction wires, the respective figures are:—£8, £13 2s., £14 9s. and £17 per line. There are at present about 31,000 lines in London and 60,000 in the provinces rented at "unlimited service" rates.

The party line service has been very little used, and it is not proposed to continue it. An exception, however, is made with regard to what are known as "Farmers' lines," which fulfil a useful function in linking up outlying dwellings and farms with market towns. A new system of charging with regard to private branch exchanges is advocated. This would include a charge of £2 5s. per annum to cover cost of providing and maintaining the switch-board of the standard type. The annual rental of the first line would be £8 10s. in London, £8 in the large cities, and £7 10s. in the provinces, and for second and subsequent lines £1 less in each case. Calls would have to be paid for at the ordinary rates.

New Mazda Gas-filled Lamps.

Many years of costly research and experiment preceded the development, in 1914, of the first commercially usable Mazda gas-filled electric lamp. From that day onwards chemists and engineers have continued their labours with redoubled energy, realising that the discovery of the "Gas-Filled" principle was merely the opening of a new vista in the steady progress of artificial lighting. At the start Mazda gas-filled lamps (for 100 and 200 volt circuits) were only manufactured in comparatively large sizes—500 watts and upwards. These powerful and highly efficient lamps represented a tremendous advance on any previous light source, but obviously they could not completely supplant the ordinary vacuum lamp. On many people, such as householders, small shopkeepers, &c., the gas-filled lamp conferred no perceptible benefit, since the only available sizes were far too powerful for any but the largest interiors. With the subsequent development of the 100-watt 200-volt lamp and the 60-watt 100-volt lamp, an enormous impetus was given to the "Gas-Filled" principle. These new lamps could be used in shops of any kind and in the larger rooms of private houses. However, there remained many conditions in which gas-filled lamps could not be suitably employed.

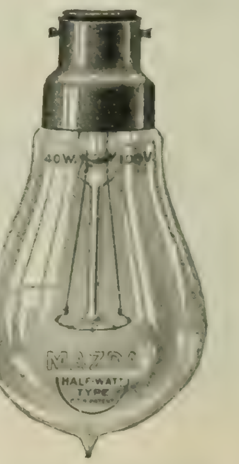


FIG. 1.

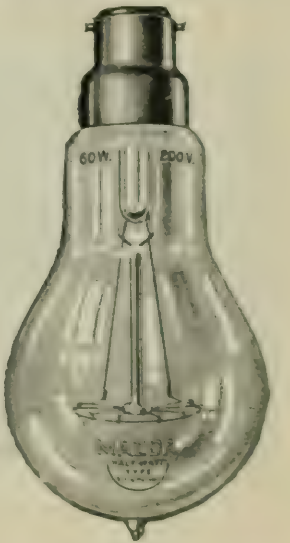
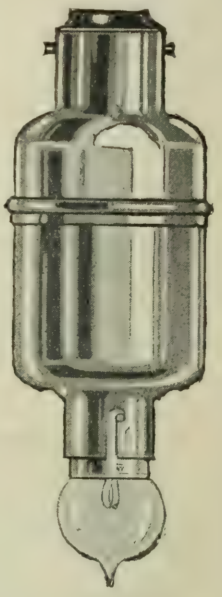


FIG. 2.

The successful production recently announced of a 40-watt, 100-130 volt, and a 60-watt, 200-250 volt lamp should have a great influence on the artificial lighting of private houses, since innumerable people who have not hitherto been able to take full advantage of the high efficiency of gas-filled lamps can now use them in any ordinary room. Apart from cellars, passages and other places where only a dim illumination is required, there seems now to be no single domestic, public, commercial or industrial condition to which the Mazda gas-filled lamp cannot be appropriately and economically applied. Both lamps have ring filaments and can be operated in any position. They are normally fitted with standard bayonet caps. The approximate overall dimensions of the 40-watt, 100-volt lamp (Fig. 1) are: dia. 2½ in., length 4½ in.; and of the 60-watt, 200-volt lamp (Fig. 2): dia. 2¾ in., length 5¾ in. Further information may be obtained from the British Thomson-Houston Company, 77, Upper Thames-street, London, E.C. 4, or from the nearest branch office.

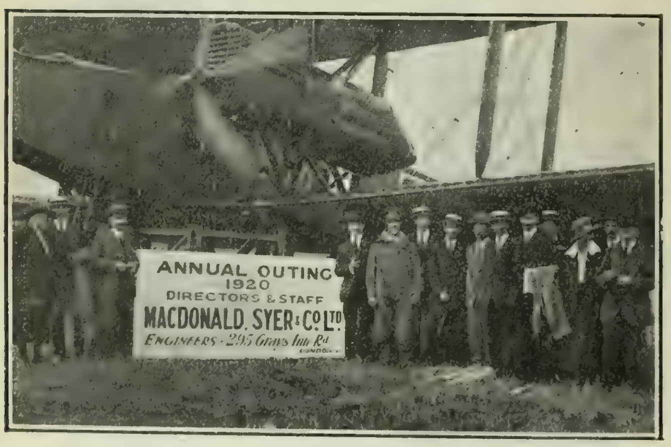
The All-Nite-Lite Transformer.



There are many places in which a little light is wanted for a long time. For ordinary use one never requires a lamp smaller than the 10 or 20 watt lamp. In entrance halls, night nurseries, &c., it is sometimes advantageous to keep a light burning all night, but the smallest 100 or 200 volt lamp would be unsuitable and uneconomical for such a purpose. In buildings supplied with alternating current, the solution is simple. The B.T.-H. "All-Nite-Lite" transformer makes it possible to use a lamp so small that its consumptoin of energy is almost negligible, although it provides ample illumination to find one's way about a room. This piece of apparatus consists of a small step-down transformer in abrass case equipped at one end with a bayonet adaptor to fit into an ordinary lampholder, and the other end with a miniature lampholder to take a 6-volt 3 c.p. lamp. The overall length is only 3½ in. It is intended for use on A.C. circuits of from 50-140 cycles. At ordinary supply rates, this small light can be burned for 40 to 60 hours at a cost of1d. A light burning all night in the entrance hall is a convenience to the late home-comer, and it is commonly supposed to have a deterrent influence on the enterprising burglar. Even in winter it would only cost about 1d. a week to use the "All-Nite-Lite" from bedtime to 8 a.m. The transformers are made in two types, for 100-150 volts and 200-250 volts respectively. Information may be obtained from the British Thomson-Houston Company, Ltd., 77, Upper Thames-street, E.C. 4.

The Aerial Beanfeast.

Messrs. Macdonald, Syer & Company, Ltd., engineers, of London, inaugurated the aerial beanfeast when the directors and staff recently flew from Cricklewood to Margate. The party were conveyed by three Handley-Page aeroplanes. One of these, which carried 16 passengers, accomplished the journey in approximately 50 minutes, whilst a smaller machine, a D.H. 4, supplied by Messrs. Instone & Company, did the return journey in approximately 30 minutes, flying at the rate of 140 miles an hour. The passengers were landed at Manston aerodrome, and taken by car into Margate, where lunch was provided. The speeches with which the luncheon concluded showed the true appreciation and goodwill which exists between the employers and the employed in this firm. The outing was voted a tremendous success, and no doubt other firms will consider the adoption of this novel way of transporting their employees to a beanfeast. The firm of Macdonald, Syer & Company, Ltd., certainly live up to their telegraphic address of "Determined" London. The illustration shows one of the aeroplanes and some of the passengers.



View of One of the Aeroplanes with Passengers.

The Wolverhampton tramway accounts for the year ended March 31 show revenue £111,662 (compared with £89,407 in previous year), and working and general expenses £89,834 (£57,415), leaving gross profit £21,828 (£31,992). The receipts of the motor omnibuses were £15,620 s(£9,592) and the gross profit £376 (£1,610). Interest required £4,660 income tax £4,214, repayment of loans £6,564, and out of the net balance of £6,766 the amount allocated to additions and improvements was £928 and to reserve and renewals £5,838. Passengers carried were 21,194,336 by tramcar and 1,926,255 by motor 'bus, and the mileages were 1,318,625 and 206,623 respectively.

Legal Intelligence.

The Half-Watt Lamp Patent.

On Tuesday the Court of Appeal (the Master of the Rolls and Lords Justices Warrington and Younger) commenced the hearing of the appeal of the plaintiffs in the case of the British Thomson-Houston Company *v.* the Corona Lamp Works, Ltd., from the judgment of Mr. Justice Sargant.

The action was brought to restrain an alleged infringement of plaintiffs' letters patent granted in 1913 for improvements in incandescent electric lamps. The lamp was known as the half-watt lamp. The specification of plaintiffs' patent stated that it was possible to manufacture a tungsten or other refractory metal gas-filled lamp in which the loss of energy due to heat conduction and conversion could be compensated if the gas employed was chemically inert and of relatively high pressure, and the filament was made of large diameter or cross-section, or in a concentrated form. Plaintiffs' contention was that the words "concentrated form" meant a filament though not originally thick was rendered thick for the purposes of the lamp by being closely coiled. The half-watt lamp used in this country was a lamp constructed with a comparatively thin filament, which had been coiled thick, gas-filled lamps with uncoiled filaments being commercially unknown here. Plaintiffs alleged that the coil of defendants' lamp was a thick filament according to plaintiffs' specification, and the defendants' lamp therefore fell within the description contained in plaintiffs' specification.

The substantial defences raised were want of subject matter, insufficiency of definition and non-infringement. Mr. Justice Sargant held that the action failed upon the ground of insufficiency of definition. He said that the patentees had in effect claimed the sole right comprised in the principle, and had sought to prevent competitors from availing themselves to any great extent of that principle, and had failed to define or limit the ambit of the claim, with the result that the patent was bad. He accordingly dismissed the action, with costs.

Mr. Colefax, K.C., in support of the appeal, said Mr. Justice Sargant had decided the issue of infringement in favour of plaintiffs, and upon the issue of validity he found that the invention was novel and good subject matter, was an invention of a very high order of merit and of undoubted utility. It was admitted that the specification was sufficient to enable anyone to whom it was addressed to put the invention into practice; it was also admitted that the specification was framed bona fide and without ambiguity. He had dismissed the action solely on the ground that the specification did not sufficiently describe the ambit of the monopoly claimed. He contended that the judge had looked at the invention from a wrong standpoint, and that plaintiffs were entitled to succeed, as they had given to the world a lamp of remarkable efficiency.

The hearing had not concluded when we went to press.

Assessment of Motors.

The Edinburgh Valuation Appeal Court (Lords Salvesen, Cullen and Hunter) heard on Monday an interesting appeal as to the assessment of motors. The Assessor for the city of Glasgow entered in the supplementary valuation roll for 1919-20 a large number of electric motors owned and used by tenants in the burgh for commercial purposes of various descriptions and entered the tenants as proprietors. The case affected about 2,500 appeals. It appeared that Edward Watson, butcher, of Glasgow, appealed to the Valuation Committee against the entry of machinery in his premises at a yearly value of £15 10s. Mr. Watson, who had installed mincing machines, a band saw and freezing apparatus, used five electric motors for driving the machines and current was taken from the Corporation. The Committee decided that, while the motors were machinery fixed or attached, they were plant for producing or transmitting "first motive power," but were not "erections or structural improvements" in terms of sec. 4 of the 1895 Act.

The Court sustained the appeal and set aside the finding of the Valuation Committee, holding that the motors were machines for producing or transmitting first motor power and were exactly comparable to gas engines or steam engines, and that the circumstance that the motors could be removed from their place without removing any part of the buildings did not disqualify them from being assessed. They held that one of the machines, which was of a hybrid character, ought not to be assessed.

Parliamentary Intelligence.

The Tyneside Tramways & Tramroads Company's Bill, which authorises the company to provide and run omnibuses, to carry passengers, parcels, animals and goods on their lines, &c., has now passed through both Houses of Parliament.

The Huddersfield Corporation General Powers Bill, which authorises the construction of two tramways from Huddersfield to Brighouse, has been passed by a Select Committee of the House of Lords. The West Riding County Council contended that the road to Rastrick should be widened throughout, and for a distance of five furlongs to 33 ft., if a double track was laid, or 27 ft. for a single line. The Corporation contended that there was ample space for tramways on the existing roadway, as there was very little other traffic.

After hearing the parties, the Committee decided that both tramway routes were to be widened in accordance with the demands of the County Council, the maintenance of the remainder of the road to be borne by the County Council, and the expenditure of any future levelling not to be be borne by Huddersfield.

Commercial Topics.

New Zealand Hydro-Electric Developments.

At the recent meeting of the National Bank of New Zealand, the chairman (the Hon. W. Pember Reeves) gave a very encouraging report of the trade outlook in New Zealand. After giving particulars of the expansion of the business of the bank, he gave statistics to show the Dominion's prosperity, and referred to the steps taken to develop hydro-electric power. This development deserves close attention by our electrical manufacturers, as they will probably mean large contracts for plant, &c. In 1919 the Dominion Parliament voted £600,000 as a start on hydro-electric works, but the contemplated expenditure in the North Island alone is over £7,000,000. Southland has launched a scheme for the electrification of the whole province. Its loan proposals have been approved by a large majority of the ratepayers, and the requisite capital (exceeding £1,000,000) is being arranged for; the survey and other preliminary work is in progress, and the scheme is expected to be in full operation within three years.

Mr. Reeves pointed out that when New Zealand's abundant water-power was harnessed, its stimulating effect upon the progress of the Dominion must be enormous. It would increase primary products, and should make possible many secondary industries. Under past and present conditions, over 90 per cent. of their exports had been the product of the soil, and it had seemed unlikely that the Dominion would ever add to its wealth that of industrial enterprises. The shortage of labour and the higher standard of wages were serious obstacles to successful competition with more advanced industrial countries; but conditions had changed; the war took heavy toll of the labour of the old world, and that, combined with higher wages in the former spheres of industry, was tending to bring the cost of production to a common level. As that level was approached the handicap against New Zealand would be reduced, and, with its exceptional sources of cheap power, the manufacturing of many of the Dominion's raw products would no doubt be undertaken. At present the loss of man-power through the war was being severely felt, and was reflected in decreased production. The supply of farm labour was short, while essential works, such as hydro-electric and railway construction, progressed somewhat tardily. There was no reason to exaggerate those difficulties; and there was nothing in them which would not be surmounted in good time.

* * * *

Progress of Manufacturing Companies.

The reports of three electrical manufacturing companies for the past year have been published and they show excellent results, notwithstanding the difficulties of reorganisation and the increased cost of raw materials. The three companies report that they have more orders than they can cope with, and various schemes of expansion, works extension, &c., are either in progress or projected.

Messrs. Crompton & Co., in whose business the Armstrong, Whitworth Company has acquired a controlling interest, made a net profit of £52,900 for the year to March 31, against £38,500 for 1918-19. The amount placed to reserve has been increased from £10,000 to £15,000, and in addition, £9,000 is set aside to cover depreciation of investments. The dividend on the ordinary shares is maintained at 10 per cent., and £18,200 is carried forward, or £800 more than the amount brought in.

The General Electric Company's trading profit advanced by £64,400 to £490,400, and after making increased appropriations for reserve and other purposes the ordinary dividend of 10 per cent. has been declared. A sum of £192,500 was spent on land and buildings, in addition to £39,200 on the new premises in the Kingsway, and £87,500 on plant and machinery. As will be seen from the report of the meeting, various schemes for the expansion of old and the erection of new works for the Company and its subsidiaries have been planned. Provision is being made for doubling the output of the turbine department; a big bay for the construction of generators has been erected at Witton, a new switchgear building is under construction and new shops for industrial motors and fans have been laid down. Among other developments is the aim of the Company to double its output of lamps, and new buildings are being erected at Hammersmith, while the Lemington glass works have been greatly extended. The Pirelli General Cable Works have been expanded, and new extensions are also projected for the Peel-Conner Telephone Works. An interesting development is the purchase of about 100 acres of land and some factories at Wembley for the greater development of the general engineering works, the lamp and glass industries and the company's research laboratories, buildings for which are in course of erection. The Company is also extending its foreign influence, for it has acquired considerable interest in a French telephone company, for the purpose of building up a telephone business in France.

The report of the British Thomson-Houston Company is also an interesting document, indicative of progress and expansion both at home and abroad. The programme includes a proposal to increase the share capital to £4,000,000, of which £2,000,000 will be £1 ordinary and £2,000,000 £1 preference shares. Of the 2,000,000 ordinary shares 400,000 will replace the 40,000 £10 ordinary shares now outstanding, and 400,000 will replace the 40,000 £10 seven per cent. cumulative preference shares. It is proposed to capitalise £250,000 of the reserve and distribute it among the shareholders in the form of fully-paid ordinary shares, in full payment of the accumulated dividends, being £5 5s. per £10 preference share and £1 per £10 ordinary share. Interesting changes have taken place in the directorate, new arrangements made for extending the territorial and patent rights of the company, and a closer relationship has been established between the Company and the French Thomson-Houston Company, while an interest has been acquired in the Société d'Electricité et de Mécanique (Thomson-Houston & Carels) of Belgium.

Electricity Supply.

The BARTON Urban Council has decided to light the Poor Law Institution with electricity.

MAIDSTONE Corporation has been authorised to borrow £1,000 for electrical apparatus to be let out on hire.

A limited company is in course of formation at DUNBLANE in order to provide the district with electric supply works.

TORQUAY Council have increased the salary of the borough electrical engineer (Mr. Woods) from £500 to £600 a year.

The charges for electric power at CHESTERFIELD have been increased by another 25 per cent., and the lighting rate has gone up 10 per cent

The ISLE OF WIGHT Electric Light and Power Company is seeking authority to increase the price of electric current to 1s. per unit.

STAFFORD Council recently applied for sanction to borrow £65,000 for additional plant and this sum has now been increased to £78,000.

The Urban Electric Supply Company has applied for an order to increase the maximum price of electricity from 9d. to 1s. per unit at GODALMING.

The WYCOMBE (Borough) Electric Light and Power Company has applied for sanction to increase the maximum price of current from 9d. to 1s. 2d. a unit.

Owing to the capital cost involved and the small revenue likely to result, ACCRINGTON Corporation cannot see their way to give a supply of electricity to Huncoat.

DOVER Council is making an experiment in the hiring out of electrical cookers, at a charge of 9s. per quarter. The price of current for heating and cooking is 2¾d. a unit.

The Board of Trade has extended by one year from June 24 the time limited by the ORMSKIRK Gas and Electricity Act, 1915, for the compulsory purchase of lands.

The HASTINGS Corporation are recommended to expend £200,000 on electric supply extensions, including the provision of a bulk supply to neighbouring districts.

ST. HELEN'S Corporation have received sanction for loans of £2,958 for extensions to the electricity works and for £22,000 for sub-stations, mains, rotary converter, &c.

In order to provide capital for extensions in the Poole district, the BOURNEMOUTH & POOLE ELECTRICITY SUPPLY COMPANY, LTD., has made an issue of £150,000 7½ per cent seven year notes.

HALIFAX Tramways and Electricity Committee propose to expend £7,400 on a 400 kw. rotary converter, transformer and switchgear, &c., for the provision of a sub-station for the Ovenden district.

The scheme for supplying electrical energy in KINGSTOWN is being extended so as to embrace Dalkey, Killiney, Rathdown and Blackrock. A conference of the representatives of these authorities is to be held to consider the scheme.

AYLESBURY Corporation propose to appoint a consulting engineer to report upon the present electric supply undertaking and its suitability to meet future demands; and also as to how soon further extensions should be carried out to meet the proposed national scheme, &c.

There was a gross profit of £7,994 on the past year's working of the LOUGHBOROUGH electric supply department, and after paying interest and sinking fund charges the net profit was £1,144. The average price was 1·95d. per unit. There is a brisk demand for current, and extensions have been urgent.

The accounts of the STALYBRIDGE, HYDE, MOSSLEY & DUKINFIELD TRAMWAYS & ELECTRICITY BOARD for the year ended March 31 show that since the inception of the scheme in May, 1904, the deficit on the tramways amounts to £122,278. On the other hand, the net profit of the electricity department during that period was £42,568.

In future DONCASTER Corporation will charge 4½d. per unit plus 75 per cent. for electricity for lighting. A minimum charge of 5s. a quarter will be made, with 1s. 6d. per quarter for meter rent. For heating and cooking the charge will be 2½d. per unit, for theatres and cinemas 3d. per unit, and for churches and chapels 3½d. per unit, plus 75 per cent.

DUNDEE Corporation recently advertised for two turbo-generators but as the contractors could only provide one in September, which would take six months to erect, it has been decided to limit the contract to one set. If the full scheme were proceeded with at least 22 months would elapse before they would have the new plant in operation.

DERBY Corporation has authorised the Electricity Committee to increase the charges for electricity for power and traction to 100 per cent. above pre-war rates. The Corporation's action against the British Cellulose Company for breach of agreement to take electric current for power purposes has been settled, the company having paid £23,000.

The proposed reduction of 10 per cent. for electric power was withdrawn at the last meeting of DARLINGTON Corporation as there has recently been an addition of £3,000 a year for coal and £1,300 for wages. The rebate of ½d. per unit for lighting stands. For lighting the rate is 4d. as compared with 3½d. before the war. Application has been made for sanction to borrow £5,000 for transformers.

The PEMBROKE (DUBLIN) Urban Council is in negotiation with the Dublin United Tramways Company on the subject of an electric supply scheme. Mr. Price, the Pembroke electrical engineer, thinks that current could be got cheaper from the Company than the Council can generate it and Messrs. Forsythe and Price are to wait on the Electricity Commissioners and place the scheme before them.

As there was a deficit of £3,746 on the past year's working of the Mansfield electricity undertaking, the price of electricity has been increased by 40 per cent., making a total increase of 100 per cent. over pre-war rates. The Highways Committee and Mansfield Woodhouse Urban Council will charge 25 per cent. more for public lighting; and the Mansfield & District Tramways, Ltd., has been requested to pay 2d. per unit in future for current supplied for traction.

For the year ended March 31 the total income of the Stoke-on-Trent electric supply department was £124,707, compared with £81,650 in 1918-19. The expenditure was £75,255, against £59,751. The gross profit was £49,432, and after providing £28,117 for the redemption of and interest on loans, the net profit was £21,335, out of which previous losses and other items were met, leaving a credit balance of £4,289. New customers brought in over £17,000 last year, and 1,041,890 more units were sold than in the previous year, but only 337 more tons of coal had been burned.

The Redditch Urban Council has had under consideration a report from the Electrical Supply Committee on the increases under the new scale of salaries recommended by the National Joint Board of Employers and Staff Members of the Electric Supply Industry. The Council were asked to determine whether the revised salaries should be granted to the engineers and clerical staff employed at the local electricity works. In the meantime application has been made for power to increase the present maximum charges to consumers in order to meet the increased expenses.

A new 100 kw. gas-driven generator at the Buxton electricity works was started last week. The gas engine was supplied by Messrs. Browett, Lindley & Co., and the dynamo by the Electric Construction Company. Hitherto the plant has consisted of one 80 kw., two 88 kw., and one 250 kw. steam driven sets. The Council has under consideration a scheme for a further extension which is being prepared by the consulting engineer, Mr. C. H. Wordingham. It is proposed to spend £15,775 on additional plant and £5,841 on extension of mains and network pillars. Mr. Wordingham is also to report on the ultilisation of local water power.

West Bromwich electric supply department reports a gross profit of £17,354 on the past year's working with a net profit £6,779. The past year was the most successful in the history of the undertaking. In regard to the supply of current for the tramways, the contract with the local company is said to operate unfairly. The company is taking more current than ever it did before at 1d. per unit, which represents a considerable loss. The Electricity Committee complain that the company, with a favourable agreement, was running its trams outside the town on current for which they paid the Council less than half the price of the cost of generation.

In accordance with the suggestion of the Electricity Commissioners the representatives of Devon County Council and of Exeter, Plymouth, Torquay and Barnstaple Corporations have now agreed to make the whole of the County of Devon into one district for the purposes of the Electricity (Supply) Act, and the Town Clerk of Exeter (Mr. Lloyd Parry) is preparing a scheme for the consideration of a future meeting of the conference. It is desired to obtain control of the source of the River Exe which lies in Somerset, and the addition of Dulverton rural district is suggested. Torquay voted against the single county area proposal on the ground that the South Devon area could be more efficiently controlled by a separate joint authority formed within its own area.

The revenue of the Worcester electricity department for the year ended March 31, 1920, was £33,115 (compared with £32,235 in previous year), working and general expenses were £19,835; gross profit being £13,280 and net profit £1,224. Total maximum demand was 1,914 kw. Units generated were 4,067,556, and sold 3,000,063. Adding the net profit to surplus from previous year makes a credit balance of £3,943, of which £1,800 (equal to a 2d. rate) is to be devoted to relief of rates. Mr. C. M. Shaw (City electrical engineer) says in his report there is every probability that the demand for energy will necessitate putting in a third alternator of not less than 3,000 kw. within the next year or so, and he advocates the building up of a reserve fund of at least £15,000, and also a further increase in charges.

Educational.

Last week His Majesty the King laid the foundation stone of the new portion of Edinburgh University at Craigmillar. The new building will be devoted to industrial chemistry and separate departments will be provided for elementary and advanced students. Provision is also to be made for research work.

Steps are being taken to inaugurate a memorial to the late Prof Righi, of Bologna University. The Italian Minister of Instruction (Signor B. Croce), Rector of the University, is president of the organising committee, and it is proposed to create a foundation to bear his name for the promotion of scientific research, especially in the domain of electricity. An appeal is being made to all scientific societies, faculties of science and former students of Prof. Righi.

The following awards have been made in the Faculty of Engineering at University College: Goldsmid Entrance Scholarship, L. W. Ball and F. R. Kay (each receiving a moiety); Archibald P. Head Medal and Prize, W. Hudson; Jews' Commemoration Scholarship (renewed for second year), H. P. Porter; L. F. Vernon Harcourt Prize, E. F. Anderson and R. W. Taylor (prize divided).

Engineering Diplomas: Civil, Municipal and Mechanical, E. F. Anderson, W. Hudson (with distinction) and R. W. Taylor; Civil, A. Calmus; Civil and Municipal, A. A. Clements and R. G. Leembruggen; Mechanical, F. W. Jones and E. N. Varian; Electrical, T. S. Pick.

Electric Traction.

Salford Tramway employees, following Manchester's lead, are asking for an increase of £1 a week in wages.

Darlington Council has decided to extend the tramway system from the market place to Feethams and Bank Top railway station at £15,000.

Under an Order of the Ministry of Transport, an increase of tramway fares at Worcester came into force on Monday. The minimum fare is 1½d.

The whole of the tramway tracks at Blackpool require to be relaid, and the work will cost £254,000. The reconstruction of the Marton routes will be commenced in October.

An inquiry was held at Barnsley last week into the application of the Corporation for sanction to borrow (among other sums) £2,600 for the purchase of two electric tipping wagons.

Colne Council has made application to the Ministry of Transport to sanction a loan of £1,115 for purchasing land on the Standroyd Estate for a new tramways depot. It has been decided to purchase a petrol electric tower wagon at £1,250.

Doncaster Corporation has applied for authority to borrow £14,070 for doubling the track of one of the tramway routes. The fares have been increased and penny stages abolished. At present the undertaking is losing at the rate of £12,000 per annum.

All fares and charges on the Bradford Corporation tramways are to be increased. The workmen's fares have been limited to 8 a.m., and ½d. has been added to ordinary tickets, the minimum being 1½d. The charges for the carriage of mails, parcels, special tramcars, &c., have also been advanced.

The annual report of Blackburn Corporation tramways shows a profit of £413, against a profit of £6,650 in 1918-19. The wages of motor men and conductors went up from £18,289 in 1919 to £26,887 in 1920; cost of cleaning and oiling cars from £2,863 to £4,163; permanent way repairs from £5,406 to £12,500; electrical equipment from £1,835 to £3,984; and electric current from £12,286 to £17,772.

In a report on the Lancaster Corporation tramways, Mr. A. R. Fearnley, of Sheffield, states that in 18 years the undertaking had cost the rates £40,306, and in addition £10,000 had been provided for a depreciation fund. He recommends the retention of the Market to Scotforth and the Market to Bowerham routes, but certain modifications are made for reducing expenditure. The Market to Castle Station section should be closed. On 22 journeys on this section no passengers were carried, and out of 47 journeys the average was 1·46 in one direction, and in the other direction 2·44 passengers per journey. The abandonment of the Marsh motor omnibus is also recommended.

About 50 skilled men of the Sunderland Tramways Department went on strike on the 9th inst., as the department refused to grant them 12 days' annual holiday with pay. The men are engineers and members of the Electrical Trades Union engaged at the Hylton-road car repair shops. The accounts of the Sunderland Corporation tramways undertaking for the year ended March 31, show revenue £149,446, and working expenses £108,081, leaving gross profit £41,365, to which is added £641 bank interest. Interest on capital required £5,315 and repayment of capital £10,349, the net balance being £26,342. After placing £3,000 to reserve and renewals fund, paying £8,030 for new cars, &c., and providing other sums for depreciation of investments, &c., there remained £5,000 to transfer to Borough Fund. Total revenue per car mile was 22·45d. (compared with 21·5d. in previous year) and working expenses were 16·24d. (12·23d.). Passengers carried were 31,634,178 and car miles run 1,597,723.

The accounts of Glasgow Corporation tramways department for the year ended May 31 show income £1,721,577 (compared with £1,531,319 in previous year), working expenses £1,554,560 (£1,177,119), and payments to dependents of employees serving with H.M. Forces, &c., £3,601 (£72,869), and the balance to net revenue account after taking into account interest on investments was £176,761 (£291,896). Proportion of traffic receipts due to Paisley District Tramways Company were £11,092 (£9,754), interest required £3,891 (nil), and sinking fund £1,714 (nil), income tax £81,295 (£83,701), Parliamentary expenses £1,056 (£123), depreciation fund £48,942 (£46,149), and permanent way renewals fund £137,299 (£137,394), and the net result was a deficit balance of £108,531 (compared with a credit balance of £14,772). Total revenue per car-mile was 15·616d. (14·366d.), and working expenses, including war allowances, were 14·134d. (11·727d.). Passengers carried were 509,339,886 (4,64,246,677) and car-miles run 26,459,015 (25,581,547).

In order to afford means for their employees to qualify to drive the new electric vehicles, tuition classes have been organised by the Birmingham salvage and stables department. Over 70 have already taken the course of instruction, and it is hoped by this means to secure a steady flow of trained drivers. The instruction classes will also ensure careful handling of the electric vehicles and economy in working.

The Committee report that the delivery of the electric vehicles has been disappointingly slow, owing mainly to the moulders' strike early in the year. An improvement has, however, been made, and of the 25 vehicles required 11 have been delivered and are in full use. It was found to be economically impossible, with horse haulage alone and the institution of the 47-hour week, to deal speedily and satisfactorily with house refuse collection, owing to the long journeys involved between points of collection and delivery; but the difficulties are being overcome by the introduction of the electric vehicles.

Institution Notes.

A Batti-Wallah's luncheon will be held on Monday, July 19, at 1 o'clock, at the Holborn Restaurant. This luncheon will be devoted to discussing Club matters and the programme for the next season.

The INSTITUTE OF TRANSPORT has approved provisionally a list of premiums, including the following :—*Institute Medal* : Gold medal to be awarded triennially for the paper read, or contribution to proceedings made, during the preceding three years, judged first in order of merit. *Railways* : Two gold medals (given by the Railway Companies' Association) to be awarded annually for best paper or contribution on railway (*a*) operating and (*b*) engineering subjects. *Road Transport* : Two gold medals (donors, the Commercial Motor Users' Association and London Underground Railways and London General Omnibus group) to be awarded annually for best paper or contribution on road transport subjects, goods and passenger respectively. *Tramways and Light Railways* : Gold medal to be awarded annually for best paper or contribution on subjects relating to tramways and light railways. In addition, the council is to be recommended to award annually two silver medals, one each for the best paper submitted by a graduate and by a student.

The INSTITUTION OF ENGINEERS OF AUSTRALIA was inaugurated in October last and the division machinery is now in operation. Twelve foundation societies have been amalgamated into seven divisions as under: *Sydney Division* includes the Engineering Association of N.S.W., the Sydney University Engineering Society, the Electrical Association of Australia (N.S.W. Branch) and the Institute of Local Government Engineers (N.S.W. Branch) ; Mr. H. A. Leverrier, Royal Society's House, Sydney, is Hon. Secretary. *Melbourne Division* : The Electrical Association of Australia (Victorian Branch) and the Melbourne University Engineering Society ; Mr. H. Clement Newton, 122, King-street, Melbourne, is Hon. Secretary. *Brisbane Division* : The Queensland Institute of Engineers and the Institute of Local Government Engineers (Queensland Branch) ; Mr. Wm. Poole, Brisbane Club Buildings, Adelaide-street, Brisbane, Hon. Secretary. *Adelaide Division* : The South Australian Institute of Engineers ; Mr. E. F. Eberbach, Town Hall, Adelaide, Hon. Secretary. *Perth Division*: Western Australian Institution of Engineers ; Mr. A. Tomlinson, The University, Perth, Hon. Secretary. *Hobart Division* : Tasmanian Institution of Engineers ; Mr. N. V. S. Wilton, Box U, G.P.O., Hobart, Tasmania, Hon. Secretary. *Newcastle Division* : Northern Engineering Institution of N.S.W. ; Mr. V. B. Collins, 8, Howard Smith-buildings, Watt-street, Newcastle, Hon. Secretary.

The DIESEL ENGINE USERS' ASSOCIATION at their June meeting discussed the proposed Research Association for Liquid Fuels. Mr. Napier Prentice read a report by Mr. Percy Still, who is acting as hon. secretary of the Provisional Committee. This referred to the difficulties experienced and partly overcome during the war in connection with the use of tar oil fuel in Diesel engines, and to the importance of obtaining further information by systematic research with a view to the possibility of the more extended use of home produced fuel in Diesel and semi-Diesel engines. It explained the steps taken by the Diesel engine users in conjunction with respreentatives of manufacturers of Diesel and semi-Diesel engines, tar producers and distillers, &c., to obtain Government support for a suitable research association. The work done in connection with endeavours to obtain laboratory premises, the preparation of the Memorandum and Articles of Association and suggestions for raising funds were also explained. The Committee's application for the loan from the Admiralty of certain Diesel and semi-Diesel types of engines to be used for testing various classes of fuel oil has received favourable consideration.

Mr. A. Abbott, of the Department of Scientific and Industrial Research, addressed the meeting on the subject of the general scheme of a Research Association. He spoke of the Fuel Research Board and stated that the Director of Fuel Research was of opinion that research work carried out by an association having for its object the investigation of the use of liquid fuels in Diesel and semi-Diesel engines would be of great value.

In the discussion that followed Mr. Abbott's address, Dr. W. R. Ormandy, Mr. Geoffrey Porter, Mr. G. W. F. Horner, Capt. N. E. Drury, Mr. H. A. D. Acland and Mr. A. J. Wilson took part.

☞ The attitude of the Home Office to electric cap lamps for mines was criticised at a recent meeting of the INSTITUTION OF MINING ENGINEERS, and in reply Mr. E. Fudge, secretary of the Miners' Lamp Committee at the Home Office, states that only two examples of electric cap lamps, both of American origin, have been submitted for test at the Safety Lamps Testing Station at Eskmeals. One which was submitted in 1915 was imperfect in design and flimsy in construction, the battery being of insufficient capacity ; and the second lamp, which was also fitted with a battery of insufficient capacity, had no efficient locking arrangement for either battery or bulb cover. British manufacturers of electric safety lamps were encouraged by officials of the Home Office as early as 1914 to design a cap lamp suitable for British pits, but no British firm had submitted an electric cap lamp for approval. The Miners' Lamps Committee, which was formed in May, 1919, was asked by the Home Office to consider the possibilities of the electric cap lamp. A Research Sub-committee, whose duty was to investigate new designs of lamps, &c., took steps immediately to get a suitable electric cap lamp made. Four British makers of miners' electric lamps were invited to submit examples. They were supplied with rough specifications and general suggestions as to design, and they were assured that ample facilities would be given for practical trial of the lamps underground. The "Oldham" cap lamp is one of the fruits of this invitation. The evidence taken shows a sharp cleavage of opinion as to the utility of the electric cap lamp in British pits, and in the opinion of the Committee this can only be determined by a sufficient number of practical working tests in differing circumstances.

Miscellaneous.

The death has taken place of Mr CHARLES McLEAN, of Walkden, in his 70th year. He was electrical engineer to the Earl of Ellesmere and his predecessors.

The death is announced of Mr. JAMES WEIR, of Messrs. J. & G. Weir, Ltd., engineers, of Glasgow. Deceased, who was in his 78th year, retired about 12 years ago.

The death is announced of Sir CHARLES PETRIE, Bart., who was for many years a prominent figure in Liverpool municipal and commercial circles. He did good work on the Tramways, Electric Power and Lighting Committees.

The staff and employees of the Benjamin Electric, Ltd., of Tottenham, had their third ANNUAL OUTING on the 26th ult. The party, which numbered well over 100, journeyed by motor char-a-bancs to Brighton, where an enjoyable day was spent.

Firms desirous of having their names placed on the list of contractors for War Department contracts for electric lighting work in the NORTH MIDLAND R.E. DISTRICT are requested to apply by July 31 to Lt.-Col. W. M. Pyne, R.E., 40, Forest-road West, Nottingham.

It is reported that some new submarines in the AMERICAN NAVY have been equipped with a WIRELESS APPARATUS for use when submerged. Messages are received quite satisfactorily from nearly the same distance as if they came through the air in the ordinary way, and they are capable of being sent through a radius of about 12 miles. The battleship "Iowa" has been commissioned for a series of experiments in wireless, including her steering and control from a station on shore.

A prize of $5,000 (about £1,250) is being offered by the "Scientific American" for the best essay of 3,000 words explaining the Einstein theory. Essays must be in English and written as simply, lucidly and non-technically as possible. They must be typewritten, and must reach the office of the journal at 233, Broadway, New York, by Nov. 1 next. The right is reserved to divide the prize between two contestants if in the opinion of the judges the best two essays are of equal merit.

The Commercial Secretary at Constantinople (Capt. C. H. Courthope Munroe), in a recent dispatch, states that he has received an inquiry for the name of a United Kingdom manufacturer of telephones, telephone accessories, wires and a central exchange of 500-600 lines ; also electric bells, wires, batteries, &c. The inquiry is from the Concessionnaire of the telephone system at SAMSOUN (ASIA MINOR). Correspondence should be addressed to the British High Commissioner's representative at Samsoun under cover to the Commercial Secretary at Constantinople.

The agents in Holland of the Arora Company, of Loughborough (Messrs. De Goede & Huf, of Amsterdam) notify that the Arora apparatus which was exhibited at the INTERNATIONAL EXHIBITION in AMSTERDAM has secured the SILVER MEDAL, the HIGHEST AWARD available, as the gold medal was reserved for other articles. This is the first occasion the Arora electric fires and cooking apparatus have been placed on exhibit, and the company, as well as their agents, are to be congratulated upon the result.

It is an ill wind that blows nobody good, and the GAS STRIKE which broke out in Manchester on Friday appears to have created a demand for domestic electric appliances. In the afternoon of that day the Simplex Conduits, Ltd., who have always got an eye to business, had their motor lorry loaded up with first aid in the shape of electric kettles, and on the road to the stricken city. By Saturday morning "Plexsim" kettles were finding a ready sale among Mancunians, some of whom are now learning for the first time that, for many purposes, gas is a back number.

The Exhibition Buildings at Shepherd's Bush having been just vacated by the Government, makes it possible for the AUTOMOBILE TRADE to be represented on a scale never before attempted in this country or elsewhere. The Society of Motor Manufacturers and Traders have arranged that their members shall have full opportunity of participating in the mammoth display which is to form the first of similar exhibitions to be held at the White City in future. The re-opening of the White City Buildings will inaugurate a still further series of exhibitions, representative of the various trades and industries of the country.

At Gateshead last week Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., were fined £10 for failing to protect a 15-ton overhead electric crane at their Close works so as to prevent danger. It was stated the company erected the crane in April last, and it was supplied with direct current by trolley wires underneath the crane. Above the crane were other wires supplying alternating current at 440 volts to three other cranes in the same bay. For the defence it was stated that when men were doing repairs work was postponed on the cranes and the current cut off. Bridging had not been placed on the crane as it was under construction at the time.

The candidate for an examination can often obtain great assistance in his work by perusing the questions which have been asked at previous examinations. To do this gives an insight into the mind of the examiner, and an idea of the way in which the questions will be propounded. As far as the City and Guilds examinations in telegraphy and telephony are concerned these needs are adequately met by Mr. H. P. Few's book on "QUESTIONS AND SOLUTIONS IN TELEGRAPHY AND TELEPHONY" (S. Rentell & Co., price 5s. 6d. net.) The value of this book is well indicated by the fact that it is now in its fifth edition. We expect that this will not be the last edition.

Mail despatches from Sweden state that successful results have been obtained from PEAT FUEL on one or two privately owned railways. On one of the minor lines, which has a length of about 250 miles, where peat fuel was used, a saving of some 16,000 tons of coal was effected. On a State-run railway, peat powder was used successfully, but to produce this fuel in bulk bigger plant than was considered expedient to erect was required. As already intimated in these notes, last winter peat fuel was used with considerable success on some of the Irish light railways.

At a dinner arranged by the proprietors of "Aeronautics" and held at the Connaught Rooms, London, on Monday, under the chairmanship of Major-General the Rt. Hon. J. E. B. Seely, C.B., D.S.O., M.P., the survivors of the First Hundred British Aviators and the Pioneers were entertained. Fifty of the first hundred aviators and 80 of the pioneers attended, and many other guests were also present, the most notable being H.R.H. the Duke of York, who in responding to the toast of "The Royal Family," praised the pluck and bravery of the guests in whose honour the function was primarily being held. The company paid a tribute "To the Glorious Memory of those who laid down their Lives to give the Empire her Place in the Air," and other toasts were "The Pioneers of British Aviation," "Greetings to our Confréres Abroad," and "The Future of Aviation." Mr. H. G. Wells, who supported the last-mentioned toast (proposed by Mr. Garvin) said the necessity for getting a passport and having it vised in all the States over which aircraft flew was likely to strangle aviation for many years to come, and he suggested that matters should be eased by setting up some super-Government to secure free right of way.

Catalogues, Price Lists, &c.

A well illustrated pamphlet of 16 pages has been issued by Messrs. A. A. Jones & Shipman, Ltd., Leicester, on their high-speed spindles for internal precision grinding. Several model forms of spindles are described and illustrated.

The Electrical Apparatus Company, of South Lambeth-road, S.W.8, has issued an illustrated leaflet relating to the "Mercantile" D.C. panels manufactured by its associated company, Messrs. Bray, Markham & Reiss, Ltd. The panels are suitable for 105-250-volt circuits, and for motors up to 5 h.p. The leaflet gives details of construction and prices.

Messrs. Thompson & Company, 48, Watling-street, E.C.4, have sent out a pamphlet which gives a description of the "Rex" single-phase alternating-current meter. These meters are manufactured in Geneva by the Société Genevoise d'Instruments de Physique, who carried out contracts for the British Government during the war, and Messrs. Thompson & Company are the sole agents for the United Kingdom.

In Messrs. Ward & Goldstone's new catalogue of electrical supplies a great variety of electrical fittings, cables, wires and flexibles, switchgear, fuses, insulators, lamps, small dynamos, motors, meters, batteries, accessories, &c., is listed and priced. The catalogue consists of 76 pages of small print, but a good index facilitates reference. Copies can be obtained by the trade on application to the company at Sampson Works, Salford, Manchester.

Messrs. Wertheimer & White, 64, Victoria-street, London, S.W.1, sole selling agents in this country of Dawson hardened copper, has issued a leaflet which gives some information about the metal. It is stated to be a "synthetic" metal, composed of copper plus some elements not disclosed by analysis, and that it is used on a large scale in the United States for various purposes, including commutator bars, trolley wheels, engine and general machine work, bells, springs, &c.

Heat Treatment Bulletin No. 20 of the Automatic and Electric Furnaces, Ltd., deals with abnormal steels Bulletin; No. 21 gives a brief description of the Wild-Barfield furnaces with a summary of their advantages, No. 22 is on the Hardness of High-speed Steel, and No. 23 deals with pyrometers. The company's monthly bulletin now circulates in twelve countries, and those on the mailing list who may change their address are requested to notify the company of the change.

Business Items, &c.

Arthur J. Allen and Bernard J. Parkes, manufacturing electricians, 15, Summer-row, Birmingham, have dissolved partnership.

Mr. M. W. Woods, of 146, Bishopsgate, E.C., is opening electrical engineering works at Denmark-street, Colchester.

Richard Williams and Jas. Hy. Waterland (trading as Richard Williams & Co.), electrical engineers, 89, Liverpool-road, Stoke-on-Trent, have dissolved partnership. Debts by Mr. Williams, who continues.

The Tudor Accumulator Company, Ltd., have removed their offices from Central Buildings, Westminster, to 2, Norfolk-street, Strand, London, W.C. 2. Telephone, Central 2947, but the telegraphic address remains "Subconical London."

The Monometer Mfg. Company (1918), Ltd., of Aston, Birmingham, have removed their head office to Savoy House, Strand, London, W.C. 2, where future communications should be sent. Telegrams, "Monometer, London;" telephone, Gerrard 3655.

The Nitrogen Fixation Department of Messrs. Brunner, Mond & Co., has now been transferred to Billingham and, as already stated in The Electrician, a separate company (The Synthetic Ammonia and Nitrates, Ltd.) has been formed for carrying on the work of erecting and operating the factory and plant on the Billingham site, which has been acquired from the Ministry of Munitions.

Tenders Invited and Accepted.

Salford Electricity Department want tenders by noon July 19 for c.i. pipes, Particular from the Borough Electrical Engineer.

The Castlederg Electric Supply Company, Ltd., invite tenders for supply and erection of generating plant. Tenders to Secretary by July 22.

Cardiff Guardians require tenders by July 22 for the supply of electrical fittings, wiring, &c., at 42, Cambridge-road, Cardiff. Specification, &c., from the Clerk, 11, Park-place, Cardiff.

Manchester Electricity Committee require tenders by Aug. 6 for low-pressure water pipes, supports, &c., and low-pressure water valves. Specification from Mr. F. E. Hughes, Town Hall, Manchester.

The New South Wales Department of Public Works, Sydney, require tenders by Aug. 2 for the supply of turbines and generators for the Barren Jack hydro-electric development.

Tenders are required (by Aug. 15) for the supply of an electric lift in the Kasr-el-Aini Hospital, Cairo. The specification (in French) can be inspected at 35, Old Queen-street (Room 50), S.W.1.

Grantown-on-Spey Council requires tender by July 31 for electric lighting work in 10 houses. Specifications may be seen at the office of Mr. H. J. Fraser, 25, High-street, Grantown-on-Spey.

Nuneaton Corporation require a 500 kw. rotary converter, transformer and accessories. Specifications from the Electrical Engineer; tenders to Chairman of Electricity Committee by July 31.

The date for the receipt of tenders by the New Zealand Public Works Department, Wellington, N.Z., for electrical equipment for the Arthur's Pass section of the Midland Railway of New Zealand has been extended from June 30 to August 7.

Bethnal Green (London) Borough Council invite tenders for e.h.t. and l.t. mains and roadwork. Specifications from Mr. H. W. Couzens, 9, Old Queen-street, S.W. 1, and tenders to Town Clerk, Town Hall, Bethnal Green, E.C., by July 19.

Grimsby Corporation invite tenders (by August 12) for the supply and erection of two water tube boilers, with economisers, fans, chimney, &c., a 3,000 kw. high pressure turbo-alternator and condenser plant. Specifications fromthe borough electrical engineer, Lieut.-Col. W. A. Vignoles.

Tenders are invited by the Commonwealth of Australia for the supply and erection of gal. iron and gal. steel stranded wire (by August 17), for copper jointing sleeves (August 21) and for porous cells and outer jars, bronze wire and covered and braided wire (by August 13).

Tenders are also invited (by Sept. 7) for supply to the Postmaster-General's Department Commonwealth of Australia of telephones and cable (Schedules 1,634 and 1,635). Tender forms from the office of the High Commissioner, Room 406, Australia House, Strand, London, W.C.2.

In connection with the Waikato electric power supply, tenders are required for the supply and delivery c.i.f. Auckland of 2,400 pin insulators suitable for a line operating at 66,000 volts. Tenders to the Secretary, Public Works Tenders Board, Wellington, by July 31.

The New South Wales Government Railways & Tramways Department require tenders by August 4 for two 1,000 kw. rotary converters, six 365 kw. s. phase transformers and two blower sets; or (alternatively) two 1,000 kw. rotary converters and two three-phase oil-insulated self-cooled transformers. Specifications from the Chief Electrical Engineer for Railways.

Tenders are required (by Aug. 3) for the supply and erection at Perth (W.A.) of 326 accumulators (in accordance with Schedule W.A. 668), and also (by Aug. 2 and 5 respectively) for (a) aluminium sheet, brass rod, &c. (schedule 769) and (b) platinum wire, gold and silver wire, &c. (schedule 768), for the Australian Commonwealth, Postmaster-General's Department, New South Wales. Forms, &c., from the High Commissioner, Australia House, Strand, London, W.C. 2.

Blackpool Corporation invite tenders for the supply and erection of two water-tube boilers, superheaters, economisers and mechanical stokers, &c.; two induced draught plants with steel chimneys, fans, &c., and coal hoppers and coal and ash elevators and conveyors. Specifications from the borough electrical engineer (Mr. Charles Furness), West Caroline-street, Blackpool, and tenders to the chairman of the Electricity Committee by Aug. 27

Northampton Council has accepted the tender of Dick, Kerr & Company for four tramcars at £3,407 each.

Walthamstow Tramways Committee has placed an order with the Electromobile, Ltd., for an electric tower waggon, at £1,351.

Runcorn Urban Council has accepted the tender of the Mersey Power Company for the electric lighting of the public lamps at £205.

West Ham Electricity Committee has placed an order with the British Thomson-Houston Company for new feeder panels, &c., at £9,344.

London County Council has accepted the tender of Bolckow, Vaughan & Company for the supply of 5,500 tons of track rails and fastenings, at £154,747.

Johannesburg Municipal Council has placed an order with the Griffin Engineering Company for an "Orwell" electric vehicle, with set of spares, &c., at £2,832.

Hampstead Borough Council has accepted the tender of Sir J. P. Payne Gallwey, Brown & Company, for the supply and erection of electrical equipment for house refuse disposal at the West Hampstead Goods Yard, at £1,264, and that of Leyland-Tatnell & Company for the supply of two second-hand 3½ ton electric vehicles for dust removal.

Marylebone (London) Borough Council has accepted the tender of W. H. Allen, Son & Co., for four 35 h.p. motors and switchgear at £2,793; that of Aiton & Co. for water pipes and valves at £1,856; that of G. & J. Weir for two turbine-driven rotary pumps at £1,179; and that of the British Insulated and Helsby Cables for generator cables, &c., at £278.

Stepney Electricity Committee has accepted the following tenders: W. T. Henley's Telegraph Works Company, 110 yds. 0·5 and 440 yds. 0·05 cable, £467, and 1½ miles 0·025 and ½ mile 0·007 cable, £859 15s. (British Insulated & Helsby Cables, Ltd., also tendered at £474 and £873 10s. less 2½ per cent.) Sutton & Company, ¼ mile 3 in. earthenware pipes, £82 10s. (Doulton & Company tendered at the same price and W. T. Henley's Company at £96 5s.)

Shoreditch (London) Borough Council has accepted the tender of the British Thomson-Houston Company (lowest tender received) for e.h.t. and l.t. switchgear for Whiston-street station at £9,210 (or £9,510 including provisional sum); and that of the Metropolitan-Vickers Electrical Company (lowest tender received) for e.h.t. and l.t. switchgear for the Coronet-street station at £1,364 (or £1,464 including provisional sum). For the former contract there were nine tenders, the highest being £10,963, and for the latter contract nine tenders, the highest of which was £2,230 (exclusive of provisional sum).

Bradford Corporation has accepted the following tenders—Tramways department: Walter Scott, Ltd., 15 tons steel fishplates, £32 10s. per ton; Pease & Partners, 10 tons c.i. brake blocks, £245. Electricity department: J. H. Holmes & Company, meter testing generator, £505; Yorkshire Commercial Motor Company, steam wagon for cable drums and transformers, £1,300; Stewarts & Lloyds, steam piping, £855; Key Engineering Company, fibre cable conduits, £2,512; Worthington Pump Company, feed water heater, £240; and Herbert Morris, Ltd., two hand-operated overhead cranes, £873.

Barrow Electricity Committee has accepted the following tenders:—Vacuum Oil Company, engine oils; British Insulated and Helsby Cables, copper wire; W. T. Henley's Telegraph Works Company, joint boxes; Chamberlain & Hookham, meters; Ferranti, Ltd., prepayment meters; W. R. Thornton & Sons, half-watt lamps; Doulton & Company, earthenware pipes; E. Last & Son, wood casing; Dussek Bitumen Company, bitumen; Tudor Accumulator Company, battery inspection; Davenport Engineering Company, two 250 kw. restacking cooling towers; and Bruce Peebles & Company, two 250 kw. motor converters (£4,812).

The following tenders have been accepted by Manchester Corporation:—*Tramways Committee.*—F. Smith & Company, trolley wire, United States Steel Products Company, tramway fishplates. *Waterworks Committee* (for Thirlmere hydro-electric installation).—Lancashire Dynamo & Motor Company, dynamo and switchboard, motor generator and switchboard, and motors; D. P. Battery Company, storage battery; Whipp & Bourne, switchboards; Brook, Hirst & Co., starting panels. *Electricity Committee.*—Callender's Cable & Construction Company, cable laying; Ferguson, Pailin, Ltd., and Whipp & Bourne, knife switches; Whipp & Bourne, extensions to balancer board; Richardsons, Westgarth & Company, 8,000 kw. to 10,000 kw. turbo-alternator and condensing plant.

Personal and Appointments.

Mr. G. D. Brock, F.I.C., has been appointed chief chemist to the British Aluminium Company.

Mr. Ernest Barker, M.A., of New College, Oxford, has been appointed Principal of King's College, London.

Dr. T. M. Lowry, D.Sc., F.R.S., has been appointed professor of physical chemistry at Cambridge University.

Prof. H. A. Lorentz, professor of physics in Leyden University, has been elected an honorary fellow of the Royal Society of Edinburgh.

On the 8th inst., the marriage took place at Holy Trinity, Sloane-street, London, of Lord Rayleigh and Mrs. Kathleen Alice Cuthbert.

Mr. T. G. Richardson, of Colne, has been appointed manager of West Hartlepool Corporation's tramways, at a salary of £600 per annum.

Mr. C. Bullock, managing engineer of the Vulcan Boiler and General Insurance Company, has resigned, and Mr. Frank H. Bullock, deputy managing engineer, has been appointed to the vacant position.

The Lord President, as President of the Committee of Council for Scientific and Industrial Research, has appointed Dr. J. S. Flett, F.R.S., at present Assistant to the Director in Scotland, to be Director of the Geological Survey and Museum. Dr. Flett succeeds Sir Aubrey Strahan, K.B.E., F.R.S., who retires this month, when Mr. G. W. Lamplugh, F.R.S., Assistant to the Director, also retires.

Bankruptcies and Liquidations.

Claims against the Globe Electric Company, Ltd., are to be sent to the liquidator, Mr. W. A. J. Osborne, Balfour House, Finsbury-pavement, London, E.C. 3, by July 24.

Lithanode, Ltd., is being wound up voluntarily and Mr. F. A. Bell, Billiter House, Billiter-street, London, E.C. 3. A meeting of creditors will take place at the offices of Messrs. John Baker & Sons, Billiter House, Billiter-street, E.C. 3, on July 16.

At the meeting of creditors of Ivor James Hodson (Dawlish) and Basil Howard Newman (Honiton), trading as Hodson & Newman, electrical engineers, Queen-street, Exeter, it was reported that the liabilities were £745, and assets were estimated to produce £227. Debtors attributed failure to want of capital and bad trade, particularly since Easter, 1920. Both debtors commenced business in July, 1919, with a capital of £20.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstracts from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1916 Specification.

143,272 B.T.-H. Co. (G.E. Co.) Multi-speed alternating current motors. (29/1/16.)

1917 Specifications.

143,580 Clarke. Directive wireless telegraphy. (12/10/17: complete specification accepted, 4/2/20; patent sealed, 4/2/20.)
143,581 Hammond. Systems for the transmission and reception of electro-radiant energy. (28/9/16.)

Comprises means for emitting a series of waves, means for impressing upon said waves a series of periodic modifications having a frequency different from the frequency of said waves, in combination with means for receiving said waves, including two elements tuned to respond selectively to said waves and modifications respectively, and a receiving device arranged to be controlled by the concurrent and successive action of said elements, the system being characterised by the fact that both of said frequencies are substantially above the frequence of audibility.

1918 Specifications.

143,277 Western Electric Co. & Polinkowsky. Machine-switching telephone exchange systems. (1/5/18.)
143,280 Elektro-Material Ges. Electric insulation. (11/4/18.)
143,583 Levy. Electrical transmission, particularly applicable to radio-telegraphy and telephony. (4/8/17.)
143,588 Vickers, Ltd., Mackness & Broughton. Systems for driving hoists, rolling-mills and electric locomotives. (19/12/18.)

1919 Specifications.

123,770 Duveau. Electric connectors. (18/3/14.)
125,991 National Carbon Co. Machines for making bobbins for electric batteries.
125,992 National Carbon Co. Machines for making bobbins for electric batteries. (10/1/18.)
130,965 Connecticut Telephone & Electric Co. Electron valves. (8/8/18.)
132,492 Benjamin Electric, Ltd. Switches. (13/9/19.)
133,051 Pohle. Means for detecting unauthorised use of incandescent electric lamps. (28/8/18.)
135,163 Scheneider & Schlegel. Electric miner's lamps. (9/11/18.)
135,219 Siemens & Halske Akt.-Ges. Fixing arrangements for electric measuring instruments. (23/8/18.)
138,854 Cesaro. Electric push-button switches. (8/2/19.)
142,329 Ames. Magnetic cores and method of making same. (29/5/19.)
142,333 Turner. Electric relays and electric relay circuits. (4/6/19.)
142,341 Weatherill. Induction coils. (14/6/19.)
142,343 Hadwen & Willis. Coupling for electric conducts or for tubes, pipes, shafts, or the like. (19/6/19.)
142,349 Selvatico. Electric heating elements. (26/6/19.)
142,363 Pollock & McKay. Arc-welding generators. (9/7/19.)
142,367 Perego. Protective transformer for preventing the passage of currents of dangerously high tension over electric signalling circuits. (16/7/19.)
142,371 Western Electric Co. High-frequency electric signalling systems. (29/7/19.)

Relates to a method of electric signalling wherein a high-frequency carrier wave is modulated in accordance with a law frequency signal wave, and the resulting energy transmitted to a distant station where it is received, and causing the received waves of carrier frequency to modulate a second carrier wave at said distant station, the energy resulting from the modulation of said second carrier wave being transmitted in whole or in part.

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

February 9, 1920.

3,866 Ravenscroft. Word counter and speed tester for telegraph circuits.
3,879 Crabtree. Switches.
3,889 Reyrolle, Leeson & Mirrey. Time limit relays, &c.
3,891 Woodburn. Magnetic deflectors for electric arcs in lamps, searchlights, &c.
3,914 Siemens & Bolton. Protective arrangements for alternating-current circuits.
3,918 B.T.-H. Co. & Clinker. Electric measuring or indicating instruments.
3,922 Kearney & Quint. Electrically-operated diaphragm horns.
3,979 Graham & Morgan. Portable electromagnetic appliance for treatment of the hair.
3,987 Dawe. Electrical resistance apparatus.

February 10, 1920.

4,003 Rutherford. Carrier for electric lamp shades, &c.
4,010 Fennimore. Electric lamp.
4,016 Bailey. Coupling dynamos, &c., to internal-combustion engines.
4,049 Codd & Martin. Incandescent lamps.
4,058 Joseph. Electric heating apparatus.
4,078 Konieszny. Electric lamps.
4,085 B.T.-H. Co. (G.E. Co.) Switches.
4,104 Jones. Means for supply of current to railway, &c., tracks.
4,117, 4,118, 4,119 & 4,120 Pouchain. Negative plates for accumulators.

February 11, 1920.

4,128 Garrard, Railing & Wilson. Electric starters and cut-outs for electric lighting plants employing internal-combustion engines.
4,144 Walsall Hardware Mfg. Co., Compson & Read. Combined switches and wall plugs and sockets.
4,172 Farrell. Trolley pole heads.
4,185 Dimitrievitch. Arrangement for receiving submarine telegraph signals, &c.
4,204 B.T.-H. Co. (G.E. Co.) Electrical apparatus.
4,214 Routin. Electrical apparatus for indicating and repeating movements at a distance. (3/1/20, France.)
4,225 Waters. Electode holders for arc welding, &c.
4,231 Akt.-Ges. R. Bosch. Distributing devices for high-tension ignition machines. (9/3/18, Germany.)
4,239 Automatic Engineering Telephone Co. Measured service devices for telephone systems. (12/2/19, U.S.)
4,255 Rosario. Electric light attachment for rifles, &c.
4,260 Vaure. Switches. (20/3/19, France.)
4,273 Morris-Airey, Shearing & Macrorie. Wireless telegraphy and telephony.
4,274 & 4,275 Shearing & Macrorie. Transmitters for wireless telegraphy.

February 12, 1920.

4,280 McClelland. Electrically producing gas for engines, &c.
4,292 Wigley. Electric overhead coke conveyors, &c.
4,293 Newman. Machine for connecting tidal, &c., energy to mechanical and electrical energy.
4,306 Waterhouse. Switches.
4,351 Berry. Fittings for arc, &c., lamps.
4,377 Compagnie Generale d'Electricite. Portable electric lamps. (27/5/19, France.)

February 13, 1920.

4,396 Turner. Wireless telegraph receivers.
4,411 Callender's Cable & Construction Co. & Hunter. Protective arrangements for electrical distribution, &c., systems.
4,417 Malone. Trolley wheel head and bearing socket.
4,426 Electrical Contracting Co. & England. Electrical device for recording fires and burglaries, &c.

Companies' Reports, &c.

General Electric Meeting.

At the annual meeting of the General Electric Company on Tuesday, Mr. Hugo Hirst, chairman and managing director, said it was not possible to convey in a few short lines, such as were usually attached to an annual report, a very clear conception of the state of flux and evolution through which the company was passing. The company was a private one up to 1900, and up to the beginning of the war private interests controlled its destinies, and it was natural that the expansion of the business was limited by the ambition, tastes and qualifications of a number of prominent shareholders who were naturally extremely careful. To some extent the company benefited to-day from that conservation. On the other hand, it was realised at the outbreak of the war how backward was the state of the electrical industry in this country, and how much depended on the foreigner as regarded experience, processes, patents and even materials. The cry to make ourselves independent arose from all quarters and the company realised that it might have the necessary qualifications to meet the country's requirements. The programme of expansion was conceived in 1916, and towards the end of the war, and particularly since the Armistice the real process of expansion had been going on. One could not carry through such a programme by periodic large increases of capital without great risks, but by financing it with a large credit from the bank, such as they had been able to do by just drawing the money as and when they required it, and no more, it was possible. The man who granted them those facilities in the first instance was the late Sir Edward Holden, to whom they owed a debt of gratitude.

Expansion and Development.

It would be remembered that the company acquired some years ago the firm of Fraser & Chalmers, whose reputation for turbines and turbo-blowers was second to none. Provision had been made for doubling the output, and the work was nearly completed. The mining machinery department was also to be considerably extended. A programme of extensions was also being carried out at Witton, which would double their output of electric plant, and before long they hoped to double their output of electric lamps. The glass works at Lemington had been largely extended and the Westlake automatic glass-blowing machines which had been installed would before long ensure the much-needed increase of output. The fixtures, accessories and heating and cooking apparatus works were again showing an upward curve. The carbon works, partly through importation and partly through the arrival of the gas-filled lamp, had drifted back into their pre-war impotence, but the lamp-black works started as an accessory to the carbon works, showed great vitality and adaptability. A similar progress could be recorded in their endeavours to produce their own moulding and insulating materials. The Pirelli-General Cable Works had been extended, and considerable additions were again in progress. Finally, very big extensions were contemplated of the Peel-Conner Telephone Works. The present works at Manchester could not be extended, and the necessary capital had been provided for erecting new Peel-Conner Works at Coventry, alongside the Magneto Works controlled by the G.E.C. It was intended to start immediately on the construction of automatic exchanges, a system having been secured which it was hoped would meet with the approval of the authorities.

Taxation and Prices.

Dealing with the Excess Profits Duty, Mr. Hirst described it as nothing short of an encroachment on capital. Could they charge their workmen a rent on the houses they had provided for them that would yield 9 or 10 per cent. on the present price of cottages ? Was enough allowed for depreciation, and expenses incurred in research work ? He said, no ! and he asked how could we compete with countries who had wisely used the profits made out of us during the war to depreciate their plants, buildings and machinery to the proverbial shilling ? Something must be done to stop what was called the vicious circle. We must produce cheaper, and that could only be done by producing more in a given time.

The report and accounts (abstracted in our last issue) were adopted, and the dividends set out therein were approved.

The directors of the Clontarf & Hill of Howth Tramroad Company have declared the usual interim dividend of 3s. per share.

The directors of the Telegraph Construction and Maintenance Company, Ltd., announce an interim dividend of 6s. per share, tax free.

The British Empire Steel Corporation proposes to spend $20,000,000 on the development of their iron and coal properties in Canada.

The directors of the Dublin United Tramways Company, Ltd., have declared an interim dividend for half-year ended June 30, at rate of 4 per cent. per annum on the ordinary shares.

The Havana (Cuba) Electric Railway, Light & Power Company, which has a plant of three 12,500-kw. turbine sets, has ordered two new 25,000-kw. Westinghouse sets, one of which will replace one of the existing sets.

It was announced at the recent meeting of the Ebbw Vale Steel, Iron & Coal Company, Ltd., last week that a considerable expansion of the iron and steel departments had taken place and additions had also been made to the electric generating station.

It was announced at the meeting of the Burmah Oil Company, Ltd., last week that the directors were proceeding with the electrification of the oilfields and other important schemes. It was, therefore, necessary to increase the company's nominal share capital.

The net earnings of the Victoria Falls & Transvaal Power Company, Ltd. (including those of the Rand Mines Power Supply Company), for the quarter to March 31 amounted to £209,240, before providing for taxation in South Africa and United Kingdom.

The directors of the Rees Roturbo Manufacturing Co., Ltd., have declared a dividend of 15 per cent. (3s. per share) on the preference shares for the years 1912, 1913 and 1914, placed £3,500 for maintenance of buildings, &c., £1,683 to bad debts reserve, and carried £2,853 forward.

Messrs. Mather & Platt, Ltd., have decided to issue 210,000 ordinary £1 shares in order to provide extra capital for the large extensions of works in progress. The directors have also decided to recommend that a number, not exceeding 200,000, of the unissued shares shall be issued as ordinary shares to the company's employees.

The accounts of the Shropshire, Worcestershire & Staffordshire Electric Power Company for 1919 show, including £8,137 brought forward, an available balance of £12,189. The directors propose to place £1,199 to reserve sinking fund, to pay the dividends on the 7 per cent. and the 6 per cent. cumulative preference shares and to carry forward £740.

For the year ended July 31, 1919, the gross revenue of the Compania de Electricidad de la Provincia de Buenos Ayres was £252,630. There was an increase in total receipts (£271,235) of 19·69 per cent. over the preceding year. The total expenses in Argentina were £199,291, an increase of 8·88 per cent. The net profit is £54,691 (against £40,835). A sum of £14,841 was recovered from the Compania Alemana Transatlantica de Electricidad.

The gross receipts of the Yorkshire (Woollen District) Electric Tramways Company, Ltd., for 1919 were £125,161. After deducting all expenses, including repairs and maintenance, payments to local authorities, debenture and other interest, and setting aside £23,000 to renewals funds, there remains £19,700, which, with £1,978 brought forward, makes an available balance of £21,679. The directors recommend a dividend on the ordinary shares at rate of 6 per cent. for the year, in respect of which an interim dividend for six months at the rate of 5 per cent. per annum has been paid.

The net revenue of the Birmingham District Power & Traction Company, Ltd., for 1919 was £95,812. After deducting administration and general expenses, payments to local authorities, &c., the surplus was £67,923, making, with £6,930 brought forward, an available total of £73,954. Interest on debenture stock absorbed £18,769, and after deducting debenture sinking fund (£8,294) provision for renewals (£10,000) and the dividend on the 6 per cent. cumulative participating preference shares (£8,811), there remains £28,080. The directors recommend placing to reserve £1,050 and a dividend on the ordinary shares at the rate of 6 per cent. for the year, carrying forward £4,354.

The profit of Fuller's United Electric Works, Ltd., for the year ended March 31, after providing for all expenses, amounted to £48,045. The directors propose to write off £5,400 for depreciation on plant, £6,500 for preliminary expenses, to pay an extra 2 per cent. on the preference shares (making 10 per cent. for the year) and a dividend on the ordinary shares of 10 per cent. (less tax), leaving £8,040 to be carried forward. Negotiations are still proceeding with the Inland Revenue regarding the liability for income-tax and excess profits duty, but the directors are satisfied that the reserve and the carry forward will be more than sufficient to meet the maximum liability. Owing to the rapidly increasing business and the higher costs of stocks it will be necessary to raise further capital.

Mr. Frederick R. Simms, who presided over the statutory meeting of the Simms Motor Units (1920), Ltd., last week, stated that the directors proposed to develop the lucrative accessory department of their business, for there were large markets for their sparking plugs, magnetic petrol gauges, mechanical and electrical horns, vulcanisers and magneto couplings. At the magneto repair and spare part departments over 100 workers were employed. The dynamo and electric motor repair department had been removed to larger premises. They were producing in their works more magnetos per square foot than anywhere in this country. Their New York branch office, established for the export of magnetos (made by the American Simms Magneto Company of East Orange, N.J.), for which the company held the export rights, owing to the increased production of the American factory, was rapidly becoming an important asset to the company.

The report of the directors of the Chili Telephone Company, Ltd., for the year ended March 31 states that the total subscribers at all centres at the end of the year was 18,789, an increase of 2,038 for the year. The total length of lines in operation was 30,734, an increase of 4,633. The gross revenue was £225,011, a decrease of £11,091, and the total expenditure (exclusive of income tax) was £152,207, a decrease of £1,746. The net revenue (£72,804) shows a decrease of £9,345. The balance to credit of revenue account, after deducting income tax, and including £8,511 brought forward, is £68,560. An interim dividend of 3s. per share, tax free, was paid in January, and after carrying £10,316 to general reserve and £12,000 to reserve for renewal of plant, the directors now recommend a final dividend of 3s. per share, tax free, leaving £19,843 to be carried forward. To enable the company to acquire the telephone business established in Antofagasta, the capital was increased in January last by the issue of 11,000 fully-paid shares at par.

Mr. W. Gascoyne Dalzell, who presided over the meeting of the South Wales Electrical Power Distribution Company, Ltd., last week, stated that although 45,127,985 units had been sold during the year, an increase of 8,534,082 units over 1918, the company had been unable to earn the full amount of interest on the debenture stock, and had to use about £2,000 of the balance in hand to enable it to be paid. That was due to the harassing and uncertain conditions, particularly in regard to labour. The troubles did not yet appear to be at an end, as they had before them a demand for a further increase of £1 per week for workmen over 18 years of age and 10s. per week for those under 18. When one contemplated the demands of the extremists in the Labour world for the confiscation of capital, the appropriation of the profits of successful commercial undertakings, one could not help thinking of the irony of the position of the shareholders of that company, who subscribed £600,000 odd for the establishment of an undertaking which had provided employment for hundreds of workmen and paid some hundreds of thousands of pounds in wages, but who had never yet, over a period of 18 years, received one penny return on their capital. There had been a satisfactory development of the business, 5,640 additional horse-power having been connected to the mains, bringing the total to 48,300 H.P. Contracts had been entered into with, amongst others, Messrs. Guest, Keen & Nettlefolds for their works at Cwmbran, the Machen Stone & Lime Company, the Rhymney Railway for their Caerphilly locomotive sheds, and the Pengam Colliery Company, which would add a further material increase to the output. There was little doubt that the company would have to consider the erection of one or more new power stations in different parts of their large area.

In moving the adoption of the report and accounts at the seventh annual general meeting of CROMPTON & COMPANY, LTD., the chairman, Mr. A. A. C. Swinton, F.R.S., stated that the past year had in many respects been abnormal. The demand for the company's manufactures had been quite unprecedented, and they had been obliged to decline a good deal of business which, had the capacity of their works been larger, they would have been glad to have undertaken. The orders booked during the year showed an increase of 80 per cent. over the previous year, and the unexecuted orders in hand at the close of the year represented a very large amount. Their ability to secure business at present was only limited by their capacity to turn out the work, and he did not anticipate any alteration in the position for some time. In view of the increasing demand on their manufacturing capacity, they had been obliged to extend their original programme for the new buildings at Chelmsford. Owing, however, to the difficulty in obtaining material and labour, it would be some time before they secured the full benefit of the expenditure.

The effects of the moulders' strike had not yet entirely passed away, and the holding up of work in hand, and the extra expenses entailed upon the company in their endeavour to minimise the inconvenience to customers, had had a very material effect upon the year's profit. It was, therefore, with a considerable amount of satisfaction that the board was able to submit accounts showing a net available profit of £52,878, an increase of about 37 per cent. He had previously spoken rather strongly of the unfairness of the incidence of the excess profit duty, and it had been a great disappointment to the directors that the Chancellor should not only have reimposed that tax, but had increased it from 40 to 60 per cent. for the current year. So far as the current year was concerned, their trouble was not to get orders, but to avoid offending customers by their inability to meet their demands, and that being so it would be agreed that the directors were justified in looking forward to a successful year.

The report was adopted and a resolution passed removing the limitation of the borrowing powers provided by article 80.

The chairman of the ANGLO-PORTUGUESE TELEPHONE COMPANY, LTD. (Mr. H. Allen) announced at the annual meeting last week that the directors had recently succeeded in securing a Decree of the Portuguese Government which authorised them to make increased charges to cover the advance in wages and working costs. The increase upon their original tariff varied from 150 to 180 per cent., the higher rate applying to commercial establishments, which constituted the greater part of their business. Another big increase in wages—and there had been many such—came into operation in February. After referring to the loss on exchange, he stated that the new tariff, even if it did nothing more, would afford them temporary relief until the substitution of the measured or message rate for the inequitable fixed subscription for large and small users alike. A general strike of their workmen and operators broke out on Jan. 14 last, and continued for nearly nine weeks. The strike was due to professional labour agitators. The deluded workers lost nine weeks' wages. They were now concentrating their efforts largely on the extension of their exchange accommodation, which was sadly behind the requirements of the times. For the new Central Exchange in Lisbon, which was intended to have an ultimate capacity of 20,000 lines, they had found a splendid site in the business centre of the city. They were getting on with the plans and specifications. The material for the extension of the switchboard in the Norte Exchange was being installed by their staff. The building to give still further switchboard accommodation was also well in hand. The only permanent solution of their difficulties was to be found in an entirely new central exchange. The number of calls passing through the company's exchanges last year was 38½ millions, an increase of 3½ millions over the number in the previous year. Although no arrangement had yet been arrived at for taking over the Government trunk lines, the service of which continued to be most unsatisfactory, steps were in contemplation under which the company would be enabled to introduce wireless telephony for linking-up Lisbon and Oporto with the other important towns of Portugal. The final dividend of 4 per cent. would make 7 per cent. for the whole year, following upon four "war" dividends of 6 per cent. Prior to that they regularly paid 8 per cent.

The report of the BRITISH THOMSON-HOUSTON COMPANY, LTD., for 1919 states that the works at Rugby, Coventry and Willesden have been maintained in good condition. At Rugby a number of extensions were begun, but their completion has been delayed by various causes. At Willesden a new building is practically completed which will considerably increase manufacturing facilities. The company has purchased a property at Blackheath, near Birmingham, which will be known as the company's "Birmingham Works." On the property (about 70 acres) there are several suitable buildings with an aggregate floor area of about 250,000 sq. ft., and plans are in hand for the erection of further buildings. The year's profits, after deducting all expenses and charges, other than interest on debentures and loans, and after making provision for estimated war taxation, were £412,480. Adding £150,783 brought forward and deducting £134,230 for interest on debentures and loans, the directors recommend that there be appropriated for depreciation, reserves and adjustments £220,602 and to carry forward £208,431. The capital reserve account has been increased from £245,555 to £251,772, and the directors recommend that dividends be declared payable out of this reserve as follows: In full payment of the accumulated dividends on the preference shares, £210,000 (being £5 5s. per £10 share); and to the ordinary shareholders, £40,000 (being £1 per £10 share). It is proposed to capitalise this £250,000 and to issue fully-paid ordinary shares to that amount to the shareholders. It is proposed to increase the share capital to £4,000,000 in £1 shares, of which £2,000,000 will be ordinary shares and £2,000,000 preference shares. The preference shares will be entitled to cumulative dividends at the rate of 7 per cent. per annum.

By a contract with the International General Electric Company, the territorial and patent rights of the company have been extended for a long period of years. Much closer relationships have also been established between the company and the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston (of Paris) by acquiring a number of the shares of that company. They have also acquired an interest in the Société d'Electricité et de Mécanique (Procédés Thomson-Houston & Carels) of Belgium. Several of the directors of this company are also on the boards of the French and Belgian companies.

In moving the adoption of the report of the ALUMINIUM CORPORATION, LTD., at the meeting on the 30th ult., Mr. S. G. Bibby stated that the profit for the three years, before deducting debenture and loan interest was £129,956, or an average of just over £43,000 per annum. That enabled them to pay the preference dividends and £30,000 would be placed to a reserve account for special depreciation. A sum of £331,486 had been expended during the past three years in additional works, including the construction of the Llugwydam and work on the construction of the Cowlyd dam. The latter had reached the stage when the concrete-core wall was above ground level. They had also constructed at Dolgarrog a large extension of their rolling mill; a new recasting shop had been erected and the area of the works very considerably increased. A new 1,200 kw. 3-phase alternator and switchboard, with direct coupled exciter, had been installed, together with a 34,000 volt transformer and other plant. After referring to the conversion of the share capital and their interests in other companies, Mr. Bibby stated that during the period under review an opportunity occurred for the purchase by the company of the controlling interest in the North Wales Power and Traction Company. That company was really the parent company of the Aluminium Corporation. The two companies were working to some extent in opposition, and, bearing in mind the fact that the two stations were connected by a 20,000-volt transmission line, they would easily perceive the great advantages of the amalgamation. The Chairman (Mr. Clark) generously found the amount required for the purchase and accepted first debentures in the North Wales Power and Traction Company. Since the purchase new machinery had been installed in both power stations, the transmission line had been strengthened, and they were now working in unison to the advantage of both companies.

In conjunction with the North Wales Company, they had large possibilities in regard to the sale of electrical energy to towns, quarries and other industries, in addition to their own consumption. The Board felt that there was every prospect of being able to pay a dividend on the ordinary shares, provided the necessary developments could be carried out; that meant further heavy expenditure on capital account. New dams to conserve the rainfall must be constructed, further pipe lines were needed and a new power house must be built. Theirs was the only high-pressure hydro-electric scheme in operation in England or Wales.

In conjunction with their interest in the North Wales Power and Traction Company, they were arranging to use a portion of their electricity for public supplies, and had in hand at present the construction of a high voltage transmission line, connecting their works at Dolgarrog with the towns of Colwyn Bay and Llandudno.

Although the production of aluminium had been greatly increased during the war, the demand had kept pace with the supply and they had found no difficulty in disposing of their output. Their rolling mill had been of great importance and had enabled them to widen their sphere of operations, both in this country and India, and in other parts of the world. The chief difficulty of the outlook was the question of supplies of raw material. The freight market showed signs of easing, but the costs of production had been considerably increased by the continuous rise in wages, coupled with the reduction of working hours and cost of coal. It was now a question whether wages have not reached their economical limit and one could only trust that labour, which had generally proved very sound at the core, would realise that before serious harm was done to the industry of the country. There was a possibility of the French Government placing an export duty on bauxite, in which case they would be obliged to interest themselves in the considerable deposits of the ore known to exist in the British Empire.

New Companies.

BANKSIDE FINANCE & INDUSTRIES, LTD. (168,918)—Private company. Reg. July 9, capital £250,000 in £1 shares, to carry on the business indicated by the title and that of dealers in and managers of lands, buildings and hereditaments, constructors of electric power stations, warehouses and shops, contractors, engineers, electricians, &c. The subscribers are J. B. Braithwaite and J. C. Bull. Solicitor: W. Morris, 17, Throgmorton-avenue, E.C.

ELECTRIC BRASS WARES, LTD. (168,534)—Private company. Reg. June 24, capital £1,000 in £1 shares, to carry on the business of electric and mechanical engineers, manufacturers of and dealers in electric cables, &c. First directors are F. C. Blackwell, A. B. Gregson and J. Roberts. Sec.: T. E. A. Killip. Reg. office: 21, Tempest Hay, Liverpool.

A. H. HUNT, LTD. (168,116).—Private company. Reg. June 9, capital £40,000 in £1 shares, to carry on the business of gas, electrical and mechanical engineers, electricians, &c. First directors are: A. H. Hunt (permanent director and chairman) and C. H. Hunt. Reg. office: H. A. H. Works, Tunstall-road, Croydon.

INDUSTRIAL ELECTROPLANT. LTD. (168,192).—Private company. Reg. June 11, capital £2,000 in £1 shares, to carry on the business of manufacturers of and dealers in electric and galvanic machinery, motor cars, range finders, gyroscopes, dynamos, cables, &c. First directors are: F. Pooley, F. C. Austin, W. L. Wreford, F. Creedy and H. St. Hill, Maudsley. Reg. office: 34, Broadway, Westminster, S.W.

MIDLAND COUNTIES ELECTRICAL ENGINEERING COMPANY, LTD (168,549).—Private company. Reg. June 24, capital £3,000 in £1 shares, to take over the business of electrical engineers and contractors carried on at Smethwick as the Midland Counties Electrical Engineering Co. Reg. office: 136, Sandon-road, Smethwick, Staffs.

NEWCASTLE ELECTRICAL & MOTOR ACCESSORIES, LTD. (168,103.)—Private company. Reg. June 8, capital £5,000 in £1 shares, to carry on business as indicated by title. First directors are: W. E. B. Dove, J. Cowper and T. Sloan; manager, G. G. Gorrill. Reg. office: 39, High Bridge, Newcastle-on-Tyne.

SEAL COMPANY (LONDON), LTD. (168,953).—Private company. Reg. June 2, capital £1,000 in £1 shares, to manufacture, install and deal in electrical, chemical or electro-chemical or mechanical and other articles and apparatus. First directors are F. H. Brewerton, R. S. Atherstone and F. A. Fraser. Solicitor: G. O. White, 31, Great James-street, Bedford-row, W.C.

SINCLAIR, PAGET & COMPANY, LTD. (168,209).—Private company. Reg. June 11, capital £2,000 in £1 shares, to take over the business of electricians, electrical engineers, &c., carried on by G. F. A. Paul. First directors are: W. P. St. John, G. F. A. Paul and L. Lambert (secretary). Reg. office: 8, New Inn Yard, Shoreditch, E.

STEWART, THOMPSON & PATRICK, LTD. (168,596)—Private company Reg. June 25, capital £3,000 in £1 shares, to take over the business of an electrical and mechanical engineer carried on by S. R. Thomson as "Stewart Thomson & Son." First directors are S. R. Thomson (managing director), T. A. Patrick, R. B. Kilgour and E. R. Patrick. Reg. office: 10 and 12, Hart-street, Liverpool.

WELDRICS. LTD. (168,838).—Private company. Reg. July 6, capital £3,000 in £1 shares, to adopt an agreement with W. H. Boorne, Rose Street Foundry & Engineering Company, and others, and to carry on the business of mechanical and electrical engineers, metal workers, &c. First directors are: A. W. Bullivant, S. H. Gordon and W. H. Boorne. Reg. office: Bush Lane House, Bush-lane, Cannon-street, E.C. 4.

WOODCROW GENERAL, MECHANICAL & ELECTRICAL HEATING, ENGINEERING COMPANY, LTD. (168,737)—Private company. Reg. July 1, capital £3,000 in £1 shares, to take over the business carried on at High-street, Stourbridge, under similar name. First directors are A. Pasfield, E. Crowther and T. R. Atkinson.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—Dinner to the Pioneers (Full Report); "A New Theory of the Screw Propeller," by M. A. S. Riach; and "The Converson of the 'Daily Mail.'"

"The Cabinet Maker":—"Furniture at the Empire Timber Exhibition"; "A Half-year's Exports of Furnishings"; and "The Modern Chesterfield Frame and Its Treatment."

"The Chemical Age":—Annual Meeting of the Society of Chemical Industry; Special Reports of Papers and Discussions.

"The Fruit-Grower":—"Economic Fruit-growing"; "Control and Encouraging Production"; and "The State and the Land."

"The Gas World":—"Installation Gas Costs in Factories"; "The Public and Wage Demands of Gas-workers"; and "Society of Chemical Industry and Coke Ovens."

"The Hardware Trade Journal":—"Punching Small Holes"; "Electric Pocket Lamps"; and "The Outlook for Hardware Exporters."

"Ways and Means":—"Minimum and Competitive Wages," by Prof. A. L. Bowley; "More Co-partnership," by H. Cooper; and "Rural Education for Women," by Mrs. B. M. Marshall.

Forty Years Ago.

(THE ELECTRICIAN, JULY 17, 1880.)

TELEGRAPHY AND "OUR BOYS."—"What shall we do with our boys?" is a question often mooted amongst the middle classes, as well as elsewhere; and on entering into it more fully telegraphy as a branch of engineering crops up to be discussed as a possible opening for a boy having some turn for mathematics, chemistry, or mechanics. When we are asked our opinion, we are puzzled what to answer, for there seems to be a haze over the subject. We do not know exactly where to point to a good and certain opening for a young man on whom some expenditure has been incurred to give him something of a scientific education.

THE PARIS FETE.—The municipality of the city (says the "Standard") during the fete had an electric light in one of the windows of the Paris office of that paper.

LITERATURE.—"An article from the pen of Mr. J. Laister of the General Post Office, entitled the 'Whitewashing of Shylock,' appears in the July number of "Modern Thought.".—"The Civilian."

SIEMEN'S ELECTRIC RAILWAY.—As the next meeting of the Iron and Steel Institute will, at the end of August, be held at Dusseldorf, many readers will have an opportunity of seeing this railway, which has been laid in that portion of the Exhibition Grounds, near Krupp's Pavilion.

ANIMAL ELECTRICITY.—"La Nature" gives the first portion of an illustrated article "On the Electrical Function of the Torpedo," in which the experimental researches of M. Marey in this direction are referred to at considerable length. M. Maray has arrived at the conclusion that "The electricity in the apparatus of the torpedo and muscular work are produced under similar physiological conditions."

NEW USE FOR THE TELEPHONE.—To avoid the inconvenience of having to cut and splice a telegraph cable unnecessarily, as when several lie close together and only one is faulty, it is now suggested to employ the telephone on an auxiliary parallel wire, in which the induction may be sufficiently strong to enable the electricians in charge to read the signals which may be sent into the cable, and so identify it.

OVERHEAD WIRES.—At the last meeting of the Islington Vestry Mr. Barton complained of a very long and unsupported telegraph wire in Roman-road. It might snap and cause an accident similar to that which happened in Duncan-street some years ago. He wanted to know if the Vestry had any control over such things. The Vestry Clerk said they had no power to interfere. Telegraphs were under the control of the Postmaster-General.

Prices of Metals, Chemicals, &c.

TUESDAY, July 13.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£105 0 0	£1 0 0	—
Electro Wirebars...	,,	£110 0 0	£1 0 0	—
H.C. wire basis......	per lb.	1s. 3¼d.	⅛d.	—
Sheet	,,	1s. 5¼d.	¼d.	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. 8¼d.	⅛d.	—
Brass 60/40—				
Rod, basis	,,	0s. 10¾d.	—	—
Sheet, basis	,,	1s. 3¾d.	¼d.	—
Wire, basis	,,	1s. 3¾d.	¼d.	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£37 0 0	£0 10 0	—
Foreign or colonial	,,	34 10 0	—	£1 0 0
Tin—Ingot	,,	265 0 0	14 5 0	—
Wire, basis	per lb.	0 3 5½	2¼d.	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 10s.

,, (Roll Brimstone).—Per ton £18 10s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s.

Copper Sulphate.—Per ton £43

Boric Acid (Crystals).—Per ton £74.

Carbon Bisulphide.—Per ton £60

Sodium Bichromate.—Per lb. 1s. 10½d.

Sodium Chlorate—Per lb. 5½d.

Rubber.—Para fine, 1s. 11¾d.; plantation 1st. latex, 2s. per lb.

Shellac.—T.N. Orange, 690s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co.

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Notes.

More Electricity Districts.

AFTER having been for some time doing useful preliminary work in secret, the Electricity Commissioners are now beginning operations in the open. As already stated in these columns, notices describing provisionally the boundaries of various electricity districts have been issued (this is the first step towards reorganisation), and in one case the inquiry into objections to the Commissioners' proposals has been commenced (this is the second step). Within the past few days three further notices provisionally determining areas have been published. As will be seen from the full details, which we publish on another page of this issue, these are referred to as the North Wales and Chester District, the Mersey and West Lancashire District, and the London and Home Counties District. The first of these includes the counties of Anglesey, Carnarvon, Denbigh, Flint, Merioneth and Montgomery, a part of the county of Cardigan near Aberystwith, a part of the county of Chester round Chester and Crewe, and including those two towns, and a part of the county of Salop including and in the neighbourhood of Oswestry. It is an area in which the development of electricity supply has not up to the present been so extended as in many other districts. It contains one or two municipally-owned stations of no great size, and also the area served by the North Wales Power & Traction Company. As regards electricity supply, it may be truly said that its future lies before it, for it has great possibilities for agricultural, electrochemical and industrial work generally.

A Lancashire Problem.

THE second district is considerably more developed electrically than the first. It includes Liverpool, Bootle, Southport, St. Helens and Warrington, where a good deal of useful if somewhat unsavoury industrial work is carried on. On the other side of the Mersey it includes Birkenhead, Wallasey, Runcorn and the districts round them, where the same remark applies, and where great extensions in the use of electricity supply may confidently be expected before long. These two districts, together with the S.E. Lancashire area, the details of which we published the other day, form together an interesting geographical problem, and makes us wonder exactly what policy the Commissioners followed in determining the boundaries. It will be noticed that the Mersey is not a boundary of an area, but passes through the middle of two areas. This may, perhaps, be due to a desire to provide each area with a share of the water of this river, in the same way that certain of the new States which have sprung out of the war have been provided artificially with a coast line. Indeed, we should have thought it would have been better to form two rather than three areas out of this district, and we shall be interested to see whether any evidence on this point is brought forward at the inquiry.

The London Area.

BY far the most interesting area of the three, and the one round which most controversy will rage, is that covering London and the Home Counties. It is roughly bounded by Windsor in the west, Tilbury in the east, Hertford in the north and Reigate in the south. It includes the whole of the City and county of London, the county of Middlesex, and a considerable portion of the counties of Berks, Buckingham, Essex, Hertford, Kent and Surrey. It is hardly necessary for us to describe to readers of THE ELECTRICIAN the present state of electricity supply in this area. Some of it is highly developed, some of it is not developed at all. It supports undertakings owned by rich companies and undertakings owned by companies which are in a very bad way financially. It possesses municipally-owned undertakings which are conducted on the most progressive lines and municipal undertakings which may almost be said to exist rather than to live. But one thing is certain—that for the proper future of electricity all these opposing interests have got to be brought into line somehow, and in trying to achieve this end the Commissioners have an arduous, but most important, duty to fulfil. And all those who see a great future for the electricity supply industry will hope that their efforts will bring about the desired end.

Wages in the Engineering Trades.

THE recent award by the Industrial Court on a claim made by the Trades Unions connected with the engineering industry for an advance in wages of 6d. an hour is interesting for two reasons. It marks a welcome change from what has too often been the usual method of awarding half the claim in the hope that the claimant will thereby be satisfied; and it exposes the weakness of that jumping-off board for so many demands of this kind, the index figures of the increased cost of living published by the Board of Trade. According to these figures, the cost of living has risen from 130 per cent. above the 1914 level in March last to 150 per cent. at the present time. Actually, of course, the rise is very much less, if there has been any rise at all; but, admitting that there has been a rise, it must obviously be partly due to increases in wages, and will neither be counteracted or overtaken by granting further increases. A shadowy increase in the cost of living is, in any event, hardly a justification for an actual increase in wages, and is still less a justification when one direct result of such increase is a further upward movement in the cost of living. In deciding, therefore, that the claims for an advance have not been established the Court have come to a conclusion with which every thinking man will agree.

Wage Claims and Unemployment.

WE should not make this statement if we thought that under present conditions workers in the engineering trades were being underpaid. This, however, is not the case, and it is, therefore, the best policy to resist firmly all fresh claims until trade has recovered from the shocks of the ever-recurring demands of the past few months. If this is not done, business will soon become impossible. As it is, no firm contracts can be given, no date of delivery can be quoted, with the inevitable sequel that the volume of fresh business is gradually decreasing, it being to every one's interest to wait for better times than to buy in a market where the only certain thing is the uncertainty that accompanies every operation. But the one person who cannot afford to wait is the one person who has principally brought this state of things about. For the worker does not appear to realise that high wages are going to be no substitute for unemployment, yet widespread unemployment can be the only result of the policy which is at present being pursued by too many trade organisations.

Quantity and Quality.

WAGES are, however, not the only factor which must be considered in this relation. High wages accompanied by high quality and good quantity of work would be welcomed by every progressive employer. Unfortunately, what occurs is the very opposite. With every advance in wages there seems to be a decrease both in the quality and in the quantity of the work turned out. The present-day employer has been likened to ISSACHAR, but even ISSACHAR, we imagine, had not an infinite overload capacity, and with matters tending in their present direction it is trite to say a collapse is inevitable. For the moment employment is good, but there is just that check in the flow of orders which makes those who look ahead a little fearful of the future. It would be well if Labour realised what that future must mean to them if they neglect the signs which are clear to those who have eyes to see them.

A Successful Visit.

A GOOD way of determining the quality of a theatrical entertainment is by measuring how far theatricality is imperceptible in its production. If the same method be applied in the case of the Summer Meeting of the Institution of Electrical Engineers at the Western Centre, which we hasten to add was not a theatrical entertainment, a very high figure of merit would be obtained. For the very great amount of work and well-thought-out organisation which must have been expended in carrying through the various functions in so easy a fashion, and in arranging for the transport of so large a body with hardly a suspicion of a hitch, were certainly not evident on the surface, though we knew, as we know in a high-class stage production, that they were there all the time. On such occasions the best organisation is one which does not lack flexibility, and here again those who were responsible for the Western Centre visit deserve high praise. There were unforeseen delays, caused sometimes by the superabundant hospitality of the entertainers, and sometimes by the idiosyncracies of the Welsh railways. Yet somewhere in the background the necessary adjustments were quietly made, and the machine moved forward again with hardly a check. The actual begetters of the details of this good work must necessarily remain anonymous, because they are unknown; but, without wishing to be invidious, the ultimate credit may be ascribed to the members of the Executive Reception Committee. To them the thanks of all who took part in the visit are most certainly due.

The Possibilities of Welsh Coal.

IT has been said that the occasion on which an engineer will refrain from talking shop has yet to be found, and the meeting of the Institution of Electrical Engineers at the Western Centre last week was certainly no exception to the rule. We overheard several conversations on highly technical topics apart from the one reported by Mr. LLEWELLYN ATKINSON on another page of this issue; while Mr. ROGER T. SMITH took two opportunities to urge that electrical engineers should use small Welsh coal under power-station boilers, because Wales is one of the few districts that has coal to spare. Mr. ROGER SMITH has not only done well to bring this matter forward, but has done better in setting an example in using this type of fuel in some of his own stations. At the moment there is no more important question than that of the proper use of fuel. And there must be no lack of striving, not only to improve our present methods of employment, but to enlarge the number of substances which can be usefully consumed in our boiler houses. In so doing we shall not only assist our own development, but apparently also bring aid to an industry with which we have always been in close alliance, but which, if Sir JOHN BEYNON is to be taken seriously, cannot be expected to hold up its head much longer.

Fuel for Motor Transport.

SOME useful work on the question of new fuels, but along rather different lines from those we have suggested above, is already being conducted by the Fuel Research Board. In a lengthy memorandum, which has recently been presented to the Advisory Council for Scientific and Industrial Research, an account is given of some work which has been done in determining the suitability of alcohol as a motor vehicle fuel. As regards its efficiency for this purpose little is said, but, in any event, that is a relatively easy problem compared with the question of its supply. The vegetable substances from which alcohol is obtained neither exist nor can be produced in sufficient quantities in this country at prices which would enable the product to be sold on a commercial basis; and while this does not apply in the colonies, the fact that the substances from which alcohol is obtained have a food value, and can therefore command a good price at the present time, prevent the use of power alcohol, or rather render necessary the discovery of some waste material of little or no value apart from its possible utilisation as a source of this fuel. Possible fields for such an endeavour are to be found in the tropics, and research work in this direction has been instituted. This, however, is all for the future, and, as the Committee rightly point out, so long as the only raw materials imported or home grown are foodstuffs power alcohol cannot be produced on an adequate scale, and other and cheaper sources of power must be looked for to assist present needs. This seems a chance for the electric vehicle, which we hope the electrical industry will be quick to seize. Possession in this case, as in many others, is worth a good deal.

The Measurement of A.C. Energy.

The development in electricity supply that may be confidently expected during the next few years will mean not only the handling but the measurement of very much larger amounts of alternating current energy (if we may so express it) than has been usual in the past, and will impose on the designers and makers of the necessary instruments certain problems which either have so far, however, not come up for solution or have been skirted in some way or other. The importance of this fact is well emphasised by a few sentences in the report made recently by the Superintendent of the Electrical Department of the National Physical Laboratory to the Director. He points out that the economy of turbo-generators is now tested by the amount of steam used per unit of electrical energy generated and that the accurate measurement of alternating power and energy in large quantities is therefore of the highest importance. It is not surprising to find that a large number of instruments used in such tests are received at the Laboratory for calibration, and that the engineers of some of the largest generating stations are making a practice of sending their reference instruments to the Laboratory for the same purpose. Unfortunately the experience of several years of the accuracy obtained from instruments used for this purpose shows that there is often much to be desired in their performance, the chief errors being due to the properties of the series transformers employed. We are glad to learn that an investigation relating to this apparatus has been approved by the Executive Committee of the National Physical Laboratory, and that some preliminary tests have been made on the subject. We hope that it will not be long before the Laboratory is able to discover the reasons for the present errors, and so inaugurate an era of more accurate measurement.

The Case of the Small Companies.

A question of great importance at the moment is the future of the small electricity companies. These concerns now find it even more difficult to make both ends meet, and it is evident that something must be quickly done for these poor starvelings, for the "winter of their discontent" is full upon them. To vary the metaphor, they hoisted the signal of distress the other day in the House of Commons, when an "honourable and gallant member" took the Minister of Transport to task in championship of their cause. As usual, the reply was the matter would receive serious consideration. This is poor comfort enough, but we have reason to believe that the Minister is really doing something. No one thinks all this a mere cry of "wolf." The facts are too patent. Some of the companies are saying flatly that they will have very shortly to go out of business; and the number of companies or undertakings thus involved is not only large, but spread all over the country. Some undertakings cannot cover even their operating costs. None of them has the remotest chance of either getting fresh capital or even raising debentures. The situation is bad for everyone concerned, and matters for some time past have slowly been drifting from bad to worse.

Closing Down Unthinkable.

Now, one thing is unthinkable. These undertakings cannot be allowed to shut down. The Electricity Commissioners are charged with the duty of seeing that the electricity supply of the country is not only maintained, but increased. For the new era to be inaugurated the shutting down of undertakings here and there throughout the country would be a moral disaster of the first order. However, in the Electricity Commissioners, we have a body of men acquainted with every detail of the industry, and lacking neither in initiative or good will. The only hope rests in them taking speedy action. We understand that labour also is taking an interest in these impoverished companies from the point of view of wages, and that Industrial Councils are making representations to the Ministry of Transport that relief should be given to such undertakings, so that, at least, they shall be able to pay the proper rate of wages obtaining in the industry. This is, of course, a somewhat oblique interest; still, it is useful in emphasising the fact that the well-being of public utility undertakings is a matter of very widespread interest to the whole community.

The Decline of Edmundsons.

If further proof is needed of the truth of these statements, we need only read the speech made by Mr. P. D. Tuckett at the annual general meeting of Edmundson's Electricity Corporation, Ltd. Mr. Tuckett said their costs had long since doubled, and were now almost trebled, the coal and wages bill having alone increased by £65,000 last year, while in the current year they were faced with a further increase of £80,000 in these two items, making a total increase of over £250,000 since 1914. This is really prodigious. The gross profit had been reduced by £2,773 and the net profit by £5,536, so that to pay either a preference or an ordinary dividend was impossible. The obvious remedy for all this is to raise the rates; but this the company has been forbidden to do by Parliament, nor are we sure that really in the long run it would have the desired effect. What is wanted is an energetic period of reconstruction, but for this fresh capital is necessary. But it is going to be difficult to raise fresh capital when the probable dividend is zero and 6, 7 and 8 per cent. can easily be obtained elsewhere. Heroic measures would seem the best; but, like persons in similar circumstances, the company do not like heroic measures. It is all very distressing, and, indeed, forms a sort of Ireland in the electrical industry.

Public Expenditure.

We are at present taxed more heavily than ever before in the history of the country, and, judging by the rate of public expenditure, there is small prospect of any alleviation from this burden. On the contrary, new Ministries and Government departments, with consequent large increases of staff and new financial obligations, are being created at such a rapid rate that further taxation will certainly have to be imposed in order to balance the national budget. Some Ministers appear to act as if there were no limit to the taxable capacity of citizens, and as if they only existed to find new outlets for squandering the public money. Under these circumstances, we welcome the weighty protest against public expenditure made by 16 gentlemen who are prominently identified with banking, commerce and industry. Among the signatories to this protest are Lords Cowdray and Inchcape, Sir R. A. Hadfield, Sir John Denison-Pender, Sir R. V. Vassar-Smith, Sir A. Steel-Maitland, Mr. Walter Leaf and Mr. W. Peter Rylands, names which are familiar to our readers. They point out that unless something be done to stem the tide of public expenditure we may be face to face with a serious financial and economic disaster. The Government are leaving no reserves of taxable capacity for any national emergency that may arise. The proportion of Government expenditure to national income is several times as great as it was before the war, with the result that a far smaller proportion is available for provision for old age, for savings and business enterprise, while those with fixed incomes have insufficient margins for food, clothes and rent. The Government appear to be quite unconscious of this. They seem to be convinced that their mission is to think out how they can spend public money on vast projects of enterprise and reform. The signatories have therefore come to the conclusion that there is no cure for the present state of affairs except by appealing to the constituencies, where they propose to initiate a campaign for the education of the public. The public accounts are passed without sufficient investigation, and large new projects are approved with little criticism. The remedy for this is to be found in greater pressure by the electors on their legislative representatives. The force of public opinion must be organised and brought to bear upon members of Parliament to put a check upon the present state of things. There was never a time when the closest economy in public and private affairs was needed than at present; but it is hopeless to preach prudence and frugality unless the Government show us the way, and unless Ministers are forced to curb their desire to waste public money.

Light Railway Progress.

If the recently issued report of the Light Railways Commissioners is carefully studied the conclusion will probably be reached that the heading of this Note is a misdescription. Only fifteen new applications were received during 1919, and during the same period four orders were submitted by the Commissioners for confirmation, two of which were confirmed, the other two being still under consideration. So that of the very small amount of corn that goes into the mill even less comes out as flour. This is all the more extraordinary when the undoubted lack of transport facilities in this country at the present time is taken into consideration. In many agricultural districts, and in not a few industrial areas, the light railway, constructed with as great economy as possible and operated cheaply by electrical or other means, should be of no little use in solving some of the more urgent problems of how to get goods and produce from where they are made or grown to the consumer.

The Standardisation of Tramway Material.

The question of standardising the material, the fittings and even the terms used in engineering practice may be considered from two points of view. On the one hand, there are certain definite advantages to be gained by adopting standardisation to a greater or less extent. Designs are thereby simplified, manufacture is made easier, mass production is possible, all of which means a lower selling cost. Indeed, it may truly be said that the advantages obtainable far outweigh any such small disadvantages which may accrue owing to the necessity of adapting standard material to particular cases.

The Old and the New Industry.

While this argument is irrefutable when applied to an old-established industry, where the experience obtained over a large number of years has shown what is best suited to the operating conditions, it is doubtful whether it is equally advantageous in an industry which has just been started, and where, if standardisation is imposed too soon, retrogression rather than progress may result. We referred the other day to this side of the question in connection with wireless telegraph science; and it is a side which requires careful examination. On the other hand, it is equally certain that standardisation might be applied to the electric tramways industry to a far greater extent than has been usual up to the present.

Standardisation Entirely Lacking.

The report of the Committee of the Municipal Tramways Association on Standardisation of Overhead Line Material brings this point out very clearly. The Committee was formed on the suggestion of Messrs. Brecknell, Munro and Rogers, who pointed out the enormous number and variety of sections and sizes of trolley wire and the multiplicity of fittings which were being manufactured and stocked in order to suit the peculiar fads and fancies of the engineers of tramways undertakings. They made the very obvious comment on this state of affairs that if some standardisation of overhead material could be agreed upon the delivery of fittings would be more quickly made, and the cost of them would be materially reduced, as manufacturers would not then have to stock the large number of patterns necessitated by small and varying sorts of orders from separate undertakings. With standard fittings they could, moreover, stock large quantities and effect delivery at considerably reduced prices. So obvious is all this that we should hardly have thought it necessary to appoint a committee to inquire into the matter at all, except on the precedent adopted by Government departments of using a committee as a convenient body on to which to shift responsibility, and to form an excuse for delay in carrying out some much needed reform.

An Extraordinary State of Affairs.

The Committee, however, have done well. They have gone into the question very exhaustively, and their report, as might be expected, only confirms the statement of Messrs. Brecknell, Munro and Rogers. Indeed, it goes farther, and shows what a complete lack of anything approaching standardisation exists. The Committee obtained a complete description of the trolley wire and fittings in use from almost every undertaking in the country, and the answers received disclose an extraordinary state of affairs, establish that there is the widest divergence in tramway practice, and emphasise the necessity for securing some method of simplification. As an example, we may say that it was found that there were upwards of 30 different sizes and sections of trolley wire in this country, and that one firm manufactures as many as 50 different sizes of insulated bolts, whilst another has over 1,000 different patterns of lineears. The loss of energy and money occasioned by this lack of co-operation between tramway undertakings, a lack of co-operation which has nothing to recommend it, must have been so large as to be almost incalculable, and, seeing the unfortunate financial condition in which the majority of these undertakings are at the present time, there is no doubt that the sooner some steps are taken towards improving this state of affairs the better it will be for all concerned.

Size and Type of Trolley Wire.

Having disclosed this extraordinary variation in practice, the sub-committee's next work was to see what could be done towards ultimate standardisation. They very wisely began their operations by attempting to lay down the size and type of trolley wire best suited to operating conditions in this country; and they point out that, while it is impossible to lay down any hard and fast rule regarding the size of wire to be used by any particular tramway undertaking, it would be to the advantage of the undertakings themselves if they would adopt certain sizes of trolley wire and certain shapes in grooved wire. For by so doing they would obtain the advantages of quick delivery and lower costs for both fittings and wire.

A detailed specification attached to the report shows that the sub-committee apparently favoured four sizes of wire—namely, one, two, three and four 0/S.W.G., general opinion indicating that one or other of these sizes would be the most suitable in the large majority of cases. The question of the best section of grooved trolley wire to recommend was not, however, so easy, and it was only after a large number of tests had been carried out that a standard section of grooved wire corresponding to a standard wire gauge sectional area was arrived at. In a similar way the question of overhead fittings was also gone into. Dimensions were standardised and patterns and samples were prepared, so that there is no reason why any tramway undertaking should not now employ material of a standard size.

The Municipal Tramways Association are to be congratulated on the work that they thus have carried out, though it need hardly be added that it was not before it is time. It seems, however, to have been forgotten that a sub-committee of the British Engineering Standards Association has or had this work in hand, and issued certain standard specifications. We certainly do not want two standards. That would be worse than none at all. The best procedure, therefore, would seem to be for the Association to approach the British Engineering Standards Association, so that this question can be thoroughly thrashed out, and specifications prepared which will not only be in accord with the engineering authorities experience, but bear the impress of a specification issued by the British Engineering Standards Association.

The Progress of the N.P.L.

The report of the National Physical Laboratory for the year 1919 marks a stage from which it is convenient to examine what this Institution has done in the past and what it may be expected to do in the future. During the whole of this time the work of the Laboratory has been conducted by an Executive Committee under the chairmanship of the late Lord RAYLEIGH, with Sir RICHARD GLAZEBROOK as director. Its development has been greater than probably any of its originators expected, and we are glad to see the just and whole-hearted tribute paid in the report which has recently been issued to the work of these pioneers. For while it is often difficult to start an Institution of this kind, it is always still more difficult to increase its usefulness and to ensure that the work is being not only carried out efficiently but that there is proper development in every branch. If these conditions are not fulfilled, rot must set in and the inevitable result must follow.

CHANGES IN ORGANISATION.

But far from having failed in its mission in any way, the National Physical Laboratory has so increased in usefulness, not only in the comparatively limited sphere in which it started, but in the much wider field into which it has spread, that certain changes in the organisation have become necessary which we hope will tend to increase its usefulness still further.

It is obvious that an Institution of this kind cannot pay for itself, or more plainly it cannot earn sufficient income by its own efforts to carry out the work which is required of it. We would go further and say that any attempt to make its earned income balance its expenditure should be discouraged. Finance is not everything. Indeed, in the first preliminaries of scientific investigation it is a factor which should be ignored as far as it can be ignored, which, unfortunately, is not very far.

As is well known, the National Physical Laboratory has hitherto mainly existed on grants from the Government, paid through the Royal Society, and though this arrangement has, we believe, worked quite well it has carried with it certain disadvantages, especially so far as the staff is concerned. The past year has, therefore, marked the development of the method of working the Laboratory under the financial control of the Treasury as a branch of the Department of Scientific and Industrial Research. We see no reason why this new arrangement should not be a success, and we hope at least the modified conditions under which the staff will work will attract and keep the right sort of worker in the service of the Laboratory.

THE STAFF PROBLEM.

For it must be admitted that this question of staff is one of the highest importance. To carry out his duties successfully in this field the worker must not only possess scientific and technical equipment of the highest order, combined with not a little skill in craftmanship, but he must be reasonably free from financial anxiety. For though poets may flourish on a starvation diet, a scientist works best under conditions which, while not luxurious, may be justly called comfortable. On other grounds low payment of a staff of this kind is bad policy. For the worker is attracted away by increased remuneration and better prospects, and with him goes accumulated experience which it takes time to recover. While, therefore, the National Physical Laboratory may well form a training ground for research workers, it should ensure by its conditions of service that it obtains first call on the services of its best pupils.

THE FUTURE OF THE LABORATORY.

The future of the laboratory is not likely to be less interesting than its past. And it is already evident that the work it is now doing will develop along two paths. In the first place there will continue to be investigations of new methods of testing and the discovery of fresh means of measuring physical quantities. An example of this class of work are the investigations into possible new methods of measuring alternating current power to which we draw attention in our Notes columns this week. In the second place there will be the heavier and heavier duty of proving apparatus which has been made in accordance with generally accepted designs and providing this apparatus with a hallmark of accuracy and suitability for its work. It cannot be said that either of these paths of development is less important than the other. But they are different.

TESTING AND PROVING.

That being so, we are glad that the question which has been raised from time to time in recent years, notably by the Institution of Electrical Engineers, whether proving work as such should continue to be undertaken at the Laboratory, is receiving the close consideration of the Government, and that the view of the Advisory Council of the Research Department, that "the routine testing of ordinary commercial products is not, and ought not to be, within the functions either of the National Physical Laboratory," is likely to prevail. In our view the Laboratory itself should be mainly concerned with what may be conveniently called new work, and another body, or bodies, should be formed for carrying out testing of a more or less routine character. There is good reason for this; for what, in our opinion, is the real work of the laboratory is greatly hampered at the present time by the necessity for devoting time to routine operations, and on the part of the higher staff by the supervision necessary to see that this work is properly carried out. At the same time we feel that both testing and proving bodies should work in the closest co-operation, so that both may take advantage in the fullest degree of the knowledge gained from what the other is doing.

Electric Winding Engines and Mine Hoists.*

By H. H. BROUGHTON.

(*Concluded from page* 55.)

Resultant Static Load at Drum Radius.—For general shaft friction an allowance will be made of 6 per cent. of the combined weight of the loaded and unloaded skips. This weight being 22,000 lb., it follows that a force of 1,320 lb. has to be exerted at the drum radius in order to overcome shaft friction

The mean angle of inclination of the shaft being 38 deg., and the length of the inclined portion 3,300 ft., the pull to overcome rope friction will be about 460 lb. if the angle of friction is 3 deg.

To overcome shaft and rope friction a force of 1,320+460 =1,780 lb. has to be exerted at the drum radius, and this force is assumed to be constant throughout the wind. Referring to Fig. 27, mark off along the *y* axis a length *Oa* to represent 1,780 lb. to the same scale as that already used for Fig. 94 (*c*) and (*d*). Through *a* draw a line *ab* parallel to the base *Ox*.

At the beginning of the wind the loaded skip is in the inclined portion of the shaft. As before, the mean inclination being 38 deg. and the angle of friction 3 deg., it follows that the rolling friction coefficient, namely, tan 3 cos 38, =0·04, and the force required at drum radius to overcome rolling friction =16,000×0·04=640 lb. When the unloaded skip is on the incline the force at drum radius to overcome rolling friction =240 lb. During the period when both skips are on the incline at the same time the friction force is equal to 880 lb. These several forces when plotted to the base *ab* give the line *cd*.

The pull in the rope due to the ascending skip and load, given in Table IX, is next plotted on the stepped base *cd*, the times being taken from Table IX. "A" side, and the resulting load line is represented by *ef*, in Fig. 27. Subtract from *ef* the rope pull at every instant due to the descending skip, taking pulls and times from Table IX., and the stepped line *gh* so found represents the resultant pull at the drum radius, due to the ascending and descending skips, and to friction.

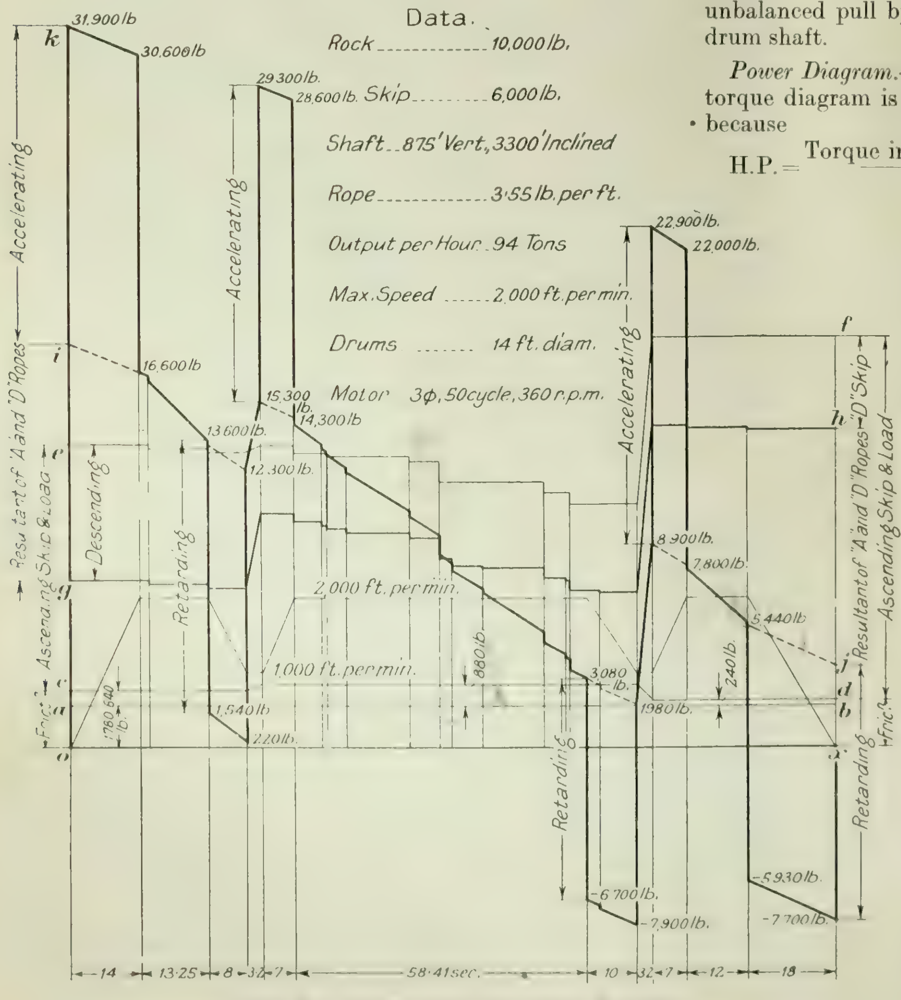

Fig. 27.—Diagram for Balanced Winding.

Re-plot Fig. 26 (*d*) on the stepped base *gh* (Fig. 27), and the stepped sloping line *ij* represents the resultant static rope pull plus friction at every instant throughout the wind.

Accelerating and Retarding Forces.—The equivalent masses at the mean drum radius, namely, 7 ft., are :—

Motor armature $=960\times 8^2\div 7^2$	1,255
Drums and clutches $=138,000\div 7^2$	2,820
Sheaves $=17,000\div 7^2$	350
Ropes $=2\times 4,500\times 3{\cdot}55\div 32{\cdot}2$	990
Ascending skip and load $=16,000\div 32{\cdot}2$	497
Descending skip $=6,000\div 32{\cdot}2$	187
Total equivalent mass M	6,099

$$Mv_1=M\times 2,000\div 60=33{\cdot}3M \qquad =203,000$$
$$Mv_2=M\times 1,000\div 60=16{\cdot}7M \qquad =101,500$$
$$M(v_1-v_2) \qquad =16{\cdot}7M \qquad =101,500$$

The several accelerating and retarding forces, found by dividing the change of momentum by the time, are, therefore :—

Initial acceleration, 14 sec.	14,500 lb.
First retardation, 8 sec.	−12,700 lb.
First and second re-accelerations, 7 sec.	14,500 lb.
Second retardation, 10 sec.	−10,150 lb.
Final retardation, 18 sec.	−11,300 lb.

These forces are added to the static pulls, and the resulting diagram is shown by a thick full line in Fig. 27. Multiplying unbalanced pull by drum radius we obtain the torque on the drum shaft.

Power Diagram.—In the case of a direct-coupled winder the torque diagram is also the power diagram (to a known scale) because

$$\text{H.P.}=\frac{\text{Torque in lb. ft.}\times\text{Ang. velocity in radians per sec.}}{550}$$

In this example, the speed of the drum is 45·5 revs. per min., or 4·77 radians per sec., and the horse-power is, therefore, 0·0087×torque in lb. ft.

In the case of a geared winder a correction has to be made for the efficiency of the gearing. Although the gear maker claims an efficiency of 98 per cent. for machine-cut double-helical gears, the author prefers to err on the safe side by assuming an efficiency of 95 per cent.

When the torque on the drum shaft is *positive*,

$$\text{H.P.}=0{\cdot}0087\times\text{torque in lb. ft.}\div 0{\cdot}95 \\ =0{\cdot}0092\times\text{torque in lb. ft.}\ ; \quad (1)$$

and when the torque on the drum shaft is negative,

$$\text{H.P.}\ =0{\cdot}0087\times\text{torque in lb. ft.}\times 0{\cdot}95, \\ =0{\cdot}0083\times\text{torque in lb. ft.} \quad (2)$$

By means of equations (1) and (2) the diagram, Fig. 27, has been converted into a power diagram, Fig. 28, and from this the rating of the motor is found to be equal to 1,025 h.p.

It may be mentioned, in passing, that in a winder specification it is usual to call for a motor sufficiently large to make a

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number of unbalanced trips under the worst conditions of loading. From the data already given it is a relatively easy matter to determine the torque diagram for unbalanced hoisting from full depth. The horse-power-time diagram is found from this. The diagram for unbalanced hoisting is depicted in Fig. 29, and the checking of this diagram may be left to the reader.

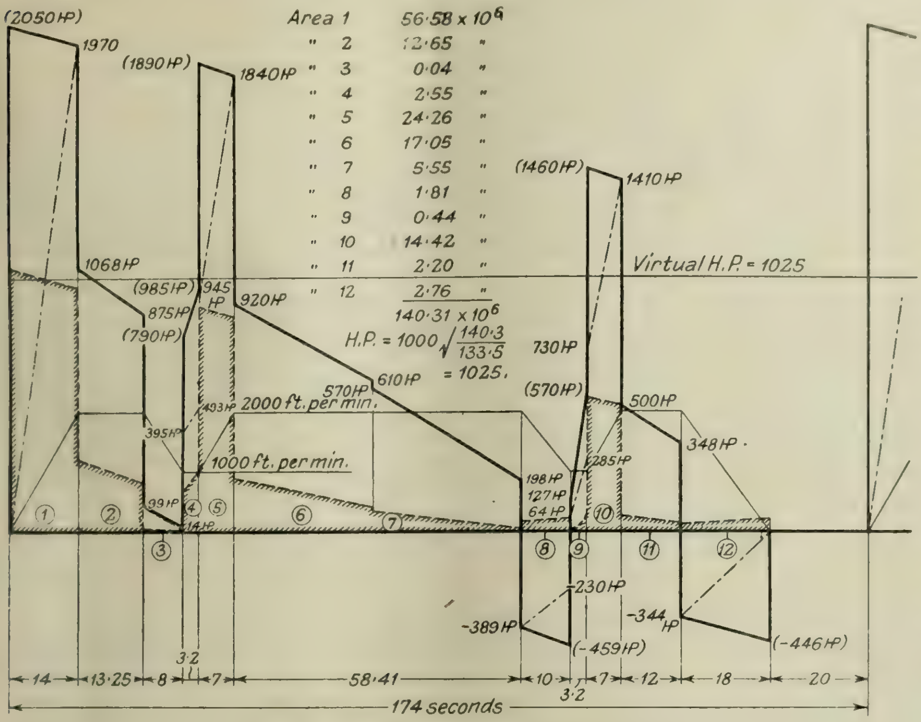

FIG. 28.—OUTPUT DIAGRAM FOR RATING.

Not only is occasional unbalanced hoisting called for, but in many cases it is imperative to be able to wind, for indefinite periods, from different levels. Thus, in the last example, operation from two levels was called for, and it will be remembered that the size of the motor was determined by the winding cycle from the 1,000-ft. level. We shall have occasion later to discuss the question at greater length, but those who are conversant with the principles underlying the rating of winder equipment will at once realise that in the short cycles the starting period represents a high percentage of the total cycle; and, as it is during starting that the motor is most heavily loaded, the rating for the short cycle must generally be higher than for the cycle in which the starting period is a small percentage of the total cycle.

In the example under consideration, balanced hoisting takes place from the foot of the vertical portion of the shaft. We have shown that for balanced hoisting from the bottom of the inclined shaft a motor rated at 1,025 H.P. is needed. Referring to Fig. 30, the diagram is drawn by the method already explained for a cylindrical-drum winder operating in a vertical shaft.* Alteration of level does not affect the mass

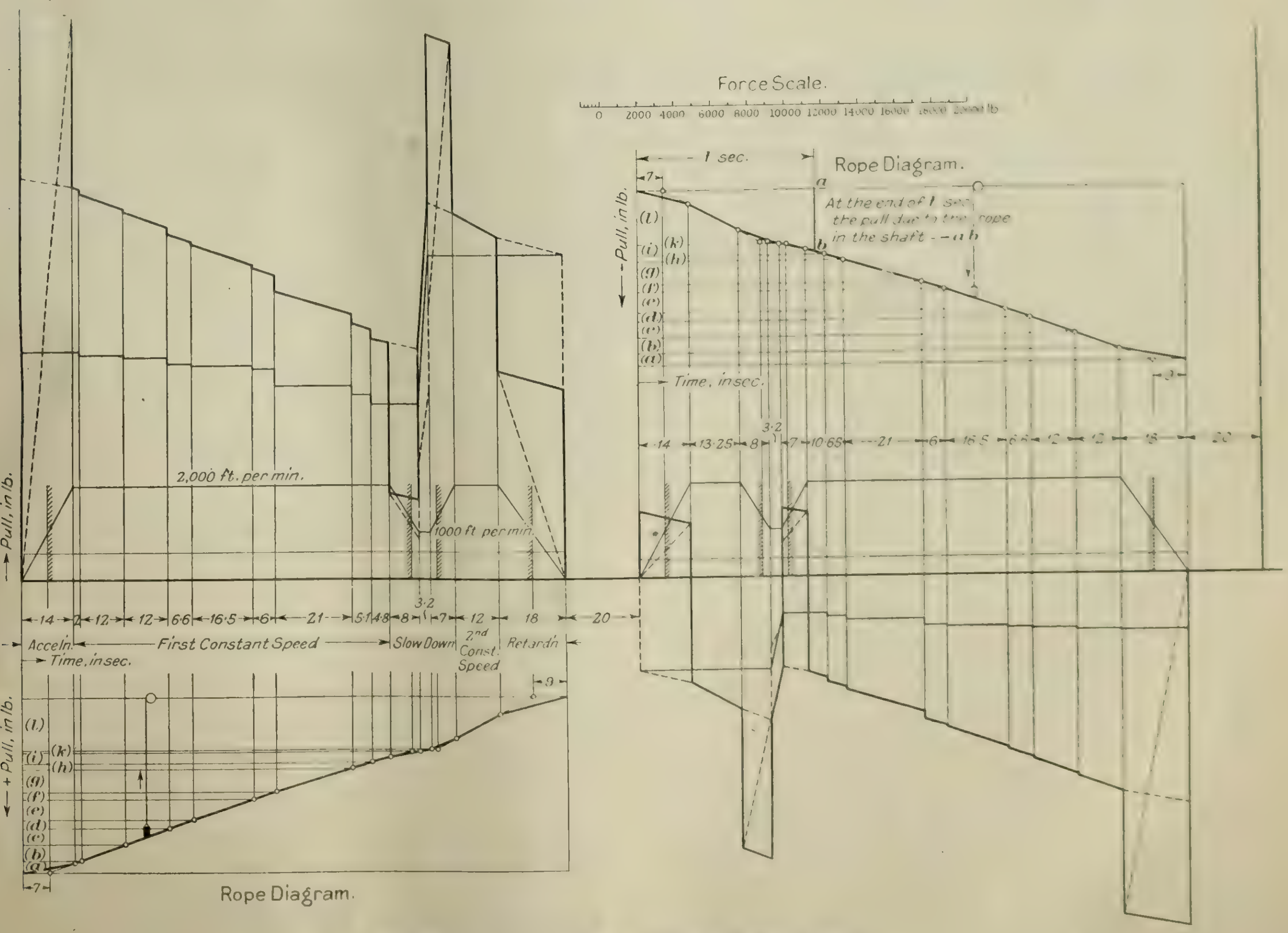

FIG. 29.—UNBALANCED WINDING FROM FULL DEPTH.

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* THE ELECTRICIAN Aug. 23, 1918, p. 354.

to be set in motion, and the equivalent mass (W/g) is, therefore, 6,100 as before. Still keeping to a maximum speed of 2,000 ft. per min. and allowing 14 sec. and 18 sec. for starting and stopping, the accelerating and retarding forces, at the drum radius, will be 14,500 lb. and −11,300 lb. respectively.

Since the depth of the vertical portion of the shaft is 875 ft. and the maximum speed 100/3 ft. per sec., it follows that the

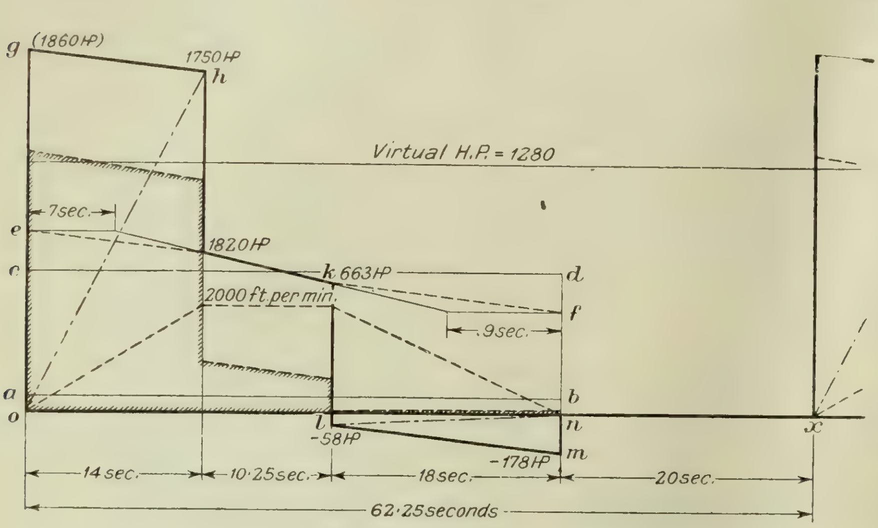

Fig. 30.—Balanced Winding in Vertical Portion of Shaft.

equivalent full-speed period is $875\div(100/3)=26{\cdot}25$ sec. Hence, actual full-speed period $=26{\cdot}25-\frac{1}{2}(14+18)=10{\cdot}25$ sec.

The several times are marked off to scale along the base Ox. Allowing 6 per cent. of the combined weight of the loaded and unloaded skips for general shaft friction, the line ab is drawn distant $0{\cdot}06(16{,}000+6{,}000)=1{,}320$ lb. (to scale) from the base Ox. The line cd is drawn distant 10,000 lb. (to scale) from ab. On cd as a base the rope-line ef is drawn, the length $ce=875\times3{\cdot}55=3{,}100$ lb. (to scale), being the weight of an 875 ft. length of rope, and the line ef being bent to allow for the starting and stopping periods. Adding the accelerating and retarding forces at the beginning and end of the wind respectively, the diagram $oghk$ . . . . $lmno$ is obtained. The torque at each of the cardinal points is found by multiplying the unbalanced pull by the drum radius, and the values may be entered on the diagram, Fig. 30. Finally, the corresponding horse-power is found by multiplying the positive torque by 0·0092, and the negative torque by 0·0083.

This has been done in Fig. 30, and from the power diagram the virtual rating of the motor is found to be equal to 1,280 h.p. Had the 1,025 h.p. motor, which is ample for full-depth winding, to be used for winding from the bottom of the vertical shaft it would be necessary to reduce the output from 250 tons to about 200 tons per hour.

Before proceeding to discuss a number of outstanding problems on the theoretical side of the subject it is thought to be desirable to devote a certain amount of space to a discussion on matters connected with the electrical equipment and to give descriptions of several typical electric winding engines. These will be dealt with in the next series of articles.

The Evolution of the Coolidge X-Ray Tube.

Few, if any, men have left greater mark on radiology than Dr. W. D. Coolidge, of the General Electric Company's Research Laboratory at Schenectady, N.Y., U.S.A. His achievements in the matter of the X-ray tube have reached an even wider and international circle ; and so it was not surprising that a large audience foregathered at University College on the 15th inst. for the address which the Röntgen Society had hurriedly arranged when it learnt of Dr. Coolidge's brief visit to this country.

Dr. Coolidge prefaced his lecture with a glowing tribute to the school of English physicists. It was, he said, the pioneer work of Crookes, J. J. Thomson, Rutherford, Richardson and others which had made the X-ray work at Schenectady possible. The G. E. C. Research Department was started in a small way in 1902 by Dr. Whitney. At the present time it employs 250 people, of whom 60 are college-trained men. At Schenectady they work co-operatively—every man is aware what every other man in the laboratory is doing, and in this way side issues of a particular piece of research are often turned to account elsewhere. Each man is given a great deal of freedom to attack a problem in the way that seems to him best, and by this means temperament and training receive full scope.

Turning to the X-ray bulb, Dr. Coolidge remarked that progress had only been possible when the art of manufacturing and working tungsten had been mastered. He dwelt in considerable detail on the present method of purifying and reducing wolframite, and the operations of sintering the powdered tungsten metal into blocks and plates from which discs could be prepared (when white hot) suitable for the targets of X-ray bulbs.

The essential requirements of a target in an X-ray bulb are

1. A high melting point—to permit sharp focussing of the cathode rays without fusing the target.
2. A high atomic number—so as to secure a large yield of X-rays.
3. A high thermal conductivity—to enable the heat to be got rid of.
4. A high heat capacity—to withstand intense momentary discharges, as in diagnostic work.
5. A low vapour pressure—to avoid the metal being deposited on the walls of the bulb.

Tungsten is almost the only commercially available metal which adequately satisfies the above requirements. In the latest design of target, a disc of tungsten is let into a large block of copper, care being taken (and this is a matter which has given much trouble) to ensure true thermal contact between the two metals.

Having settled the question of the metal of the target the next subject of inquiry was the most suitable residual gas. Nitrogen, oxygen, hydrogen and the rare gases were all tried and found wanting. The nitrogen and oxygen were objectionable in that they combined with the tungsten when it became heated ; and in the case of all the gases the bulb showed the progressive "hardening" with which X-ray workers with gas tubes are very familiar. The gas molecules are shot into the glass walls of the bulb and mechanically trapped there, the effect being enhanced if there is much metallic deposition on the walls. Furthermore, with heavy discharges the glass stem round the cathode gets very hot and is apt to crack. This can be cured by immersing the bulb in oil. The aluminium cathode is also liable to melt, but this may be remedied by substituting tungsten. These several features of a gas-bulb each contribute to the "crankiness" which soured the dispositions of many of the earlier X-ray workers ! The effects are all actuated by the positive-ions produced in the gas by the discharge ; and Dr. Coolidge and his co-workers came to the conclusion that salvation lay only in as effective removal as possible of all the gas. This agreed, it at once became necessary to look for another method of generating cathode rays, and Dr. Coolidge turned to the work of Prof. Richardson and afterwards Dr. Langmuir for quantitative data on the well-known emission of electrons from hot metals. Many technical difficulties had to be overcome ; and the present cathode takes the form of a flat tungsten spiral (heated by a subsidiary current) mounted within a focussing bowl of molybdenum, the relative positions of the two and their distance from the target, controlling the sharpness of focussing of the cathode rays, and with it the definition of the X-ray photographs.

Besides the main output of X-rays from the focus there is a good deal of extraneous radiation from the body and stem of the target, the lip of the cathode bowl, and the glass walls of the bulb. The extent of this was investigated by the method of the pin-hole camera, which showed that the radiation from the stem and back of the target was about 1-9th of that from the focal spot. A variety of devices were employed to diminish this, but in the end it was concluded that the extent of the defect did not justify the loss of simplicity in design and construction.

The glass bulbs are now made by glass-blowing machines similar to those used for electric lamps and valves. Uniformity of size is an incidental advantage. The very complete exhaustion required is carried out by Langmuir condensation pumps, suitably "backed-up" by a cascade or other type of pump. Liquid-air traps prevent mercury vapour from passing over. While exhaustion is proceeding the whole bulb is surrounded by an electric oven and raised to a temperature just short of the softening point of the glass walls, which, in consequence, give up the large quantities of gas which they normally occlude. This operation is followed by passing a heavy continuous discharge through the bulb to eject the gas occluded in the electrodes. It may be remarked here that the electrodes have all been previously heated in vacuum furnaces, a process which cuts down the time of exhaustion of the X-ray bulb by one hour. Electrodes thus treated may be left about in air for some days, and only reabsorb but a trifle of their initially contained gas. The exhaustion is continued until there is no visible fluorescence in the glass walls of the tube, after which it is sealed off.

The "radiator type" of Coolidge tube acts as its own rectifier, and can be excited by high tension alternating current. A recent modification is the employment of glass bulbs ¼ inch thick (containing 55 per cent. of lead) which afford protection for the operator. A thin window allows egress for the rays. The latest "fool-proof" model is immersed in the same oil-filled tank as the transformer, so that no high tension wires are outside the tank.

The Schenectady Laboratory has also recently brought out a portable outfit weighing 125 lb., which packs up into four packages, the heaviest weighing 45 lb. This outfit operates at a fixed voltage and milliamperage, the exposure only being varied to suit the work in hand.

We have no space to touch on the many other features to which Dr. Coolidge devoted considerable time and detail. One came away greatly impressed with the extraordinary and elaborate care which has to be exercised throughout the manufacture of a Coolidge X-ray bulb. Dr. Coolidge's modest and attractive exposition proved greatly to the taste of the audience. His final plea was that this country in its new-found love of industrial research should not neglect the pure research for which she has always shown pre-eminent ability.

Those who recall the early development of the "ionics" of the Cavendish School of Research and its apparent utter uselessness at the time will not have to go further than the subject of Dr. Coolidge's address for an illustration of the latent possibilities in pure research. The private research worker is now well nigh extinct; and it is the Universities who should foster the old traditions and provide the opportunities for the development and turning to account of the individualism of the English race.

The Institution Summer Meeting.

Some Important Lessons from South Wales.

The summer meeting of the Institution of Electrical Engineers was held at the Western Centre last week from July 13 to 16. About 150 attended, including Mr. Roger T. Smith (President) and Mrs. Smith, Mr. L. B. Atkinson (President-Elect) and Mrs. Atkinson, Mr. and Mrs. C. H. Wordingham, Mr. and Mrs. C. T. Allan, Mr. and Mrs. W. A. Chamen, Mr. H. W. Clothier, Dr. W. H. Eccles, Mr. A. Ellis (chairman, Western Centre) and Mrs. Ellis, Mr. H. S. Ellis, Mr. W. B. Esson, Mr. Haydn Harrison, Mr. and Mrs. S. B. Haslam, Mr. A. Nichols Moore, Mr. F. H. Nalder, Mr. F. Faraday Proctor, Mr. and Mrs. W. M. Selvey and Mr. P. F. Rowell (Secretary).

Tuesday, *July* 13.

A general assembly and settling down in the hotels took place this afternoon. It was found impossible to accommodate the whole party in one hotel, and the necessity for separation gave an opportunity for a display of humour on the part of the organisers which was much appreciated by those not affected. One gentleman, who is not a teetotaller, was given a room in a temperance hotel not by way of insurance, we hope, though the opportunities for the consumption of "non-pussyfoot" liquids during the week probably in some part reconciled him to his lot, while two representatives of the Electrical Press were sent to sleep at Penarth, four miles from the centre of things, an arrangement which did not make keeping in touch with what was going on any easier, and entailed a great deal of extra travelling. This, however, is being captious, and it is only right to add that the Executive Reception Committee worked indefatigably to make the visit a success, and those living at Penarth especially have no reason to complain of the transport arrangements, while the anxiety evinced that they should not suffer for their isolation gave them a sense of their own importance which some certainly did not deserve.

Reception at Cardiff.

The first official function took place this evening when the Lord Mayor of Cardiff (Councillor G. F. Forsdike, O.B.E.) and the Lady Mayoress held a reception in the City Hall. This Hall is a magnificent building, both externally and internally, and is thus an indication that in the past at least the ratepayers of the City were not unwilling to house their representatives in a style worthy of the prosperity of their town. During and after the reception a musical programme was contributed by Mr. A. Roberts' orchestra, and a series of demonstrations of wireless telephony were given by the Marconi Company, including the transmission of musical selections from Chelmsford. These were an entire success.

There was also dancing, and the Lord Mayor not only showed great pertinacity in making both the unwilling and the over modest dance, but in giving a practical demonstration of how to do it. Evidently Cardiff, like another place, made famous by its posters, is bracing. Those who did not dance inspected the building. Here are some natural history exhibits of a character which makes us hope the Darwinian theory will one day be disproved, and some pictures, some of which are good and others which are not so good. About this time it was discovered by the enterprising that something of great interest was going on in Committee Room A. But the unenterprising did not find it out until it was too late.

Wednesday, *July* 14.

An early start for Newport was made on Wednesday morning. The ladies and a certain select few of the other sex "proceeded" by char-à-banc to Usk, where they spent their time viewing the scenery. The male element of this party was, we understand, gratified that the arrival at Usk was timed to synchronise with the hour of noon! The remainder of the party, including a very few select ladies, were taken in char-à-bancs to the Mannesmann Company's works at Newport. The O.C. Transport on this occasion was Capt. S. B. Haslam, who is to be congratulated on the military way in which he marshalled his somewhat unruly convoy. Next time, however, he should arrange that the President is taken in the fastest char-à-banc, as on this occasion the "tortoise" in which he was accommodated cut down the average speed of the convoy. The route was enlivened by a race between the Institution and another convoy carrying what was apparently a Mothers' meeting, the result being a draw. And we are glad to add that neither competitor was upset.

The Mannesmann Works.

On arrival at the Mannesmann works the party was split up into groups, each in charge of a guide, and conducted through the shops, where the various processes are carried out. As our readers are aware, Mannesmann steel tube is made from the red hot billet by passing it through a special rolling machine with the rolls arranged at definite angles. The billet is kept in place by a mandril with a pear-shaped end, and the effect of the rolling is to expand it into a short thick tube by the formation of a central cavity. This tube is then passed through a second series of rolls where it is expanded into a tube of the required length and thickness. After re-heating a bell mouth is where necessary given to the tube, and it is straightened after cooling. Other processes, such as painting, wrapping with tarred cotton tape, &c., follow. We understand that tubes made by this method have given satisfaction for a number of different uses, and that the demand at present greatly exceeds the supply owing to the shortage of raw material.

Before leaving the Mannesmann works the visitors were given a specimen of the Company's products, the exact use of which was a puzzle to some, for though shaped not unlike a port glass it unfortunately had a hole at the bottom so that its designers do not seem to have intended it for the holding of liquid. We have no doubt, however, that the usual ingenuity of the engineer, not to speak of the ingenuity of the engineer's wife, will find some use to which it can be efficiently put.

A visit was next paid via the Transporter Bridge to the Alexandra Docks, Newport. These were inspected by the easy method of driving round them to the Pier Head, where the party descended from the various conveyances to view the pumping and power station at the sea locks entrance. This station contains centrifugal pumps for maintaining the water level in the dock, generating plant for supplying the lighting and power, and hydraulic pumping plant for supplying hydraulic power to the cranes.

The centrifugal pumping plant attracted a great deal of attention by its imposing size and by the natural anxiety to know (this also applied to the cranes and other machinery) why they were not driven electrically. As far as the pumping sets were concerned it was explained that it was not worth while, but we surmise that if the work had to be done again now it would be done rather differently These sets each consist of a twin impeller centrifugal pump direct coupled to a triple marine type steam engine made by Messrs. Cole, Marchant & Morley, and are capable of dealing with 5,000,000 gallons of water per hour against a maximum head of 36 ft. The engine develops from 800 to 1,600 i.h.p. when running at speeds from 80 to 125 revs. per min.

Two Howden-B. T.-H. 500 kw. electric generating sets are installed. These deliver three-phase current at 3,633 volts between the phases and a frequency of 50. The hydraulic power plant is steam driven, and is capable of pumping 1,250 gallons per minute against a pressure of 830 lb. per sq. in. when running at 40 revs. per min.

Luncheon at Newport.

By this time everyone was ready for lunch. A short voyage was made across the dock to where the char-à-bancs were waiting, and a drive of about equal length—this time, we are glad to say, without having to wait at the transporter bridge—brought us to the Town Hall, Newport. Here we were joined by the party from Usk and were received and entertained to lunch by the Mayor (Councillor Peter Wright, J.P.), and the Electricity Committee of Newport.

We had always understood that Wales, including Monmouth, was justly celebrated for two things, oratory and music. This luncheon confirmed our impression. For, while the playing of Mr. J. A. Gaccon and the singing of Mr. D. H. Thomas were superlative in quality, the speeches certainly did not lack in quantity. One result of this was that the lunch concluded at 3.45 p.m. instead of 2.45 p.m. We gathered from the speeches that Cardiff is anxious to absorb Newport and Newport is equally anxious to absorb Cardiff; and that between the two there exists that rivalry which is not unusual when cities of nearly equal size and similar interests are adjacent to each other.

Caerphilly Castle.

When the speeches were finally concluded the party proceeded by char-à-banc to Caerphilly Castle. From some notes kindly prepared by Mr. C. T. Allen we understand that this castle was built between 1268 and 1271 to keep the Welsh out of the Lowlands. This it has not succeeded in doing. It was the scene of various encounters of the Barons onwards, and was finally dismantled during the Civil War. The only part of the building which now has a roof is the old banqueting hall. Great interest was taken in the leaning tower, which is now about 9 ft. out of plumb, and the mathematically minded attempted to calculate how much further it could lean without falling altogether.

These suppositions were interrupted by the call of the camera, the result of which we reproduce herewith. After this most necessary function the company were entertained to tea in the banqueting hall by the South Wales Electrical Power Distribution Company.

On the way back to Cardiff we passed, at a place written Fwrnws Btwm, and pronounced we know not how, a long span on the transmission line of the South Wales Company. This carries four lines from the top of one hill to the top of the next, the total span being about one-third of a mile. The three conductors are 1 sq. in. in section and the fourth (earth wire) 0·75 sq. in. These wires are of phosphor bronze. The poles are of K construction and the line carries 2,000 k.w. at 11,000 volts. We are interested to learn that there has been no trouble with this lengthy span or with two others of approximately the same length on the other part of the system. In windy weather the whole span swings and remains some distance from its normal position, but this does not affect its efficiency.

A Boccacian Feast.

After a hurried visit to their hotels the company assembled half an hour later than the scheduled time at the City Hall, Cardiff, where they were entertained to dinner by the Monmouthshire and South Wales Coalowners' Association, the Chairman, Sir John Beynon, Bart., C.B.E., being in the chair.

Sir John Beynon is evidently a pessimist and equally evidently an orator. In proposing the toast of "The Institution of Electrical En-

The Institution of Electrical Engineers Resting at Caerphilly Castle—July 14, 1920.

gineers," he said that like the gladiators of old, he, as the head of a moribund trade, saluted them that evening. The coal trade was in danger of being stifled by red tape. In South Wales the coal trade owed a great debt to the electrical industry, and it was to them they were looking to provide the coal industry with up-to-date machinery which would enable them to add materially to the output of coal. Electrical engineers could also assist in the improvement of railway transport.

(The excellence of the entertainment made it difficult to take this pessimism seriously. The only explanation is that Monmouthshire and South Wales Coalowners' Association, like the lady told of by Boccaccio, had killed their pet peacock (or peacocks) to provide a meal for their guests.)

The **President** (Mr. Roger T. Smith) in reply thought that electrical engineers should undertake researches to make the use of small Welsh coal possible in power stations.

Mr. **Llewelyn Atkinson**, in proposing "The Monmouthshire and South Wales Coal Owners' Association," said they had now reached the end of a perfect day. The electrical industry had always suffered so much from Government control that they were now a little glad to see others similarly suffering. It was a good thing that an Association like the South Wales Coal Owners existed to protect the rights of the coal owners, for in the past when they asked for coal they gave them a stone. (This seems a matter for a Consumers' Association.)

Mr. **Percy D. Ward**, vice-chairman of the South Wales Coal Owners' Association, replied.

Ald. C. H. **Bird** proposed "The Industries of South Wales." In reply Sir **Leonard Llewelyn**, K.B.E., said that Cardiff was absolutely dependent on the coal trade. It was unfortunate business men were not allowed to carry on their own industries, and he believed that the salvation of the country lay in the industries being restored to those people who built them up. The Excess Profits Duty was a premium on extravagance. The best thing that statesmen could do for industry was to leave it alone.

THURSDAY, *July* 15.

This morning, in spite of the late hour at which the festivities ended the night before, the majority of the party came up bright and smiling for the journey to Bristol by special train. The train was late starting, fortunately for the Penarth party, who had experienced trouble on their own particular railway (the Taff Vale), and the lackadaisical progress through Monmouth and the Severn Tunnel was quite a rest cure.

On arrival at the Stapleton Road Station the party were conveyed by char-à-bancs to the Town Hall, where they were received by the Lord Mayor of Bristol (Mr. G. T. Franscombe) and the Sheriff (Mr. E. W. A. Titley) and were then entertained to luncheon by the Electricity Committee under the chairmanship of Ald. G. **Pearson**, who we were pleased to see looking so well in spite of his advancing years.

CHEDDAR GORGE.

After luncheon a fleet of motor char-a-bancs took the party round Clifton Downs, across the Suspension Bridge and thence to Cheddar via a route specially selected for its sylvan charm. The weather conditions were perfect and never were the natural beauties of the country seen to better advantage, or in greater comfort. As the char-à-bancs descended the winding road between the towering cliffs of the Cheddar gorge, a lady summed up the situation by exclaiming: "Isn't it perfectly gorgeous!" *Le mot juste!* Arrived at Gough's Caves, the party alighted and paid a visit to these fairy-like grottoes, which, by the way, would not be fairy-like at all but for the effective way in which metal filament lamps shine up behind the stalactites and reveal in mystic grandeur the lofty vaulted chambers of these extensive subterranean caverns. Coming out again into the bright sunlight of a perfect summer afternoon, the party proceeded on foot to the Cliff Inn, in the gardens of which a rustic tea was provided. Here, Mr. **Wordingham** was noticed to be particularly active with his Kodak.

Afterwards the char-à-bancs drove on to Weston-super-Mare and dropped the party at the Wellington Rooms for dinner. By this time it was getting late, and Mr. **Arthur Ellis** therefore announced that since time and Campbell's steamers waited for no man, it would be necessary to cut out the speeches and proceed to the pier immediately, in order to make sure of catching the boat. After a pleasant crossing, for which no one was the worse, the party landed at the Pier Head, Cardiff, and were taken back to the centre of the city by tramcars specially provided by the Corporation.

FRIDAY, *July* 16.

According to the programme a special train was to leave Cardiff for Swansea at 9 a.m. Much to the relief of those who were late in coming in from Penarth, there was some delay in starting. On arrival at Swansea, the President was met by Mr. J. W. **Burr**, the Borough Electrical Engineer. To make up for lost time the projected visit to the Hafod Copper Works was abandoned. The party drove down High Street and Wind Street, which were gaily decked with bunting in anticipation of the Royal visit, and then made a circular tour of the Docks. After seeing the warehouses stacked high with boxes of tin plates, the patent fuel works, the ship-breaking operations, the coal tips, the electrically operated rolling bridge, the five-masted schooners now doing a flourishing trade again in consequence of the high price of coal, the lock gates, &c., the party proceeded round Swansea Bay, dropping the party at Mumbles Pier.

"SHOP" AT SWANSEA.

Here a civic reception, followed by a luncheon was given by the Mayor of Swansea (Col. A. Sinclair, J.P., M.I.E.E.).

In proposing the toast of the "County Borough of Swansea," coupled with the name of the Mayor, the **President** remarked that Col. Sinclair was the only Mayor in the United Kingdom who was also a member of the Institution. Besides the metalliferous industries for which Swansea was famous the port exported a great deal of anthracite, and he was burning anthracite shipped from Swansea in two of the power stations under his charge.

The **Mayor**, in reply, said he had joined the Society of Telegraph Engineers and of Electricians, as it was then called, as far back as 1887.

Mr. L. B. **Atkinson**, in proposing the toast of the "Western Centre," said the visit had been an unqualified success. One of the contributing causes was that the members, out of regard for the ladies, had refrained from "talking shop." The ladies, on the other hand, had not been able to altogether exclude the topic of dress. He had heard it mentioned that a new type of wireless stays had been produced, the chief advantage of which was that it dispensed with the need of a petticoat insulator. Due to the zeal of the Reception Committee and the unremitting labours of the secretaries, Messrs. C. T. Allan, A. J. Ostler and P. F. Rowell, the visit had been perfectly organised in every detail and had gone off without the slightest hitch.

Mr. **Arthur Ellis**, in reply, said that it had been a great pleasure and privilege to entertain the Institution at its Western Centre. The labours of his local committee would have proved of little avail had it not been for the generous hospitality so readily accorded by the Mayors and Corporations of Swansea, Bristol, Cardiff and Newport. He hoped the Council of the Institution would be as generous as possible in providing the Western Centre with funds, for owing to the scattered nature of their district expenses were unavoidably heavy. Mr. C. T. **Allan** also replied.

After lunch the party went for a drive to Langland and Caswell Bay, where a light tea was provided. Those who were not under the necessity of catching the 5.30 train to London made a more extensive tour into the Gower Peninsula, turning back at Penrice Castle.

This brought the visit to an end, and the organisers are to be congratulated on the success of their efforts to make every one happy, contented and comfortable.

Siemens Navigation Lights Indicator.

Usually it is difficult, and at times impossible, to see from the bridge of a vessel whether the navigation lights are burning satisfactorily. The Siemens navigation indicator has been designed to show clearly, by means of luminous indications, when the lamps are burning satisfactorily, and also to give an audible signal when they fail and a visual warning when one of the filaments of double filament lamps breaks. The indicator consists of a substantially constructed teak case, on the front of which is shown a deck plan of the ship in white enamel and having small circular windows in positions corresponding to those of the navigation lights. The glasses of the windows indicating the side lights are coloured red and green respectively, the windows indicating the mast-head and stern lights being of white glass. The teak case, to which access is obtained by a door fitted with a lock and key, contains switches which control the navigation lights, each switch being clearly labelled.

As long as the navigation lights are burning satisfactorily, the windows of the indicator are illuminated from the inside by small indicating lamps, each window having its own lamp. The indicating lamps are not directly in series with the navigation lamps, but are connected in parallel with coils in circuit with the navigation lights; and failure of the indicating lamp does not interrupt the circuit of the navigation lamp. The coils in the circuit of the navigation lamps act as relays and they control the circuit to a watertight bell mounted on top of the case. In the event of any of the navigation lights failing, the indicating lamp corresponding to that particular light is extinguished immediately. At the same time the armature of the series coil falls away, and in doing so, completes the circuit to the bell, which commences to ring, thus giving audible warning of the failure of the light. The bell continues to ring until the switch controlling the particular circuit is opened. In the case of navigation lamps having double-filaments, when both filaments are intact, the indicating lamp burns with its full brightness. If one filament breaks the indicating lamp continues to burn with diminished brightness, and the bell does not ring. If the second filament should then break, the indicating lamp is extinguished immediately and the bell will ring. The belli s operated from the lighting circuit and batteries are not required. Further particulars may be obtained from Messrs. Siemens Brothers & Company, Ltd.

Annual Report of the Bureau of Standards.

The annual report of the Director of the Bureau of Standards to the Secretary of Commerce of the United States of America for the year ended June 30, 1919, contains an interesting account of the work of that Institution, which holds much the same position in the United States as the National Physical Laboratory in this country. It not only carries out standardisation and check tests on scientific and engineering apparatus, but also conducts a considerable amount of research work.

As regards the electrical side of its activities, in the first half of the year under review, the demands of the military departments were numerous both on the testing and the research sides; but during the latter part of the time it was possible to revive the normal work of the Bureau to a certain extent. The whole of the work undertaken for military purposes will not, however, be given up, as a large portion of this is likely to be useful for peace-time purposes. A considerable amount of testing was required in connection with the work of the Standards Committee of the American Institute of Electrical Engineers. Among the extensive investigations carried out were those on trucks and tractors, and the storage batteries used in such vehicles.

In the resistance division, work was carried out on the question of the non-destructive tests on welds, as some method whereby the quality of the weld may be examined without its destruction is very much needed. It has been suggested that the electrical resistance of such welds would give an indication of their quality. An investigation made on this point showed that with a current and potential terminal on either side of the weld, and all four terminals fairly close together, the resistance of a small portion of the plate, including the weld, could be determined with accuracy. It appears, however, that the plates which are only partly welded may make excellent electrical connection with each other, and the resistance method can, therefore, be looked upon as successful for this purpose.

The necessity for aeroplane guns firing through the propellers led to the development of an electrical control apparatus which allowed the shots to be timed with respect to the time of passage of the blades through the line of fire to less than 0·02 of a second. A number of investigations carried out on gun firing, including a theoretical study of the motion of the projectile, the variations of gun pressures with time, of ejection velocities, of recoil and of velocity measurements by means of the magnetic effect of the projectile. These questions are still under investigation. A large amount of work was also carried out on the ignition systems of petrol engines and on wireless sets for aeroplane work.

For instrument testing, an attachment has been developed for employment with the deflection potentiometer, which serves to plot automatically the corrections of the instrument under test, so that all numerical computations are avoided. A new form of variable resistance has been constructed for use in testing current transformers, by whose employment it will be possible to reduce the labour on such tests by at least 30 per cent. The question of the ignition of cotton by electric sparks has been gone into, and a large amount of interesting work has been done in the way of magnetic measurements and analysis and in testing magnetic compasses.

In the photometry section the investigations included those on military searchlights, and an examination of the distribution of light from the bare arc and from the searchlight beam from various distances. A number of routine tests were carried out on incandescent lamps, both of the vacuum and gas-filled type. Records of these tests were kept separately for each month of manufacture, and it was found that gas-filled lamps considerably exceeded the guaranteed life, and, following the usual practice one of the large manufacturers has improved the efficiencies of these lamps so as to take up a great part of this excessive life. It is found that the efficiencies of vacuum lamps are also undergoing a gradual improvement. An investigation into the illumination in office buildings showed that 2·5 ft.-candles was the average illumination. This is considered to be the lowest allowable for office work. It was found that the existing illumination can be maintained by substituting more efficient lamps of a lower wattage, or by using more efficient lamps of equal wattage. The intensity can thus be raised to about 4 ft.-candles and brought into conformity with good practice.

In the wireless division, besides a large amount of very interesting work, experiments have been continued on the development of the coil as an aerial in place of the ordinary antenna. A study was also made of the way in which the accuracy of direction finders was effected by various kinds of objects in the vicinity, such as trees, brooks, banks of earth. As a result, it was concluded that a direction finder must be kept at least 300 ft. away from such objects. An apparatus for determining the absolute direction as well as the line of direction of a wireless wave was developed. This device utilises the capacity of the coil structure to earth, an inductance in series with this capacity being tuned to the same frequency as the coil circuit. Experiments in the field showed that this device determines the absolute direction satisfactorily. Investigations were also made to determine whether a crystal detector could be developed having a permanent contact. The methods employed included alternating-current electrolysis, cathode spluttering, direct-current electrolysis, soldering, arcing, spark welding and mechanically maintained contact. The latter method gave a thoroughly satisfactory detector, but the general conclusion was that the sensitiveness of the best crystal detectors depends upon the existence of an imperfect contact. The use of an earthed shield in connection with measuring circuits was developed. It was found that a shield in the form of a grid between the generating and measuring circuits improved the steadiness of the deflection and the precision of measurement. A shielded cage for the induction coil of a measuring circuit was also developed, so that the entire circuit can be thoroughly shielded.

In electrochemistry a large amount of work was done in studying the methods of dry cell analysis, and a systematic study of the causes of deterioration of these cells when not in use, and of a means for obtaining satisfactory shelf life, was undertaken for the military authorities. The question of purity of acids used in storage batteries was also gone into, and a series of experiments to determine the effects of such impurities was carried on during the year. The methods for measuring the single potentials of the plates in storage batteries was also studied. As regards railway signal batteries, it was found that the performance of some makes of these batteries varied greatly with the temperature, and it is considered that the usual specifications for test should make proper allowance for this variation.

A number of publications dealing with public electricity supply were issued during the year; these include one dealing with standards for electric service, while others have for their subjects street lighting and electric heating. The various apparatus used for telephone work has also been carefully studied, and in this way the circuits and mechanism of the various automatic or semi-automatic types have been made the subject of publications. Descriptions have also been prepared covering the general functions of each switch, the functions of each switch element, and the sequence of the operation of the elements from the moment the switch moves in the process of making a call to the time it is released. Circulars covering the results of these examinations are in course of preparation.

In conjunction with the Standards Committee of the American Institute of Electrical Engineers and the Institution of Electrical Engineers in this country, work has been carried out for standardising the definitions of the terms employed in telephony. A large amount of work has also been done in the study of the electrolysis effects caused by tramway circuits and their effects on the corrosion of cables.

The Thermal Efficiency of the Generation and Use of Gas and Electricity.

We have received from Sir Dugald Clerk a copy of his reply to the discussion on the Paper which he recently read before the Institution of Electrical Engineers on "The Thermal Efficiency of the Generation and Use of Gas and Electricity." These remarks are given in abstract below. We published an account of the Paper and of the discussion thereon in our issue of June 25th.

Sir **Dugald Clerk** said he had hoped that the question of the actual efficiency figures given in his lecture and in the Clerk-Smithells-Cobb report would have been fully examined and discussed. No criticism of them, however, had been made. Mr. Wordingham stated that when a gas engine was running light it was running uneconomically and wasting a large amount of heat. But, even as early as 1905, most ordinary horizontal gas engines were running with coal gas on a 27 per cent. brake efficiency at full load, and at one-third load the efficiency was still 20 per cent. Mr. Merz was quite mistaken in assuming that 20 and 25 per cent. were exceptional efficiencies in the ordinary coal gas engines of to-day. Thirty per cent. brake efficiency at full load was not at all uncommon. With regard to heating by electricity, no criticism was made of his figures. Mr. Wordingham, it was true, pointed out that the ease of turning a switch to produce electric heating or motive power was so great that economies could be made when heat was required for short periods, or motors had to run for similar short periods doing discontinuous work. Gas engineers quite understood the advantage of electricity used in this way; but the main point of the lecture and the joint report was to show the actual efficiencies in extended and continuous use.

He (Sir Dugald) agreed that thermal efficiency was not the sole determining factor leading to the use of gas or electricity. With regard to Mr Wordingham's remark that large gas engines were at present under a cloud, he would like to call his attention to the inverted vertical gas engines which had been rapidly introduced into use during the past eight years. One firm alone had supplied over 100 000 B.H.P. in these engines in units from 500 to 3,000 H P. These engines were largely used for generating electricity at collieries and in other places.

The large and extending use of the smaller gas engines running with town's gas showed how much manufacturers do appreciate cheap motive power. For work of this kind, the gas engine industry showed an ever-increasing expansion which had not been checked by the use of the electric motor. At a certain power it became more economical to use a gas engine for a small works than an electric motor, and accordingly gas engines were so used in very large numbers.

It was necessary for the gas industry to deal with not only motive power and light, but also with electrical heating. A campaign for the general use of electricity for light, power and heat began with Mr. S. Z. de Ferranti's presidential address to the Institution of Electrical Engineers in 1910. He was followed by Mr. Merz himself, by Lord Haldane, by Mr. Sydney Brooks. Even Mr. Patchell said, "Electricity was to be the cure-all. Rivers of electricity were to wash away the effects of the war, if not the whole of the national debt." He could assure Mr. Merz, Mr. Sparks and Mr. Patchell that, under these circumstances, it was necessary for the gas industry to bestir itself and show the high economies which were obtained in gas-making processes for the supply of heat, power and light.

With regard to Mr. Merz' statement that the figures obtained at some of the largest gas-driven stations in the world were inferior to those obtained at steam turbine stations, he (Sir Dugald) would refer him to a recent Paper read by Mr. Patchell before the Institution of Electrical Engineers, where the combined thermal efficiency of electrical generation is given as 19·9 per cent. with a relatively small gas-producing plant and gas engines of about 500 H.P..

He was very much in agreement with Mr. Highfield as to the necessity for co-operation between the two industries, and quite understood his argument that even cost is not the sole determining factor.

Electric and Other Methods of Applying Water Japan.*

By WHEELER P. DAVEY.

Baking japan, as ordinarily used in industry, consists of a "base" and a "solvent." The base contains one or more of the various asphalts, together with linseed, china-wood oil, &c. This dilutes this base to a liquid, so that the metal may be easily coated with the desired amount of japan base. Such solvents as naptha, kerosene and similar products entail considerable fire risk, especially in the oven in which the japanned metal is baked. It was to eliminate this fire risk that "water japan," which consists of an emulsion of japan base in water, was developed.

An enormous number of tiny ultra-microscopic globules of japan base float in the water japan in the same way that globules of butter fat are suspended in cream. The diameter of the globules is about 0·00001 in. The emulsion is permanent, showing no tendency to settle out even after several months. The viscosity of water japan is much less than that of the same base dissolved in kerosene or similar solvents. Accordingly it is necessary to employ different methods of applying the japan base to metal before baking. Such methods all have this feature in common—the japan base is deposited on the metal in a solvent-free condition.

The Electric-dip.—The electric-dip method is adapted to small odd jobs of japanning rather than to quantity production. The water japan is put in an iron tank, connected to the negative terminal of a direct-current circuit. The metal to be coated is connected to the positive terminal of the circuit. Since the globules of base in the water japan carry negative charges, the base will be attracted to the positively charged metal. The water is left behind and the metal is covered with a thin film of japan base, free from solvent. This film possesses some insulating properties even before baking, so that, as soon as the most exposed portions of the metal are coated, deposition starts in whatever holes and recesses may still be bare. The thickness of the deposit of base depends upon the product of the current-density and the time. Using a 125-volt circuit, the time required for a satisfactory coat is about $2\frac{1}{2}$ sec. In using the electric-dip method no special voltage is necessary. The work is connected directly across a direct-current line of high current carrying capacity without series resistance, so that the current flowing will be proportional to the area to be covered. The current on 125 volts will average about 0·8 ampere per square inch of surface to be covered. Owing to the polarisation effect, the current is higher at the instant the circuit is closed than at the moment of breaking. Time is conveniently measured by means of a time switch connected to a relay. Accidental short circuits are prevented by a wooden grating on the sides and bottom of the tank. The surfaces of the metal to be coated should be absolutely free from grease or other insulating material. During the time the japan base is being deposited, the metal should be submerged at least 2 in. below the surface of the water japan so as to allow it to be in approximately uniform electric field. Only one coat can be given by the electric-dip process, as baked water japan acts as an insulator.

The Hot-dip.—The hot-dip method is adapted to work with large quantities of small castings, punchings, &c., where labour cost must be kept at a minimum. The metal to be japanned is placed in wire baskets and heated in an oven to a temperature of about 500°F. (260°C.). It is then cooled to about 400°F. (200°C.) and quickly plunged into the cold water japan. The japan base leaves the water and collects in a film on the surface of the metal. After the basket has remained in the water japan about 10 secs. it is removed, drained for about 30 secs. and placed in the baking oven, where it is baked in the usual manner. After baking, the basket is emptied into storage boxes. There is no handling of the individual pieces from the time the basket is filled until it is finally emptied into the storage box. Pre-heating was originally developed as a cheap method of cleaning grease and oil from metal before japanning. It is useful on steel punchings and on brass, copper and aluminium. It was soon found that if the pre-heated metal was quickly plunged into water japan while still hot (250° F. to 400° F.) that the heat in the metal had the same effect as the electricity in the electric-dip process in causing the japan base to adhere to the metal leaving the water behind. There was this additional advantage, that the surface of japan base immediately in contact with the metal started to bake from the residual heat of the metal, thus tending to ensure good adhesion.

In using ordinary japan the thickness of coat depends upon the viscosity of the japan, measured in terms of its density as shown by a hydrometer. In none of the foregoing methods described for using water japan has the viscosity been important. The concentration of japan base in the liquid, and not the viscosity, is the important factor. Even here the limits are quite wide, for the maximum permissible concentration is about twice the minimum.

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* Abstract of an article in the "General Electric Review" (U.S.A.).

Track Circuits.

By M. G. T.

During the last 10 years the track circuit has been greatly developed and is now an established feature in the signalling of railways. It has been found so reliable that Rule 55 (which requires the fireman of a train or engine detained at a signal after 5 minutes wait to walk to the signal-box and report the presence of the train or engine to the signalman) need not be complied with, when there is a track circuit to the rear of the stop signal. An indicator of some kind is attached to the signal so protected to inform enginemen of the presence of the track circuit.

THE DETECTION PROBLEM.

The most difficult problem at present is the detection, without fail, of single four-wheel vehicles. Experience has shown that where engines discharge sand or where rails are not frequently run over, the track circuit cannot be trusted. It is better to use fouling bars with electric contacts in series in such places. These are not suitable on a high speed line, however.

The problem of obtaining a successful track circuit is somewhat complicated. The variable resistance from rail to rail is the fundamental difficulty. The ballast resistance varies with weather, construction of permanent way, nature of ballast and length of track circuit.

BALLAST RESISTANCE.

The ballast resistance in dry weather may be more than 10 times the value in pouring rain. Certain railways attach the chairs to the sleepers by bolts with heads, and washers on the under-side of them. This construction tends to decrease the ballast resistance. Clean slag ballast or crushed granite possess good insulating properties when dry. Cinder ballast is poorer but not so variable. The length of a track circuit frequently has to be curtailed owing to bad insulating conditions. In some wet places very few rail lengths can be obtained to ensure a ballast resistance of not less than 5 ohms. A good average value for a ballast resistance is 20 ohms. In cases where such short track circuits are necessary, a number are connected in series through relays, to obtain the required length of protected section.

INSULATION AND BONDS.

The practice on different railways varies in detail somewhat for direct-current track circuits, but the main features remain the same. The type of insulating rail joint, and insulating connection for point fittings, &c., vary considerably, but all do the same thing effectively. Track circuit bonds also are of many types, double and single No. 8 galvanised iron wire, ditto copper wires, copper flexible bonds and so on. The double No. 8 .-GI. wire bond is perhaps the best and cheapest. It should be protected from damage by being passed inside the chair on the same side of the rail as the key and under it and the fish plate.

The voltage used across the rails is between 0·7 and 1·2 volts. One large railway with more than 900 track circuits uses a 2-volt 100 A.H. accumulator as the standard track battery. In one section however, to obtain a high minimum track shunt a 20-volt battery of 150 A.H. accumulators is used, and the section is divided into eight lengths all fed from the one battery. The total steady current taken is 1·1 amperes. 50 ohm relays are used in this special case. The 2-volt accumulators are of the portable type and are changed every 14 days. The 20-volt battery is in duplicate and is re-charged without being moved. The average discharge for a normal track circuit is 0·15 ampere. This increases very little when the track is short circuited, as a considerable total feed resistance is inserted between the accumulator and the rails. Four and nine ohm track relays are used, depending on the ballast resistance obtainable.

It is always the endeavour to get the resistance of the minimum track shunt as high as possible. The minimum resistance which will normally cause the track relay to be released is about 2 ohms. An average train shunt is about 0·4 ohm. The release current for a relay is about 0·03 ampere and the minimum pick-up current is about 0·05 ampere. It is, of course, desirable that the pick-up current should be considerably higher than the release current.

The Use of Track Circuits.

Track relays have been vastly improved of late years and usually have two coils, and solid well built high conductivity contacts in a glass enclosed base. Current is continuously flowing through the top contacts except when the track is occupied when the bottom contacts come into use.

The uses to which a track circuit is put are very varied. In its simplest form it merely operates an indicator in the signal box showing whether the track is "occupied" or "clear." It is also employed to lock the starting signal in the rear of the track circuit, to break down the "line clear" circuit between the block instruments, to control the movement of automatic signals, to act instead of facing point lock bars, to cause a lamp to be extinguished or lighted on an illuminated signal-box diagram, to cause an electric hooter to sound at dangerous level crossings or stations, and many other uses. In whatever way it is used electrical signal engineers always arrange for any failure to give the "danger" signal. Thus a broken rail or discharged battery would both cause the danger signal to be received. The cost of installing a direct-current track circuit varies very much with different railways. £120 is one figure for a simple track circuit 250 yards long. With prices for labour and material fluctuating so frequently this figure is of little value.

Alternating-Current Track Circuits.

Alternating-current track circuits are more costly, as they require transformers, special relays and impedance bonds, instead of the insulating rail joint, when used on electric railways, as they usually are.

Track Circuit Nomenclature.

It will be noticed that many special terms are used to describe parts or features of a track circuit. Those adopted have been recommended for this purpose by the Institution of Railway Signal Engineers, which has a Committee still sitting on track circuit nomenclature.

From a traffic point of view track circuits are invaluable. In addition to the concession with regard to Rule 55, it is possible to introduce automatic signals controlled by track circuits and so divide long block sections and enable more trains to be handled. They relieve the signalman of much anxiety particularly in fog, falling snow and darkness, and at places where he cannot see his signals. During the war the installation of track circuits was encouraged.

What the eventual result of track circuiting will be on traffic operation it is difficult to foretell. As the money put into them is well invested, for it makes accidents less possible, thus saving much paying out in claims and repairs, it is certain they will be strongly developed. They may so improve train working that they will in some places do away with the necessity for providing more running lines.

Those who wish to obtain more detailed information with regard to the electro-technical side of direct-current track circuiting are recommended to study the Papers read by Mr. C. M. Jacobs before the Institution of Electrical Engineers, January 1918, by Mr. W. J. Thorrowgood before the Institution of Railway Signal Engineers, April 9, 1918, and by Mr. H. M. Proud before the same Institution on June 11, 1918.

Correspondence.

STRAY LOSSES IN TURBO-ALTERNATORS

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Mr. Carr's letter in your issue of July 2 does not serve to advance our knowledge. The matter in dispute is not one of opinion but of fact, for there is much experimental data in existence to show that Mr. Carr's theory is untenable. He is tilting at fact with argument, and I would suggest that the logical course is for him to leave the matter in abeyance until he is in a position to compare his philosophy with his results. —I am, &c.,

Manchester, July 13.

S. F. Barclay, Ph.D., M.Inst.C.E.

Reviews.

Collected Scientific Papers. By John Henry Poynting, Sc. D., F.R.S. (London: Cambridge University Press.) Pp. xxxii.+768. 37s. 6d. net.

No better memorial to Prof. Poynting could have been devised than this handsome volume of his scientific papers. The editor is to be congratulated on the result of his labours and the printers have turned out a volume worthy of the best traditions of the Cambridge Press. To his old students it will be welcome, bringing back the memory of a much-loved teacher, and to every student of physics it will be a help, as Poynting not only made many valuable researches but possessed the rare gift of clear exposition of the most recondite subjects.

Poynting's scientific work may be divided into three sections. His studies on gravitational attraction come first. Next his work on the transfer of energy in the electromagnetic field, and lastly his work on radiation and the pressure produced by it. For the "weighing of the earth" he used a large bullion-balance with a 4-ft. beam. In place of the usual scale-pans two lead spheres each about 50 lb. in weight were hung from the two ends of the beam. A large lead sphere weighing about 350 lb. was brought first under one lead weight and then under the other, the gravitational attraction between the spheres thus producing twice the tilt of the balance beam that one attraction alone would have produced. The increase in the weight due to the attraction was only about $\frac{1}{5}$ mgm. in a total weight of 20 kilograms, *i.e.*, about one in a hundred million. The accuracy of the measurement was well within one in 5,000 million of the total weight. The difficulties that had to be overcome were great and the corrections that had to be applied were numerous, but in 1890 he deduced from his experiments that the density of the earth was 5·493 times that of water. He thus verified Newton's marvellous guess "that the quantity of the whole matter of the earth may be five or six times greater than if it consisted all of water."

The researches by which Poynting is most widely known are those on the transfer of energy in the electromagnetic field. They were published in the "Philosophical Transactions" for 1884 and 1888. Every electrician knows that neither electric nor magnetic energy is confined to the regions in which electric charges and permanent magnetism are found. It is known, for instance, that the motion of an electrostatic charge alters the distribution of the electrostatic energy in the field. There must, therefore, be a transfer of energy through the ether to produce this readjustment of the energy. Poynting looked for the mechanism of this flow of energy in what Maxwell called the "displacement currents" which accompany the motion of the charge. By rigorous mathematical reasoning he found the direction and the magnitude of this flow of energy through the ether. He proved that the flow of energy was perpendicular both to the electrostatic force R and to the magnetic force H. Its magnitude also was $RH \sin\theta/(4\pi)$, where θ is the angle between R and H. This resulting flow is known to the mathematician as the "Poynting flux of energy."

Poynting applied his theorem to the transmission of light which physicists regard as an electromagnetic phenomenon. If v be the velocity of light, then, by the theorem given above, assuming that θ is 90 deg., we have

$$\frac{RH}{4\pi v}=\frac{kR^2}{8\pi}+\frac{\mu H^2}{8\pi},$$

where k is the inductivity and μ the permeability of the medium. It is also easy to show from first principles that

$$H=kvR.$$

It follows from these two equations that

$$\frac{kR^2}{8\pi}=\frac{\mu H^2}{8\pi}, \text{ and } v=\frac{1}{\sqrt{k\mu}}.$$

Thus in a light wave the electrostatic energy equals the electromagnetic energy and the velocity of light depends only on the electrical constants of the medium.

In his later years Poynting devoted much attention to the question of radiant heat and the pressure produced by light. He applied Stefan's fourth power law of radiation to determine the temperature of planets, and amongst other interesting results deduced that the temperature of Mars would be so low that life as known to us would be impossible on its surface. This led to a controversy with Lowell, but Poynting saw no reason to modify his conclusions.

Another interesting deduction he made was that two equal hot spheres in the presence of one another were acted on by a repulsive force. He also deduced the curious result that if one of the spheres was very small compared with the other and the distance between them very great, then the repulsive force can be greater than their gravitational attraction and thus they move apart. He applies these theorems to interesting astronomical speculations about the rings of Saturn and the Zodiacal light.

The latter part of the book contains his addresses and papers on subjects of general interest. These can be read with pleasure and profit by every reader. His views on educational subjects are of special value. In the following extract he criticises some of our examinational methods. "Too much of our teaching and examining . . . . is like the charging of secondary batteries, ... which only give back what was put into them with some inevitable loss by leakage. So we charge our students with instruction and estimate their value by the percentage they can restore in the examination room."

A. Russell.

Principles and Practice of Electrical Testing. By R. G. Allen, B.Sc. (London: Longmans, Green & Company.) Pp. 363. 18s. net.

This is a good book. It deals with apparatus, circuits and machines, and the principles upon which they depend. In the first five chapters, occupying about one-third of the book, are enunciated the fundamental principles of electromagnetism, inductance, capacity, alternating currents, skin effect, eddy currents, measurements, harmonic analysis, ballistic and other moving-coil galvanometers, &c. The material is well chosen, and the treatment good, while no attempt has been made to avoid mathematics where mathematics is necessary. In addition to the usual electromagnetic and electrostatic definitions in a book on practical testing we should have been glad to find a definition of the international ampere, ohm and volt. Also, considering the great importance of the transient term in the expression for an alternating current in its application to short-circuit phenomena in transformers and alternators, more attention might profitably have been bestowed on this matter.

The next two chapters are devoted to the measurement of resistance and testing of insulation, and to the testing of live circuits and the location of faults. These, together with a chapter on the testing of the magnetic qualities of iron and steel, are fairly complete. The author then deals with the temperature rise in electrical apparatus and machines, and the reader is introduced to the heating and cooling curves for steady and intermittent working. This is followed by a description of the usual methods for the measurements of self and mutual inductance and of capacity.

The remaining six chapters are taken up with the principles and testing of electrical machines. The chapter on the principles contains the usual textbook information on the subject, though we would point out that, in addition to neutralising armature reaction, it is seldom necessary to add as much as 50 per cent. more ampere-turns for commutation purposes. Of course, in a book of this description the treatment is necessarily brief; yet many things have been left out which one would have gladly seen in it. Apparently the guiding principle of the writer has been to give what was really essential for an understanding of testing, and from this point of view the selection of material is perhaps satisfactory.

The chapter on the testing of continuous-current machines does not call for much comment, though the reader might have been given more precautionary instruction; *e.g.*, not to attempt to maintain a constant speed when taking a magnetisation curve; also not to make the final test before preliminary readings have been taken. In reference to the chapters on alternating-current machines, it seems to us that a very extensive range of subjects, including synchronous generators and motors, repulsion and induction motors and rotary converters, has been rather summarily dismissed. Though four chapters are devoted to the principles and testing of these machines, much modern work on theory and testing has been overlooked. Perhaps the inclusion of so many kinds of apparatus and machines in a single volume compelled the author to make the treatment cursory in places.

The last section of the book deals with the Duddell, and especially with the Irwin, oscillograph in a creditable manner, and we are glad to think that the author regards a book on testing as incomplete without reference to these important instruments. Throughout the book there are numerous examples, with numerical answers, which are of great value to the serious reader.

While we think that the more general parts are better than those referring specifically to machines and testing, we consider the book a very useful work to possess, and few purchasers will regret the outlay.

S. P. Smith.

Electricity Supply Districts.

The Electricity Commissioners have provisionally determined the areas of three additional districts, viz., the London and Home Counties, the Mersey and West Lancashire and the North Wales and Chester areas. In the case of the first-mentioned district objections to the proposed delimitation must be made, or alternative proposals submitted, to the Secretary of the Commission by Dec. 31 next, and in the other two by Nov. 30. The areas of the districts are as under:—

London and Home Counties.

The Electricity Commissioners have provisionally determined that the under-mentioned area shall be constituted a separate Electricity District:—

The City of London; the whole of the Counties of London and Middlesex; so much of the County of Berks as is included in the Municipal Borough of New Windsor, and the Rural District of Windsor; so much of the County of Buckingham as is included in the Urban districts of Beaconsfield, Eton and Slough; the rural district of Eton, and the parishes of Chalfont St. Giles, Chalfont St. Peter, Chenies and Seer Green Chapelry in the rural district of Amersham; so much of the County of Essex as is included in the county boroughs of East Ham and West Ham; the urban districts of Barking Town, Brentwood, Buckhurst Hill, Chingford, Epping, Grays Thurrock, Ilford, Leyton, Loughton, Romford, Tilbury, Waltham Holy Cross, Walthamstow, Wanstead and Woodford; the rural districts of Orsett and Romford; the parishes of Childerditch, Little Warley, South Weald and West Horndon in rural district of Billericay; the parishes of Chigwell, Epping Upland, Theydon Bois and Theydon Garnon in rural district of Epping; and the parishes of Lambourne, Navestock, Stamford Rivers, Stapleford Abbotts, Stapleford Tawney and Theydon Mount in rural district of Ongar; so much of the County of Hertford as is included in the municipal boroughs of Hertford and St. Albans; the urban districts of Barnet, Bushey, Cheshunt, Chorleywood, East Barnet Valley, Harpenden, Hoddesdon, Rickmansworth, Ware and Watford; and the rural districts of Barnet, Hatfield, Hertford, St. Albans, Ware, Watford and Welwyn; so much of the County of Kent as is included in the municipal boroughs of Bromley and Gravesend; the urban districts of Beckenham, Bexley, Chislehurst, Dartford, Erith, Footscray, Northfleet, Penge and Sevenoaks; and the rural districts of Bromley and Dartford; with the parishes of Brasted (excluding detached portion), Chevening, Dunton Green, Halstead, Kemsing, Otford, Riverhead, Seal, Sevenoaks Weald, Shoreham, Sunbridge and Westerham in rural district of Sevenoaks; so much of the County of Surrey as is included in the county borough of Croydon, the municipal boroughs of Guildford, Kingston-upon-Thames, Reigate, Richmond and Wimbledon; the urban districts of Barnes, Beddington and Wallington, Carshalton, Caterham, Chertsey, Coulsdon and Purley, Dorking, East and West Molesey, Egham, Epsom, Esher and the Dittons, Ham, Leatherhead, Merton and Morden, Mitcham, Surbiton, Sutton, The Maldens and Coombe, Walton-upon-Thames, Weybridge and Woking; the rural district of Epsom; the parishes of Bisley, Byfleet, Pyrford and Thorpe in rural district of Chertsey; the parishes of Dorking Rural, Effingham and Mickleham in rural district of Dorking; the parishes of Addington, Bletchingly, Chelsham, Crowhurst, Farleigh, Godstone (except the detached portion), Limpsfield, Oxted, Tandridge (except the southern portion), Tatsfield, Titsey, Warlingham and Woldingham in rural district of Godstone; the parishes of E. Clandon, E. Horsley, Merrow, Ockham, Pirbright, Send and Ripley, West Clandon, West Horsley, Wisley and Worplesdon in rural district of Guildford; and the parishes of Betchworth, Buckland, Chaldon, Chipstead, Gatton, Kingswood Liberty, Merstham, Nutfield and Walton-on-the-Hill in rural district of Reigate.

Mersey and West Lancashire.

County of Lancaster: The City and County Borough of Liverpool; the County Boroughs of Bootle, Southport, St. Helens and Warrington; the Municipal Borough of Widnes; the urban district of Formby, Great Crosby, Huyton-with-Roby, Lathom and Burscough, Litherland, Little Crosby, Newton-in-Makerfield, Ormskirk, Prescot, Rainford, Skelmersdale and Waterloo-with-Seaforth; the rural districts of Sefton, West Lancashire and Whitson, and the parishes or townships of Burtonwood, Cuerdley, Great Sankey, Houghton Middleton and Arbury, Penketh, Poulton-with-Fearnhead, Southworth and Croft, Winwick-with-Hulme and Woolston-with-Martinscroft in rural district of Warrington. County of Chester: the county boroughs of Birkenhead and Wallasey; the urban districts of Bromborough, Ellesmere Port and Whitby, Higher Bebington, Hoylake and West Kirby, Lower Bebington, Neston and Parkgate and Runcorn; and the rural districts of Runcorn and Wirral, and the parish or townships of Bridge Trafford, Dunham-on-the-Hill, Elton, Hapsford, Ince, Little Stanney, Stoke, Thornton-le-Moors and Wimbolds Trafford in rural district of Chester.

North Wales and Chester.

The Counties of Angesley, Carnarvon, Denbigh, Flint, Merioneth and Montgomery: so much of the County of Cardigan as is included in the Municipal Borough of Aberystwith; the rural district of Aberystwith and the township of Scybor y Coed; so much of the County of Chester as is included in the City and County Borough of Chester; the Municipal Borough of Crewe; the Urban Districts of Hoole, Middlewich, Nantwich, Northwich, Tarporley and Winsford; the rural districts of Malpas, Nantwich, Northwich and Tarvin, and the parishes or townships of Bache, Backford, Blacon-with-Crabhall, Capenhurst, Caughall, Chester Castle, Chorlton-by-Backford, Christleton, Claverton, Croughton, Doddleston, Eaton, Eccleston, Great Boughton, Great Saughall, Hoole Village, Lea, Little Saughall, Littleton, Lower Kinnerston, Marlston-with-Leach, Mickle Trafford, Mollington, Moston, Newton-by-Chester, Pickton, Poulton, Pulford, Shotwick, Shotwick Park, Upton, Wervin and Woodbank in rural district of Chester; and so much of the County of Salop as is included in the Municipal Borough of Oswestry; the Urban Districts of Ellesmere, Wem and Whitchurch; and the rural districts of Ellesmere, Oswestry, Wem and Whitchurch.

The Healey Variable Speed Gear.

On the 14th inst. a demonstration was given at the works of the British Universal Variable Gears, Ltd., at Shepherd's Bush, London, of the variable speed gear invented by Mr. F. J. Healey, the sole British rights of which have been acquired by the company. It is claimed that the gear permits of an entirely new combination of movements which is superior to the hydraulic, electric, friction and spur gear systems at present in use. The new variable speed gear will be manufactured for change speed gears on machine tools, lifts, printing machine drives, colliery winding gears, electric motor reduction and electric traction gears, &c. It consists of an expansible and contractible driven sprocket, both sprockets being disposed in one plane and upon parallel shafts. The sprockets are adapted to be operatively engaged by an endless chain, and means have been adopted to expand and contract simultaneously the driving and driven sprockets respectively, and vice versa. Means are provided to enable the individual tooth, by a series of two or more teeth, to be temporarily displaced relative to their normal position during the operation of expansion or contraction, while the teeth are in engagement with the chain, and to return the individual tooth or series of teeth to their normal position upon disengagement from the chain. The rim of each sprocket is divided up into segments, some or all of which are provided with teeth, the movement of each segment being constrained so as to maintain the tooth or teeth normal to the axis of the shaft. Each segment is carried on and supported by a block which is provided with an angularly disposed keyway of dovetail or T section, which engages with an angularly disposed key of dovetail or T section, attached to or formed on the body of the expanding and contracting device. Each segment is mounted on its associated block, so that its possible displacement is limited to movement of a circumferential character relative to the sprocket as a whole, within predetermined limits and under yielding control. Upon movement of the expanding and contracting device along the longitudinal axis of the shaft coaxially associated with it, the angularly disposed keys, engaging with their respective slots, cause the blocks and segments associated with it to move radially and normally to the axis of the shaft.

The following is the ratio of speeds of the gear installed in the machine shop: Speed of motor, 960 revs. per min.; speed of lay shaft in box, 432 revs. per min.; ratio of change in box, 9; speed of box varies from 144 to 1,296 revs. per min.; speed of line shaft varies from 60 to 540 revs. per min.; pulley on motor, 9 in. diameter; pulley on lay shaft, 20 in. diameter; pulley on second shaft in box, 10 in. diameter; pulley on line shaft, 24 in. diameter.

Touchbutton House.

On Friday last, at the invitation of Berry's Electric, Ltd., representatives of the technical Press were shown over Touchbutton House, 86, Newman-street, London, W., a new permanent exhibition in which the use of central heating by hot water and of electric fires and other apparatus is demonstrated.

In Touchbutton House there are many beautiful rooms, furnished with genuine antiques of the period represented and having the old fireplaces fitted with magical electric fires.

In the basement are installed many devices for the abolition of domestic drudgery. Here, too, is a reconstructed Norman archway fire place in which a pile of sticks and logs reproduces the earliest known form of home heating but, actually, the warmth is supplied by electricity. There are also the early hooded mantle-piece of the 13th century, a Jacobean mantle-piece belonging to the first half of the 16th century, and a grate of the Queen Anne period in a room, the panelling of which is valued at £2,000. In a magnificent hall of stone, with 14th century oaken beams and 15th century doors, is a replica of the Tattershall Castle mantle-piece, the original being fashioned in stone for the Lord Treasurer Cromwell between 1433 and 1455. Close by is a genuine William and Mary walnut mantle, dated 1695. In upper rooms are shown the most up-to-date methods of heating houses and flats.

Mr. H. H. Berry, in a short address at a luncheon which preceded the demonstration, said it was in the year 1256 Henry III. granted a Charter to the inhabitants of Newcastle-on-Tyne to dig coal in the vicinity of that town. In 1306 Parliament passed a Bill prohibiting the use of coal as fuel on account of the noxious and poisonous fumes which it was said to produce, and it was a capital offence to infringe the law. He drew attention to the way in which history was repeating itself. The Smoke Abatement Committee in its interim report recommended the Ministry of Health only to grant licenses to public bodies for state-aided buildings provided they had no chimneys nor flues. With the appliances shown in Touchbutton House the work of a household ordinarily done by 10 servants could be done more easily by five, and the ordinary drudgery in the home was absolutely eliminated. To meet the objection that housekeepers and cooks could not use the appliances, he had started a continuous and free class of instruction from 9.30 a.m. to 6.0 p.m. He could justifiably say that the putting in of these electric labour saving appliances was a 20 per cent. investment. His system consisted of employing a hard fuel such as coke or anthracite, in conjunction with electricity or gas for topping up. A small furnace in the kitchen of Touchbutton House gave for a small consumption of fuel a continuous supply of hot water, without the necessity of a calorifier, and a distribution of heat to convertors placed about the house. In America a minimum temperature of 75°F. was used for central heating, and the effect was a stuffy atmosphere. In this country the maximum was from 60° to 65°, and the system of getting the 75° directly from coal was as wasteful as doubling the steam raising power on a vessel to get a few extra knots. Reverting to the Smoke Abatement Committee, he said he did not know of the existence of the Committee until its report was printed. He thought the methods of advertising these Government Committees was wrong, and he hoped he would be invited to give evidence before the Committee. By adopting a central heating temperature of 55° instead of 75° there was a saving of 40 per cent. of hard coal during the whole 24 hours. If food were cooked by electricity or gas alone, energy was wasted in heating up a mass of metal, but by his system one had only to raise the temperature by electricity or gas from the constant temperature obtained by a little fire to the temperature of cooking, and there was a saving of 20 to 30 per cent. in cost and in the time taken for cooking.

German Radio-Telegraph Developments.

In order to supplement the ordinary telegraph system and to serve as a substitute in cases of extensive breakdowns of the telegraphic communication, the German State Ministry of Posts and Telegraphs is establishing a comprehensive State Wireless System. The following transmitting and receiving stations are in operation: Berlin, Breslau, Darmstadt, Dortmund, Frankfurt a/M., Friedrichshafen, Hamburg, Hanover, Königsberg, Königswusterhausen, Konstanz, Leipzig, Stettin and Dantzig. In addition there are receiving stations at Brunswick, Breslau, Chemnitz, Kottbus, Darmstadt, Dortmund, Dresden, Dusseldorg, Duisburg, Elberfeld, Essen, Frankfurt, a/M., Halberstadt, Hamburg, Hanover, Königsberg, Konstanz, Leipzig, Liegnitz, Magdeburg, Rostock, Stettin and Stuttgart. The State wireless system is being constantly extended. Bavaria and Württemberg will also be linked up in the system by the establishment of transmitting and receiving stations in Munich and Stuttgart. The Ministry has also established in Königsberg, East Prussia, two transmitting and two receiving wireless stations in order to render independent of the "Polish Corridor" the telegraphic communication of East Prussia with the remaining parts of the State. At present time the main traffic passes between Königsberg and Stettin and between Königsberg and Berlin. Other developments are projected, and it would appear that the Government is determined to make its telegraphic service as independent and self-contained as possible.

The Telephone Service.

The Select Committee on Telephone Charges has continued to hear evidence. Mr. A. D. Kidner, assistant secretary to the P.O. telephone department, explained that a charge of £20 per year covered 12,000 calls, but no credit was made for unused calls, nor were such carried forward. In France, Mr. Kidner said, there was an unlimited local service. Before the war the French flat rate was £15 17s., but it had been increased to £27 15s. His impression was that the service in that country was not so good as it was in this. In Germany, the pre-war rate of £17 13s. was now £35 6s. Before the war the service was very good, but it was not so good now. It was desired to extend the service in this country, but the Post Office wanted to make charges that would enable them to do it without loss.

The chairman (Sir Edward Coates) said the report of the Telephone Rates Committee showed that in America the telephone system was in the hands of approximately 11,000 private companies. In New York the charge worked out at 1½d. per call.

Mr. Kidner said there were indications that the telephone rate in America would be increased in the near future, and he pointed out that the trunk rate which had been increased recently was almost identical, step by step, with the proposals being put forward in this country. The question of automatic telephones were being studied here. The percentage of such telephones in America was smaller to-day than in England.

At Tuesday's sitting Mr. Pearson, Assistant Accountant-General of the G.P.O., stated that when the Post Office took over the National Company's system the net cost to the department was £11,000,000. Added to that was the capital cost of the Post Office system of some £14,000,000, and since then the Department had expended about £11,000,000, so that the capital expenditure on telephones amounted to approximately £40,000,000. Mr. Pearson put in figures which showed that in 1912-13 the estimated pension liability of the Department was £335,868, and the pension payment £51,251. For 1920-21, the estimated pension liability had risen to £740,000, with an estimated payment of £192,100. The latter sum had been provided for in the pension sinking fund account. War bonuses were largely responsible for the increase in the figures. 75 per cent of war bonuses now counted as pensions. At present 49,080 persons were employed in the telephone department, against 43,130 in 1913-14. There was an increase of 21 per cent. in the operating staff, which compared favourably with the increase of 26 per cent. in the number of stations.

In the House of Commons on Monday last the Postmaster-General announced that about 20 new telephone exchanges were to be built in London and 60 in the country, and there were 38 schemes in hand for putting large cables underground at a cost of four and a-half millions. The congestion was caused by the fact that the system was curtailed through the National Telephone Company working on a terminable license, and after the system had been taken over by the State the war prevented much development. During the past year they had not been able to make the desired progress owing to contractors being unable to get the raw materials.

Mr. H. Pike Pease, Assistant Postmaster-General, stated that it could not be disputed that the telephone development of the United Kingdom was wholly disproportionate to the commercial and industrial demands of the country. This unsatisfactory condition was due, first, to the fact that the local exchange system was until the end of 1911 largely in the hands of the National Telephone Company, which, in the later years of its existence, naturally refused to spend capital on new extensions owing to the uncertainty as to the financial results of State purchase. Secondly, soon after the Post Office were in a position to take in hand arrears of construction, the war broke out and capital expenditure was necessarily restricted to war requirements, with the result that for nearly four years no new telephone works for ordinary purposes had been commenced. For 1914-15 capital expenditure of over £4,000,000 was authorised, but owing to war, works costing only a little over £3,000,000 could be completed. The present position was, therefore, that the Post Office had to provide for arrears accruing not only during the period of the war, but also during the later years of the company's existence. At present, in nearly every town of importance in the United Kingdom, the Post Office experienced more or less difficulty in taking new orders for want of spare wires. There was also a serious deficiency of spare switchboard equipment. In London the position was even more serious. In about 50 per per cent. of the London telephone area it was impracticable to serve new subscribers. Before the war new orders numbered about 8,000 a month. Since 1914 it had been possible to deal with only between 3,000 and 4,000 a month, and the arrears of unexecuted orders might be estimated at about 200,000 at present. Applications were being received in London at the rate of between 800 and 900 a week. Of these less than 200 could be accepted owing either to the want of spare plant or the amount of work involved.

PROPOSED EXPENDITURE.

The expenditure proposed out of telephone capital for 1919-20 was:—(1) On trunk lines, £1,019,000, (2) On exchanges, subscribers' circuits, and junction circuits £2,091,000, and (3) On sites and buildings £120,000, a total of £3,230,000. The total amount spent was £2,647,000. The expenditure proposed for the present financial year was: On trunk lines £2,018,000, on exchanges, subscribers' circuits and junction circuits £4,366,000, and on sites and buildings £500,000, a total of £6,884,000. Mr. Pease gave details of the trunk line and underground works to be put in hand during 1920-21. The latter include sections required to complete underground telephone routes from London to Glasgow and from Birmingham to Bristol and Cardiff; a number of short routes designed to afford a rapid trunk service between London and the home counties, and an additional cable from London to Brighton, with an extension to Worthing. The total cost would be between £4,000,000 and £5,000,000. On the provision of new and extension of existing switchboards £1,184,000 was to be spent. This work includes "Relief" exchanges in London, the extension of about 20 exchanges in London and suburbs, and the re-equipment of about 12 of the more important exchanges. Large sums have also been allocated to underground cables for subscribers' lines, the provision and recovery of overhead subscribers lines, junction circuits and sites and buildings.

Applications for telephone service were being received at the rate of about 2,600 a month in London and 5,300 in the provinces. During the last 12 months orders had been executed at the rate of 2,300 a month in London and 3,900 in the provinces. Nevertheless, on April 30 there were 35,000 applications recorded, which it had been necessary to refuse on account of lack of plant.

Parliamentary Intelligence.

The EDINBURGH BOUNDARIES EXTENSION & TRAMWAYS BILL has been re-committed by the House of Commons, with an instruction to the Committee to have regard to the finding of the Joint Committee of both Houses on the Ministry of Health Provisional Order (Birkenhead Extension) Bill. The re-committal is mainly due to the perseverance and skill of the Member for Leith, who has been a consistent and vigorous opponent of the measure. The Joint Committee on the Birkenhead Extension Bill stated that, "subject to special considerations of public advantage, no provisional order for borough extensions should be brought before Parliament for confirmation which had not previously received the substantial support of the ratepayers in the areas proposed to be incorporated." In regard to BIRKENHEAD, the Committee were unanimously of opinion that the promoters had not established the case they sought to make. Consequently, the Bill was not allowed to proceed. Under these circumstances, it is probable that the Edinburgh Bill will now share the same fate.

A Select Committee of the House of Lords has passed the SHEFFIELD CORPORATION BILL in an amended form. The Bill has already been through the other House, and the only point on which there remained opposition was in respect to motor omnibuses. The Corporation had secured powers from time to time to run their omnibuses on different routes outside Sheffield, and the Bill contained provisions for the extension of these routes. The Chairman announced that the Committee had gone into the matter carefully, and had come to the conclusion that the "Standard clause" of the Ministry of Transport could only apply to the new routes. It was desirable all those undertakings should be on the same basis, but it was a matter that should be dealt with by general act and not in a private Bill. With regard to the running on the unauthorised route, the Committee thought that the same provisions must apply over the portion of the road on which the unauthorised running took place, as was in force on the other portion of the same route at that time.

Legal Intelligence.

The Half-watt Lamp Patent.

The Court of Appeal has continued the hearing of this appeal of the B. T.-H. Company from the judgment of Mr. Justice Sargant dismissing their action against the Corona Lamp Works for alleged infringement of their Letters Patent, granted in 1913, for improvements in half-watt lamps.

Mr. Kerly, K.C., on behalf of respondents, argued that if plaintiffs' specification was looked at carefully all it came to was that you got better results with a big lamp than you did with a little lamp. That was the whole story of the patent, and unless plaintiffs could make out that "large" meant something they must fail. It was no good giving to the word "large" a wider or different meaning than what the ordinary reader would understand by it. In defendants' view it was quite possible to take a filament which nobody would call large and run that so as to get a valuable light. Mr. Justice Sargant had delivered a very careful considered judgment and he (counsel) was thoroughly satisfied with that judgment so far as it dealt with the word "large," but he was not so satisfied with that judgment so far as it dealt with the question of subject matter.

The hearing was adjourned.

Books Received.

[Copies of the undermentioned works can be had from THE ELECTRICIAN Offices, on receipt of published price, plus postage.]

"Questions and Solutions in Telegraphy and Telephony." Grade I. Examinations, 1904-1919. Solutions by H. P. Few. (London: S. Rentell & Co.) Fifth edition. Pp. 328. 5s. 6d.

"Ozone." By G. K. Rideal, M.B.E., M.A., Ph.D. (London: Constable & Co.) Pp. ix. + 198. 12s. net.

"Induction Coil Design." By M. A. Codd. (London: E. & F. N. Spon.) Pp. 238. 21s. net.

Commercial Topics.

Lighting and Power Sets for New Zealand.

H.M. Trade Commissioner in New Zealand (Mr. R. W. Dalton) has recently requested to be furnished with information relating to British-made lighting and power sets, for which it is understood there is a possible market in that country. Firms interested should send two copies of their catalogues and price lists, together with information as to terms, delivery, export arrangements, &c., direct to His Majesty's Trade Commissioner, P.O. Box 369, Wellington, New Zealand.

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The British Industries Fairs.

The President of the Board of Trade has appointed a Committee to consider the best policy to be adopted in future as regards British Industries Fairs, particularly in respect of the centres at which they should be held, the trades which should be included, and the classes of exhibitors who should be allowed to participate. The members of the Committee are: Sir Frank Warner, K.B.E. (chairman), Mr. W. A. Anderson, Mr. P. W. L. Ashley, C.B., Sir W. H. Clark, K.C.S.I., C.M.G., Mr. J. W. Murray, Mr. G. C. Vyle and Major F. H. Wedgwood. Mr. A. G. Chuter, M.B.E., Department of Overseas Trade, is secretary.

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Trade with China.

Mr. H. H. Fox, C.M.G., F.R.G.S., H.M. Commercial Counsellor for China, who recently arrived in this country, is at present at the Department of Overseas Trade, and can be interviewed by firms in London who are desirous of obtaining information as to the possibilities of extending their trade in China. Firms who desire to consult Mr. Fox should communicate with the Department, 35, Old Queen-street, S.W.1. During the months of September and October Mr. Fox will visit the leading industrial districts, including Coventry, Birmingham, Sheffield, Manchester, Leeds, Belfast, Glasgow and Newcastle. He will be pleased to meet manufacturers and merchants who wish to consult him in regard to steps to be taken for opening up trade with China, and who are desirous of obtaining information as to the state of trade in that country.

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New Electrical Engineering Capital Issues.

Many electrical and engineering companies have recently made, or propose to make, new issues of capital. This activity is indicative of progress, and foreshadows important developments in the British electrical engineering industry. The Brush Electrical Engineering Company, Ltd., one of the pioneers of electrical progress in the United Kingdom, is making extensive additions to its well-equipped factories at Loughborough, and it is building an entirely new factory on the most modern lines for the manufacture of "Ljungstrom" turbines, which are now in great demand for the economical generation of electrical energy. The unceasing demand for British-made steam and electrical power-house plant, dynamos, motors and transformers, railway and tramway rolling stock, and body work for motor omnibuses, &c., finds expression in the remarkable industrial activity at Loughborough. Every department of the Brush concern is fully occupied with work for home and overseas customers, and it is understood that the orders booked during the first six months of the current year largely exceed in amount the whole of the contracts executed during the past year. The immense after-war demand for every kind of electrical plant, stimulated by the appointment of the Electricity Commissioners, and the associated changes in electrical legislation, are generally regarded as an exceptional guarantee that business in this direction will be ample for many years to come. To cope with the extending business, the Brush Company will shortly make an issue of 339,512 ordinary shares of £1 each at par. The dividend paid in 1917 was12 per cent., in 1918 18 per cent., and in 1919 15 per cent.

The Midland Electric Corporation for Power Distribution, Ltd., is making an issue of 250,060 ordinary shares of £1 each at par.; the Calcutta Electric Supply Corporation, Ltd., are inviting applications for £500,000 5 per cent. (tax free) first mortgage convertible debentures at 95 per cent; and the directors of Vickers Limited are also inviting applications for £1,500,000 7 per cent. seven-year notes at 95 per cent. The issue of the Fuller's United Electric Works, Ltd., takes the form of £200,000 7 per cent. tax free five-year notes.

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Italian Market for Electrical Fittings.

In a report by H.M. Consul at Turin, it is stated that, while the demand for all kinds of electric fittings continues large, conditions have changed much of late, as various local companies have been formed for the manufacture of these goods, as well as electric heating and cooking apparatus. There is, however, a great scarcity of all kinds of good electric light fittings, which will take a long time to satisfy. French, German and Swiss competition will have to be reckoned with as soon as production permits, and several newly-established companies in Milan are preparing to meet the demand. There is also some importation from the United States, Spain and Japan. At present, when the supply is not equal to the demand, everything sells as quickly as it arrives. Otherwise, the trade is largely of a seasonal character. It slackens during the early summer, but revives again in August for inside work and in the spring for outside plants. The best means of trading is through a British export house with local branches, travellers, &c., or through locally-established Italian concerns. The most essential point is to offer goods ready for early delivery. Payment is generally effected on receipt of the goods, or at 30 to 60 days after the date of the invoice. It is always better to give prices c.i.f. Genoa, if possible. While restrictions are not, as a rule, severe, there is, however, a Government monopoly on the sale of electric bulbs, which are subject to a tax of 25 per cent.

Electricity Supply.

An electric supply scheme is under consideration by BLAIRGOWRIE Town Council.

LINCOLN Council have purchased a 2,000 kw. turbo-generator from Stockport Corporation for £10,000.

BARNSLEY Corporation has received sanction to borrow £36,250 for new plant at the electricity works.

MAIDENHEAD Council has applied for sanction to an increased loan of £10,000 for extensions of mains.

BURY (Lancs.) Corporation has asked the Ministry of Transport for authority to borrow £95,000 for extensions of the electricity works.

CHIPPENHAM Council have accepted the offer of the local Electric Supply Company to supply current for public lighting at 6½d. per unit.

Halifax Corporation and Yorkshire Electric Power Company have been requested by HEBDEN BRIDGE Urban Council to submit terms for a supply of electricity in bulk.

A further increase in the electricity tariff is proposed by the HULL Electricity Committee. The flat rate for lighting units is to be raised to 8d., while other consumers (except those supplied under certain agreements) will have to pay a further 20 per cent. This brings the cost to 120 per cent. over the pre-war rates.

The SHOREDITCH Lighting Committee has approved estimates, amounting to £9,305, for providing and laying cables to new consumers. The Committee has also decided to purchase a 1,700 k.v.a. transformer for £2,900, and to become annual subscribers to the funds of the Electrical Development Association.

A conference of representatives of electricity undertakings in the MID-LANCASHIRE DISTRICT was held at Preston last week, when it was decided to appoint a committee of one representative, together with the engineer of each undertaking to report to a future conference as the preparation of schemes for improving the existing organisation for the supply of electricity in the district, including the formation of a joint electricity authority.

The application of the Urban Electric Supply Company for power to increase the maximum charge for electricity at GRANTHAM from 7d. to 1s. 2d., will be opposed by the Council. VENTNOR Urban Council is opposing a similar application of the Isle of Wight Electric Light Company to increase the charge from 9d. to 1s., and LYMINGTON Corporation also objects to the application of the local Electric Light & Power Company for an increase from 9d. to 1s. a unit.

The annual report of the PAISLEY Corporation electricity undertaking shows that the gross revenue for the past year was £64,254, compared with £40,943 in 1918-19. The gross expenditure was £42,699, leaving a gross profit of £21,555. Capital charges amounted to £20,810, leaving a credit balance of £745, compared with a debit of £14,275. The units generated were 7,245,121, and units sold 5,883,975, an increase of 14½ per cent. over the previous year. The maximum demand was 2,950 kw., and 260 new consumers were added, making a total of 2,278 to date.

LOUGHBOROUGH Corporation have decided to carry out extensions of the electricity works at an estimated cost of £149,000. It is proposed to put down a 3,000 turbo-generator set at once and to lay additional mains, &c. It is anticipated that a second turbo-generator will be required before the projected extensions are finished. The station may be closed when energy is obtained from a joint authority for the area, but Ald. Bumpus, chairman of the Electricity Committee, states that the financial conditions of such an arrangement would be that they would not lose by the installation of the additional plant.

The accounts of BLACKBURN CORPORATION'S ELECTRICITY UNDERTAKING for the year ended March 25 show revenue £91,321 (compared with £70,493 in previous year), and working and general expenses were £70,744 (£53,594), leaving gross profit £20,577 (£16,899). After providing for interest, instalments for loans and sinking fund, the net result was a deficit of £344 (compared with £2,226). Total maximum demand was 5,019 kw. (3,712 kw.). Units generated were 9,615,979 (9,177,686) and sold 8,448,036 (8,353,803). The borough electrical engineer (Mr. P. P. Wheelwright) says in his report: Applications for new business have rolled in, and applications for power alone total between 8,000 kw. and 9,000 kw., with which, of course, it is impossible to deal until the generating station at Whitebirk is producing. The manufacture of the turbine and alternator for the first set was, at the date of the report, well on the way, and a second similar set is on order.

Last week the SUNDERLAND Corporation approved a recommendation of the Electricity Committee to increase the salary of the Borough Electrical Engineer and Manager from £1,200 to £1,500. Councillor R. J. Wilson, who moved that the increase be granted, said in 1907, when Mr. Blackman came to Sunderland, his salary was £800, and by four annual increases of £50 he drew £1,000 per annum in 1911. At that time the output was seven million units, but it was now 20 million. Compared with other Corporations, they had made but a poor show with regard to the head of the electricity department. Mr. Blackman was one of the best electrical engineers in the country, and there were undertakings who were paying as high as £2,500 for similar work. Coun. F. W. Taylor also pointed out that in 1907 they were 95th on the list of the municipal concerns as regards consumption of coal, now they were fifth. On the list for works costs in 1907 they were 64th from the top, and to-day were sixth. Finally, the recommendation was carried by 30 votes to 11.

As Mr. Blackman was the only borough official entitled to six months' notice of termination of appointment, an agreement has been made to alter the period to three months on either side.

An interesting report from the borough electrical and tramways engineer, Mr. A. Nichols Moore, recommending extensions of the electric supply undertaking (estimated to cost £208,861) was adopted by the Newport (Mon.) Corporation last week. The report stated that the maximum demand last winter was 4,100 kw. It is expected that next winter it will be 5,000 kw., and in 1921 7,000 kw., or even higher. The total units generated during the year ended March 31 were approximately 11,000,000. This year the output should exceed 12,000,000; and assuming various large bulk supplies are fully established by the end of 1921, then in the following year the output will probably reach 20,000,000 units. Mr. Moore's recommendations included alterations to the boiler house buildings and the addition of two boilers, with economisers, induced draught plant, flue and steel stock and ash-conveying plant; also an additional turbo-alternator of not less than 5,000 kw. At the East power station it is proposed to put in an additional 750 kw. rotary converter, with switchgear, additional e.h.t. feeder cubicles with l.t. control gear. An application is to be made for an immediate loan for additional e.h.t., h.t. and l.t. mains and distributors.

In moving the adoption of the proposals, the chairman of the Electricity and Tramways Committee (Ald. Moxon) said the proposed expenditure was not in the nature of a speculation as regards the future. It was the definite redemption of an obligation in respect of Whitehead Steel Works, the Mannesmann Steel Works and the Dos Works. The Corporation's requirements could be easily measured, especially having regard to the progress of the undertaking during the past six years. When the war started their revenue was £44,000; last year it was £106,000, and they were still advancing. Expenses had also gone up, but the concern was still paying.

At the meeting of the Sheffield Corporation last week the question of the electricity charges was again discussed. The Electric Supply Committee recommended the Council to rescind its resolution to charge a flat rate for all energy, whether used for light or power, and to affirm the proposed increases in charges as recommended by the General Manager. In moving the adoption of the Committee's report, Ald. Styring said that the matter was one of such extreme importance to the City that it deserved the most careful consideration. Lighing supply involved the provision of an amount of plant which must be specially and at all times allocated for that supply, and must be available for that supply entirely independently of the power supply. At present a very large proportion of the consumers were not remunerative, and by putting more of them on they weakened rather than strengthened the resources of the undertaking. The proposal previously passed by the Council would be a very great injustice to power consumers, who paid for the entire cost of producing and distributing the power which they received, and in addition returned a handsome profit to the Corporation. The alteration would cast a very heavy charge upon the large power users, who had been induced to take their supplies from the Corporation, on the understanding that they would be given as cheaply as possible. Such action would send the power consumers away with a feeling of injustice. If they were to subsidise the lighting consumers and if they wanted to introduce for secondary purposes the electric light into smaller houses in the City it was infinitely better to face that problem fairly and subsidise the cost of that provision from the rates direct, rather than they should endeavour to put the burden upon some other section of the electric supply consumers.

Councillor Graves moved an amendment to reaffirm the decision come to on June 9, but before proceeding to act upon that decision a special committee be appointed to consider how that policy might best be carried out. He recognised that there must be no question of doing an injustice to the power consumers, but when one found that the percentage of light consumers was comparatively so small it was difficult to discover where there could be any injustice in a flat rate. While the power supply had extended enormously in the past five years there had been very little extension of the lighting section, and it was therefore absurd to argue that the load factor for lighting to-day was what it was five years ago. He drew attention to the fact that the charge for light was the same as it was 21 years ago. The cost had gone down from 2·93d. per unit in 1905 to ·75d. in 1916, but the light consumer had not received any of the saving. During the past year six limited companies took considerably more than half of the entire output of the generating stations.

After Ald. Hobson and Councillor Neal, M.P., had spoken, Sir Wm. Clegg moved: "That in view of the grave importance of the resotion passed on June 9 it is desirable that a Special Committee be appointed, consisting of Aldermen Sir Wm. Clegg, Cattell, Marsh, Styring, and Councillors Blanchard, Bailey, Graves, Lambert, Simpson, Truelove, Tummon and Cecil H. Wilson, for the purpose of reconsidering the whole question, and that such Committee be empowered to obtain such advice and assistance as may be necessary to enable it to make such recommendations to the Council as may be deemed expedient." Sir William said that the debate had not advanced the question a very great deal; rather had it tended to confuse the issue, if it were possible to confuse it any more. He was not going to express any opinion as to whether the Electric Supply Committee were justified in increasing the charges for power or light, but the tramways department were large consumers of electrical energy for both purposes, and on its behalf he would want to know if the increases were necessary, to what extent, and how they would be allocated.

Ultimately Sir Wm. Clegg's amendment was carried.

Electric Traction.

Sunderland Electricity Committee propose to purchase two electric battery vehicles.

Mansfield Corporation has decided to purchase two electric tipping wagons at £1,820 each, and two petrol driven ones at £1,800 each.

The Bolton tramway men propose to adopt a new form of strike to increase wages. If a concession of about ½d. per hour is not made by July 24 they will not work on that day, and will strike every subsequent Saturday until they get what they want.

Exeter Tramways Committee has applied for authority to charge a minimum 1½d. fare. It is also proposed to purchase two new tramcars at £2,275 each in order to improve the service. It is hoped to establish a 5-minute service in the centre of the city.

Rotherham tramwaymen are disaffected owing to the fact that they are paid 3s. a week less than in Sheffield, and they are agitating for an advance of a penny an hour. As a result of the recent award, the local tramways were placed in according to the size of the undertakings. Sheffield was placed in group 1, with an advance to the men of 1d. per hour; Doncaster men were given an additional half-penny an hour; and Rotherham and Chesterfield a farthing each per hour. At present Rotherham men are running cars into Sheffield for three farthings an hour less than the Sheffield men and there are threats of a refusal to continue the through service.

The accounts of Manchester Corporation tramways department for the year ended March 31 show revenue £1,585,594 and working expenses £1,207,230, leaving gross profit £378,364, to which is added bank interest £6,261, interest on investments £12,601 and balance from parcels department £1,269. Interest on capital required £67,175, rent of leased lines, &c., £26,911, writing off outlay on leaseholds £385, and amount required to meet cost of working and depreciation of motor omnibuses in excess of the revenue (which was £19,051) £309. After providing for sinking fund and loan instalments, renewals fund (£80,229), income tax and street improvements, there remained £111,891 to be applied to relief of rates. Total revenue was 20·127d. per car-mile (compared with 18·114d. in previous year), and working expenses, including power, were 15·325d. (12·821d.). Passengers carried were 285,046,914 (253,940,203) and car-miles run 18,146,551 (18,906,654).

Owing to the increase in working costs, the Liverpool Tramways Committee propose to revise the fares and to adopt the principle of a penny a mile upon the zone system. The general manager (Mr. P. Priestley) also suggests that long-distance passengers should be given some little advantage over short-distance riders. By the revised scale, the approximate increase in receipts would be about £340,000, assuming that the same number of passengers will be carried as at present.

The estimated expenditure on renewals of the permanent way for the years 1920-1924 inclusive is put at £864,197. For renewal of rolling-stock, overhead equipment, alterations to building and cars, &c., during the same period, the expenditure will be £331,000, or a total of £1,195,197. For the year 1920 a sum of £318,197 will be allocated for reconstruction purposes. From the beginning of the present year to May 31, the tramways accounts showed a net surplus of £8,175, compared with over £50,000 for the corresponding period of 1917. It is stated that the right amount to provide for depreciation and renewal is 3d. per mile. In the general manager's return for the first five months of the year it is said that if 2d. per mile were set aside the amount to be provided for that period would be £52,572; if 3d. per mile, £78,859. The various awards granting increase in pay to employees since the beginning of the year will increase the wages costs for 1921 and following years by £12,700, over 1920.

Catalogues, Price Lists, &c.

The July issue of the "Installation News" contains articles on "Simplex Wiring in a large Engineering Works," Notes on the New "Plexim" Iron, on How Simplex Conduits are made, &c.

In a four-page pamphlet, issued by the Enterprise Mfg. Company, Ltd., Gun-street, Bishopsgate, E. 1, particulars and prices are given of the Vincent ironclad switch and switch-fuse manufactured by the company. The gear complies with the Home Office Regulations.

A few examples of J. & P. Switchboards are illustrated and described in a 16-page pamphlet issued by Messrs. Johnson & Phillips, Ltd., of Charlton and London. Particulars are given of some typical examples of direct-current and alternating-current switchboards for lighting, power and traction, which have been supplied by the company to various British and Colonial undertakings.

Two recent pamphlets by the British & Helsby Cables, Ltd., of Prescot, relate to Leclanche batteries and to Prescot jointing materials and accessories. The former gives prices and details (E.M.F., internal resistance, dimensions and weight) of cells of various sizes, and the latter contains particulars of insulating compounds, jointing tapes, tinned copper cable timbles, cable grips, &c., used by cable jointers.

Leaflet C2, which gives an illustrated description of the totally enclosed Lea V Notch Meters for measuring boiler feed water has been issued by the Lea Recorder Company, 28, Deansgate, Manchester. The accuracy of the meter, which measures up to 212°F. and at higher temperatures and lower pressures, is guaranteed within 1 per cent., and hundreds of them are said to be in successful operation in various parts of the world. Though the enclosed is more expensive than the usual open type of apparatus, it has certain advantages, one being that in the case of condensate the water is not exposed to the air. Further particulars may be obtained from the company by station engineers and others interested.

Institution Notes.

The U.S.A. Bureau of Standards has issued Scientific Paper No. 379, "Reflecting Power of Monel Metal, Stellite and Zinc," which gives data on the reflecting power of monel metal, stellite and zinc in the visible and in the infra-red spectrum.

The discovery of a new alloy, named Elinvar, is announced by the Academie des Sciences, Paris, M. Guillaume, the discoverer, was the inventor of Invar. It is claimed that Elinvar is an improvement on Invar, and is peculiarly valuable, by reason of its uniform elasticity, in more delicate parts of watches.

The Committee of the Engineers' Club, Manchester, recently purchased the freehold of the present club premises and of the adjoining property for £43,500 in order to provide suitable accommodation for the members. The club has a capital of £50,000 in £1 shares, of which £2,876 have been subscribed, and it has now been decided to issue the balance of the shares in order to provide money for the completion of the purchase. Each individual member is expected to contribute his share, and subscriptions are also invited from firms in which members are interested.

The annual general meeting of the Electro-Harmonic Society will be held on the 28th inst., at 4.30 p.m., at the Institution of Electrical Engineers, 1, Albemarle-street, W.1., for receiving the statement of accounts for the 34th (1919-20) Session, the election of officers for the ensuing season, &c. During the past session 78 new members were elected, but 44 resigned, two members died, and six were removed from the register for non-compliance with Rule 11. There are now 635 names on the register. The concerts next season wil be held in the Great Hall, Cannon-street Hotel.

The Electricity Supply Commercial Association held a meeting at Newcastle-on-Tyne on the 12th inst., when Mr. G. R. Smith, general secretary, gave an address on the progress of the Association. There were now nearly 3,000 members as a result of two years' labour. The Association was recognised and registered as a trade union and had representation on the National Joint Board of the electrical industry.

At a meeting at Cardiff on the 10th inst. it was decided to form a divisional branch council of the Association for South Wales and Monmouthshire.

A joint symposium and general discussion on "The Physics and Chemistry of Colloids and their Bearing on Industrial Questions," is being arranged by the Faraday Society and the Physical Society of London. It is proposed to hold this meeting in October next, but the exact date and place of meeting will be announced later. Anyone desirous of using the opportunity of the discussion to bring forward experimental matter or theoretical considerations bearing on emulsions and emulsification; physical properties of elastic gels; cataphoresis and electro-endosmose; precipitation in disperse systems; glass and pyrosols and non-aqueos systems; is asked to communicate as soon as possible with the secretary of the Joint Committee, Mr. F. S. Spiers, 10, Essex-street, Strand, London, W.C.2.

The second annual general meeting of the British Engineering Standards Association took place on Thursday last, when the Chairman (Sir Archibald Denny, Bart.) presented the report and made a review of the position, dwelling with especial emphasis on the need for further financial support. Last year the Chairman showed the vast increase in work of this national organisation both at home and abroad, and this year he was again able to chronicle further progress. The Association is rendering an indispensable service to British trade at home in co-ordinating standards, promoting efficiency and eliminating waste, and is also doing much to push British trade abroad. It is, therefore, regrettable that even after 20 years of useful work the engineering industry of the country is only now slowly putting the Association in a position adequately to cope with the increasing demands made upon its organisation. There are some 300 Committees, manned by over 1,400 members, who give their time and experience to this great national work, and the country as a whole, as well as the industry, owes a deep debt of gratitude to these gentlemen for their loyal service.

The Chairman mentioned that since the last annual meeting 27 British Standard Specifications had been issued and some 70 are under revision, the most important of which, the steel sections for general building construction, including shipbuilding, has just been completed. The new work in hand includes the drafting of specifications for various chemical products, copper alloys, materials and constructional strength of chemical fire-extinguishers, steel wire ropes, steel bridge construction, and milling cutters and reamers.

Probably the largest development during the year has been in connection with the electrical industry, for which some 45 specifications for electrical apparatus are in course of preparation. The work of standardising details in the construction of ships and their machinery is also making good progress. That an organisation such as this should close the year with a deficit of £1,100 is a matter which no doublt will be dealt with by the industry at once and generously, and it is to be hoped that the appeal now being made to those firms who have not so far subscribed and also to those who are subscribers, will at once be responded to. It is interesting to see that the engineering public is making increased use of the British Standard Specifications, for the Chairman stated that 31,000 of the specifications had been sold, almost all in this country, against about 3,000 in pre-war years.

Imperial and Foreign Notes.

A Commission has been appointed by the Governor-General of Algeria to report on the possibility of adopting electric traction on the Algerian Railways, and also the question of the general supply of electricity for industrial and agricultural purposes. It is suggested that the waterfalls of the Oued-Agrioum might be utilised for supplying electric power for the proposed railway line to connect Setif with Bougie, a seaport about 100 miles east of Algiers.

The Commercial Secretary to H.M. Legation at Lima (Mr. F. W. Manners) reports that a Peruvian Telephone Company has been reorganised with a considerable increase in capital, and that it intends to improve and extend the present service and to undertake the construction of long-distance lines to the provincial centres. The increase in capital has been largely provided by American interests, but the management is mainly Peruvian, and it is understood that the board are prepared to purchase in Great Britain, if prices and terms of delivery can compare with those of American firms. The Company has in the past purchased extensively in the United Kingdom, though not lately, on account of the difficulty in obtaining delivery and the lack of funds. The present time is, however, considered to be a favourable one for British manufacturers. Those interested may obtain further information from the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

The revenue of the Shanghai Municipal Electricity Department for 1919 was 4,382,144 taels (against 3,813,023 in 1918); gross profit was 856,614 (726,602) and net profit 386,326 (302,138) taels. In the report of Mr. T. H. U. Aldridge, engineer and manager, it is stated that the Riverside station was still operating without a sufficient reserve plant, but the situation was made somewhat easier by the commissioning of the 5,000 kw. Fraser & Chalmers-Vickers turbo-generator in January, although the two A.E.G. 2,000 kw. generators were not repaired until the autumn. The reconstruction of those generators by the Mitsu Bishi Works at Nagasaki has been quite successful. Both the 5,000 kw. A.E.G. generators again broke down. Towards the latter part of the year the erection of the new 10,000 kw. Parsons turbine and the first of the two 18,000 kw. General Electric turbines was commenced. Combined maximum load at the Riverside and Fearon-road stations was 28,365 kw., load factor was 42·39 (against 44·38). Units generated were 128,844,547 and sold 102,338,137 (86,275,659). The equivalent of 103,781 30-watt lamps were added to the connections, making the total 844,391, exclusive of motors and street lamps. Hired motors connected during 1919 were 94 (of 1,332 h.p.), consumers' motors 210 (3,806 h.p.) and lift and d.c. motors 10 (117 h.p.), making the aggregate total connected 2,093 (33,062 h.p.).

As already announced, Mr. Aldridge submitted to the Electricity Committee in December last a programme of the probable requirements of the Department up to the end of 1922. Very large extensions are contemplated and orders have been placed for a considerable amount of plant, including four B. and W. and four Stirling boilers, 22,000 volt switchgear (with the B. T.-H. Company) and for trunk feeders and cables with the British Insulated and Helsby Cables. The scheme was, however, delayed for several months owing to the necessity of waiting for the ratepayers' sanction, which was given at the annual meeting in April.

Personal and Appointments.

The King laid the foundation stone of the new Swansea University College on Monday.

Mr. Alan A. Campbell Swinton, F.R.S., has been elected chairman of the Council of the Royal Society of Arts.

Carlisle Corporation has increased the salary of the electrical engineer, Mr. C. W. Salt, to £885 per annum, rising to £1,000 on April 1 next.

Prof. A. M. Tyndall has been elected dean of the faculty of science in the University of Bristol in succession to Prof. F. Francis, who recently resigned.

Mr. J. Higham, M.Sc., senior physics master at the Durham Johnston School, has been appointed lecturer in physics and electrical engineering at the University of Manchester.

Mr. J. C. Maxwell Garnett, M.A., whose resignation from the position of principal of the Manchester College of Technology were announced in our last issue, has been appointed general secretary to the League of Nations' Union.

We regret to learn that in consequence of continued ill-health, Mr. W. G. Pickvance, chief electrical engineer to Wrexham Corporation, has resigned. Mr. Pickvance's breakdown is really due to overwork, and the Council have expressed their very high appreciation of his services during the past 13 years, and their sincere wishes for his complete recovery and future welfare. Pending the appointment of a successor, Mr. S. Thornton, of Messrs. Thornton & Evans, electrical engineers of Wrexham, will fill the vacant post. From a losing concern Mr. Pickvance rapidly turned the electricity undertaking into a flourishing one, and up till the war each year's working showed a profit, but, like many others, it has latterly been run at a serious loss owing to the enormous increase in the cost of coal and labour, and the deterioration of plant. Early in 1915 Mr. Pickvance conceived the scheme of munitions for Wrexham, and when the national shell factory was established, he was invited to act on the board of management. Mr. Pickvance, given a temporary free hand by his committee, threw himself with characteristic energy and zeal into the work of equipment, with the result that Wrexham was one of the first towns to be turning out every week thousands of 18 lb. shells. The Council have agreed to pay Mr. Pickvance his salary until the end of the year when we hope to learn that he has been fully restored to health.

Telegraph and Telephone Notes.

The new Telephone Exchange at Waltham Cross was opened on Saturday last.

The new Telegraph (Money) Bill authorises the Treasury to borrow a further sum of £10,000,000 for telephone development. The actual expenditure out of this sum in each year and the works to be carried out are subject to approval by the Treasury. The last Act was passed in 1913, and authorised the issue of £10,000,000, which is now exhausted.

By permission of the Postmaster-General and with the co-operation of Marconi's Wireless Telegraph Company, the Press Association is this week making a series of experiments in the distribution of news by wireless telephone. The Chelmsford transmitting station of the Marconi Company is used as the distributing centre, and news services were telephoned by one of the regular telephonists of the Association. The messages were received at newspaper offices in London, Sheffield, Newcastle, Manchester, Preston and Belfast.

The King of Spain paid a visit on Saturday to Marconi House, Strand, where he was given a demonstration of the reception in a small room without an outside aerial of Wireless Messages, Songs and Instrumental Music from the Marconi telephone station at Chelmsford. A loud speaking receiving appatatus was also demonstrated to His Majesty, the wireless messages and music being audible over a large area. His Majesty was escorted throughout the building by Senatore Marconi and Mr. Godfrey Isaacs, Managing Director.

Business Items, &c.

On and after the 26th inst., the official address of the Board of Education will be King Charles-street, Whitehall, S.W.1.

The whole of the assets, liabilities and contracts of Robert Beldam, Ltd., of London and Hounslow, have been acquired by Beldam Asbestos Company, Ltd., who have also taken over the directors and all employees of the old company.

It is the custom of many engineering firms to Close their Works during the August Bank Holiday Week. Among those who have decided to do so are the following: Messrs. J. H. Tucker & Company and Higgs Bros., Birmingham, from July 30 until Aug. 9; and Messrs. Alfred Herbert, Ltd., from July 30 until Aug. 10. The Trafford Park Works and Offices of the Metropolitan-Vickers Electrical Company will be closed from July 23 until Aug. 3, but a small staff will be in attendance to attend to urgent business.

Mr. W. G. Watson, managing director of Messrs. W. G. Watson & Company, Ltd., electrical engineers and merchants, of Sydney, N.S.W., who has been in America for some months, is at present in England on behalf of the company. Manufacturers and others desirous of extending their trade in Australia are invited to communicate with Mr. Watson, care of English, Scottish and Australian Bank, 5, Gracechurch-street, London, E.C.

Messrs. Johnson & Phillips, Ltd., have recently acquired new premises at 212, Clarence-street, Sydney, N.S.W., which will serve as headquarters for the company in Australia. Their business in the Commonwealth is under the control of their branch manager, Mr. E. A. Kinsley, who carries large stocks of the company's manufactures, including cables, wires and all their representative lines. Inquiries regarding the Commonwealth of Australia should, therefore, be addressed to Mr. Kinsley at the Sydney office. A view of the new premises is given in the accompanying illustration.

Miscellaneous.

The Lancashire Light Railways Co., Ltd., is being wound up voluntarily, with Messrs. H. P. [illegible] and E. H. Edwardes as liquidators. A meeting of creditors will be held at 10, [illegible]-street, Liverpool, on the 28th inst.

An Inquest was held at Aberavon on Friday on a young blacksmith's helper named Thos. J. Mort, who was killed at [illegible] Colliery on June 29. The evidence showed that the blacksmith went away on an errand, but on his return Mort was dead. The smith was using a portable lead to give additional light, and while absent Mort must have tampered with it. Mr. Isaac T. Dixon, chief electrician at the colliery, said he did not know that the practice of supplying leads to the smith was going on. It was dangerous and contrary to the regulations. The lead, only suitable for a voltage of 10 to 20, was used on a lighting circuit of 250 volts.

Wm. Jenkins, assistant electrician, said it had been the custom to fit those leads before he went to the colliery, but, although he knew they were contrary to the regulations, he fitted them. He had warned the blacksmiths and the strikers of the danger if the insulation was wet. The jury returned a verdict of death following electric shock, and found there was negligence by the management in allowing the practice.

The sixth Exhibition of French Manufactures, organised by the French Commercial Intelligence Department at 153, Queen Victoria-street, London, was formally opened by M. Perier, Ministre Plenipotentiare Commercial Attaché at the French Embassy, on the 15th inst. It is hoped that the exhibition, which will remain open until July 30, will provide a stimulus to the development of commercial relations between France and Great Britain. In addition to a good display of optical and photographic apparatus, fancy goods, &c., there are a few stands on which electrical scientific apparatus is shown, including those of Louis Ancel, who shows wireless telegraph and telephone apparatus; J. Carpentier, electrical and other scientific instruments; Ph. Decaix, projector and reflector mirrors, lenses, bulbs, &c.; L. Doignon, telegraph apparatus, electrical appliances, &c.; H. Duclos, transformers, mirrors, &c., for surgical purposes; Maurice Dutertre, electrical, medical and surgical apparatus, and L. Struciano, the orthophone microphonic apparatus.

The Machine Tool and Engineering Exhibition, which will be held at Olympia in September next was to have been held in 1916, but on account of the war it was postponed. The first exhibition was held in 1912, and the fact that eight years have elapsed since the last exhibition of machine tools in this country will mean that more new models and new types will be on view than have ever been shown at any previous exhibition. The whole of Olympia has been booked up for some months past and the number of separate exhibitors will exceed 200. Progress in engineering production largely depends upon the success of the machine tool maker in improving existing machines and in inventing new ones. Those who visit Olympia in September will have the opportunity of seeing over 1,000 machines in actual operation. The exhibition, which is being organised by the Machine Tool Trades' Association, will be held from the 4th to the 25th of September next.

The Industrial League and Council is continuing its useful week-end conferences of employers and employed. During the summer of last year a few informal conferences were held as an experiment, and this summer a regular series has been arranged. The latest of these conferences took place at the residence of Mr. E. J. P. Benn, C.B.E., Blunt House, Oxted, on Saturday and Sunday last, and others will follow, when Sir Samuel Waring, Mr. Hugo Hirst and Mr. H. V. Roe will in turn act as hosts. Last week-end seven representative trade unionists and an equal number of employers spent their time discussing "Employment and Production." The Industrial League is determined, as far as it is able, to leave no excuse to any employer or employee for not knowing and understanding the view of the other side. We understand that it is prepared to accept offers from others who are willing to act as hosts, and any of our readers who possess premises capable of accommodating eight, ten, or a dozen men for a week-end meeting should communicate with Mr. J. Ames, General Secretary of the League, 82, Victoria-street, S.W. 1.

As the Industrial League and Council cannot be incorporated until the Industrial Reconstruction Council is wound up, an extraordinary general meeting of the latter will be held at 82, Victoria-street, S.W. 1, on the 26th inst., at 4.30 p.m., to pass a resolution for winding up and to appoint Mr. W. H. Chantrey, 61, Lincoln's Inn Fields as Liquidator.

Educational.

The consideration of the future policy of the Manchester College of Technology has been deferred for a year. This step has been taken in deference to the views of the representatives of the University on the sub-committee who considered that the shortness of time and the uncertainty of the financial position made it impossible to deal with the question before the new session.

There are now nine suggested sites for the rehousing of the University of London, the latest being Lord Mansfield's Kenwood estate at Hampstead Heath. We believe that, apart from the financial aspect of the question, the Bloomsbury site is the best. It is close to the University College and the British Museum, and it is more central, more accessible and convenient than any of the others. Failing the Bloomsbury scheme, we believe that the suggestion to utilise the Imperial Institute, or some other centrally situated area might be considered. Accessibility and transport facilities for students are important points to be borne in mind, and in these respects the Kenwood estate is lacking.

Tenders Invited and Accepted.

Inverkeithing Corporation require tenders for electric lighting work in 40 houses to be erected on the Spencerfield site. Plans from Messrs. Williamson & Reid, 6, High-street, Inverkeithing.

The New South Wales Department of Public Works, Sydney, require tenders by Aug. 2 for the supply of turbines and generators for the Barren Jack hydro-electric development.

Grantown-on-Spey Council requires tender by July 31 for electric lighting work in 10 houses. Specifications may be seen at the office of Mr. H. J. Fraser, 25, High-street, Grantown-on-Spey.

Manchester Electricity Committee require tenders by Aug. 6 for low-pressure water pipes, supports, &c., and low-pressure water valves. Specification from Mr. F. E. Hughes, Town Hall, Manchester.

Nuneaton Corporation require a 500 kw. rotary converter, transformer and accessories. Specifications from the Electrical Engineer; tenders to Chairman of Electricity Committee by July 31.

Johannesburg (Transvaal) Council require tenders by August 11 for supply of steel tyres for tramcars and tramway track material (contracts 625 and 627). Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

Tenders are invited for the equipment and running of electricity supply works at Cape Coast and tramways at Coomassie (Gold Coast). Further information from the Secretary for Works, Accra. Tenders to the Colonial Secretary, Victoriaborg, Accra, by Sept. 1.

Grimsby Corporation invite tenders (by August 12) for the supply and erection of two water tube boilers, with economisers, fans, chimney, &c., a 3,000 kw. high pressure turbo-alternator and condenser plant. Specifications fromthe borough electrical engineer, Lieut.-Col. W. A. Vignoles.

Tenders are invited by the Commonwealth of Australia for the supply and erection of gal. iron and gal. steel stranded wire (by August 17), for copper jointing sleeves (August 21) and for porous cells and outer jars, bronze wire and covered and braided wire (by August 13).

Tenders are also invited (by Sept. 7) for supply to the Postmaster-General's Department Commonwealth of Australia of telephones and cable (Schedules 1,634 and 1,635). Tender forms from the office of the High Commissioner, Room 406, Australia House, Strand, London, W.C.2.

The date for the receipt of tenders by the New Zealand Public Works Department, Wellington, N.Z., for electrical equipment for the Arthur's Pass section of the Midland Railway of New Zealand has been extended from June 30 to August 7.

Manchester Electricity Committee invite tenders for supply and erection of one 75-ton and one 15-ton electric crane at the Barton power station. Specifications from the Secretary, Mr. F. E. Hughes, and further particulars may be obtained from the chief engineer and manager, Mr. S. L. Pearce. Tenders to the chairman of the Committee by August 13.

Blackpool Corporation invite tenders for the supply and erection of two water-tube boilers, superheaters, economisers and mechanical stokers, &c.; two induced draught plants with steel chimneys, fans, &c., and coal hoppers and coal and ash elevators and conveyors. Specifications from the borough electrical engineer (Mr. Charles Furness), and tenders to the chairman of the Electricity Committee by Aug. 27

The New South Wales Government Railways & Tramways Department require tenders by August 4 for two 1,000 kw. rotary converters, six 365 kw. s. phase transformers and two blower sets; or (alternatively) two 1,000 kw. rotary converters and two three-phase oil-insulated self-cooled transformers. Specifications from the Chief Electrical Engineer for Railways.

Tenders are required (by Aug. 3) for the supply and erection at Perth (W.A.) of 326 accumulators (in accordance with Schedule W.A. 668), and also (by Aug. 2 and 5 respectively) for (a) aluminium sheet, brass rod, &c. (schedule 769) and (b) platinum wire, gold and silver wire, &c. (schedule 768), for the Australian Commonwealth, Postmaster-General's Department, New South Wales. Forms, &c., from the High Commissioner, Australia House, Strand, London, W.C. 2.

Carlisle Council has accepted the tender of the Metropolitan Vickers Electrical Company for a rotary converter and switchgear, at £8,824.

The tender of Johnson & Phillips (at £3,603 15s.) has been accepted by Grimsby Corporation for the supply and laying of e.h.t. feeder and pilot cables.

Malton Urban Council has accepted the tender of the Northern Counties Electricity Supply Company, for lighting 124 50-c.p. lamps for three years at £580 12s. 6d per annum.

Newport (Mon.) Corporation have accepted the tender of Babcock and Wilcox (at £38,393) for the supply of two water-tube boilers, and that of the A.E.G., of Berlin, for the supply of a rotor at £1,600.

Liverpool City Council has accepted the tender of Babcock & Wilcox, Ltd., for the supply of three water-tube boilers, economisers, &c., for the Lister Drive power station, and that of E. Green & Son, for three economisers.

Salford Corporation recently accepted the following tenders for the electricity department: Macintosh Cable Company, cable, £625 8s.; Metropolitan-Vickers Electrical Company, sheet metal plates on doors of oil switch cubicles at the electricity station, £154 10s.; supply and delivery of two 500 k.v.a. transformers, £1,900; Babcock & Wilcox, steel steam and exhaust piping for 5,000 kw. turbo-alternator set, £707; Aiton & Company, c.i. piping, £273; Ferranti Limited, Reason Mfg. Company, and Chamberlain & Hookham, meters.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane. London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1918 Specifications.

143,941 Jones. Electric lamp holders. (30/4/19.)
144,333 Holslag. Metallic electrodes for use in electric arc welding operations. (11/12/18.)
144,337 Carey. Electromagnetic apparatus for recording signals. (16/12/18.)

1919 Specifications.

142,375 Western Electric Co. Telegraph systems. (11/8/19.)
142,523 Warburton. Electric switches and switch fuses. (2/1/19.)
142,524 Creed. Submarine telegraph cables. (2/1/19.)
142,548 Gardner & Knight. Tools for slotting commutators. (4/2/19.)
142.558 Pritzker. Electric heaters or radiators. (6/2/19.)
142,571 Western Electric Company. Method and system for producing and selectively transmitting harmonics of electric oscillations. (12/2/19.)

Relates to a method of obtaining frequency harmonics of electric oscillations of a base frequency, in which an electric discharge device, including an electron-emitting cathode, an anode and a control electrode, is overloaded to produce oscillations having a distorted wave form including harmonics of a base frequency.

142,574 Edison Swan Electric Co. & Freedman. Gas-filled electric lamps. (13,2,19.)
142,578 Pestarini. Rotary current collectors for electric machines. (19/2/19.)
142,598 Murray. Printing-telegraph cut-page feed. (10/3/19.)
142,610 B.T.-H. Co. (G.E. Co.) Antennæ for wireless signalling systems. (21/3/19.)

Relates to a radiating antenna system comprising a conducting aerial network extending over a considerable area and supplied with radio frequency current, a number of earth connections for the aerial network, a second system of conductors insulated from earth and extending over the area between the aerial network and earth, the aerial network and the second system of conductors being so connected that the earth potential of the system is an intermediate potential between that of the aerial network and that of the second system of conductors.

142,630 B.T.-H. Co. (G.E. Co.) Regulators for electric generators. (8/4/19.)
142,635 Smith & Callender's Cable & Construction Co. Junction boxes for electric cables. (11/4/19.)
142,643 Clifford Bros. & Riddel. Switches for electric lamps. (22/4/19.)
142,645 Vaughan Crane Co. & Stanley. Speed-control gear for electric motors, especially applicable for crane motors and the like. (22/4/19.)
142,655 Turnock. Electrical resistance and manufacture of same. (3/5/19. Cognate application, 26,935/19.)

1920 Specifications.

138,075 Boucherot & Soc. Alsacienne de Constructions Mecaniques. Methods of protecting electric networks comprising armoured cables with multiple conductors. (1/5/14.)
143,480 Imray. (Eisemann Magneto Corpn.) Magneto-electric machines with oscillating armatures. (7/1/20.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

February 13, 1920.

4,431 Etna Lighting & Heating Co., Hookham & Prosser. Electrical conductors.
4,454 Jones. Wind power electricity generating plant.
4,455 Appleton. Electric alarm for motor vehicles.
4,462 Garrard, Railing & McCole. Protective devices for alternating-current systems.
4,467 Zweigbergk. Magnetic blow-out devices.
4,470 Imray. (Akt.-Ges. Bosch.) Terminal connections.
4,471 Akt.-Ges. R. Bosch. Releasing devices for armatures of electric starting motors. (20/2/19, Germany.)
4,479 Teppati. Electrical illuminating apparatus for kinematograph projectors. (27/8/19, Italy.)
4,494 B.T.-H. Co. & Taylor. Controlling devices for alternating-current machines.
4,495 B.T.-H. Co. & Gray. Vacuous electric discharge devices.
4,501 Automatic Telephone Mfg. Co. Automatic telephone systems. (31/5/19, U.S.)

February 14, 1920.

4,521 Endecott. Automatic attachment for turning of electric switches, &c.
4,523 Jenkins. Electric apparatus for heating air used in machines for drying wool, &c
4,526 Hall. Electric pianos.
4,529 Jenkins. Cooling tanks for electrical transformers, &c.
4,531 Guiseppe. Single-phase transformer.
4,544 Rutherford. Carrier for electric lamp shades, &c.
4,570 Gibson & Yorke. Magnetic deflectors for electric arcs in lamps, searchlights, &c.
4,577 Calloway. Incandescent lamps, &c.
4,583 Dowsing. Crystal detectors of electric currents.
4,592 Henley's Telegraph Works Co. Flameproof boxes for switches, &c.

February 16, 1920.

4,640 Midland Electric Mfg. Co. & Sutherland. Switches.
4,661 Muir. Attachment of dynamo for lighting side car combination.
4,662 Hansen. Electrically-driven mechanism.
4,667 Van Swany. Storage batteries. (15/2/19, Holland.)
4,676 Dixon. Electric lamp mountings.
4,679 Hayes-Gratz. Electric hand lamps.
4,681 B.T.-H. Co. & Clough. Control of excitation of electric machines.
4,696 Knight. Selenium cells or bridges.
4,713, 4,714 & 4,715 Hackbridge Cable Co. & Kennett. Transformers.
4.728 Cox. Electric irons.
4,737 Holland. Line selector switches for intercommunication telephone systems, &c.
4,739 Macrorie & Shearing. Valve transmitters for wireless telegraphy and telephony.

February 17, 1920.

4,764 St. Helens Cable & Rubber Co. & Brooking. Protecting cables, &c., from being pierced.
4,766 Mechanical Supplies, Ltd., & Baynes. Sensitive pressure relays for amplification of sound waves, &c.
4,786 McIntosh Adjustable carriers for electric lamps.
4,790 Kersting & Lane. Electric fires.
4,792 Poynter. Incandescent lamps.
4,795 Boller. Electric induction gas radiator.
4,799 Eccles & Vincent. Wireless communication.
4,809 B.T.-H. Co. & Clough. Power transmission systems.
4,810 B.T.-H. Co. (G.E. Co.) Electric power transmission devices.
4,829 Automatic Telephone Mfg. Co. Automatic telephone systems. (11/4/19, U.S.)
4,863 Hamilton. Insulating splice covers.
4,887 Twiss. Connectors for cable suspension.

February 18, 1920.

4,9[illegible]9 Harman. Electric heating apparatus.
4,915 White. Bonding clips for wiring.
4,916 White. Junction box for wiring.
4,950 Westinghouse Electric & Mfg. Co. Control mechanism for electric cars with pneumatic brakes. (18/2/19. U.S.)
4,958 Clark. Primary cells and batteries.
4,959 Le Bas. Electric heating apparatus.
4,970 Igranic Electric Co. (Cutler Hammer Mfg. Co.) Means for indicating at a distance movements of a shaft, &c.
4,986 Weymann. Bayonet sockets for electric lamps. (22/2/19, Switzerland).

Companies' Reports, &c.

At their meeting on the 14th inst., the directors of the WESTMINSTER ELECTRIC SUPPLY CORPORATION, LTD., appointed Captain E. I. Bax to succeed the late Lord Downham as chairman of the company.

The accounts of the KENT ELECTRIC POWER COMPANY for 1919 show a profit of £9,656. After meeting debenture interest, providing £3,000 for depreciation, &c., and including £3,764 brought forward, the balance is £10,830, which the directors propose to carry forward.

The directors of the EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH COMPANY, LTD., announce that the interest on the four per cent. mortgage debenture stock for the half-year ending July 31 will be paid by warrant on the 2nd prox. The share register will be closed from the 28th to the 31st inst.

The directors of the ST. JAMES'S AND PALL MALL ELECTRIC LIGHT CO., LTD., have declared an interim dividend at rate of 7 per cent. per annum on the preference and ordinary shares for the half-year ending June 30, payable August 5 next. The share transfer books are closed from the 22nd inst. to August 4 inclusive.

At the meeting of the BARNSLEY & DISTRICT TRACTION COMPANY, LTD., on Friday it was reported that the past year's revenue was £65,212. After providing for all expenses, the balance was £14,954, which, added to £685 brought forward, made an available amount of £15,640. The directors recommended placing to reserve £1,500; a dividend at the rate of 12 per cent. per annum on the ordinary shares, in respect of which an interim dividend at the rate of 6 per cent. had been paid, and carrying forward £10,324. The report and accounts were adopted on the motion of the chairman, Capt. L. M. Myers.

At the meeting of EDMUNDSON'S ELECTRICITY CORPORATION, LTD., last week the chairman (Mr. P. D. Tuckett) dealt at some length with the difficulties of electric supply companies. He said that all their costs had long since doubled, and were now all but trebled. Their coal and wages bill alone increased by £65,000 last year, following on an advance of nearly £50,00 in the previous year, while for the current year they were already faced with an additional burden of £80,000 on those two items, bringing the total increase since 1914 up to over £250,000 per annum, quite apart from the heavy increases in rates, taxes, repairs and all other items of costs. Nevertheless, 10d. a unit was the highest figure to which they had been allowed to raise their rates, while in some cases they were still limited to 7d. He believed that the Electricity Commissioners were now taking steps to enlarge their powers, so that they might be able to grant more adequate relief. To have to withhold the preference dividend when, with any semblance of fair treatment, the company ought to have been paying a dividend on their ordinary shares, was deplorable.

For the year ended March 31 the net profit of WARD & GOLDSTONE, LTD., was £33,147. Out of this £11,325 has been paid to the vendors (proportion of profits to date of formation), dividends of 7 per cent. on the preference and ordinary shares for the half-year, and income tax, leaving £16,678. The directors propose to pay a further 4 per cent. on the ordinary shares, making 11 per cent. in all for the half-year, and a participating dividend of 1 per cent. on the cumulative preference shares, carrying forward £15,627. The profit for the year, due to the increased turnover, substantially exceeds that of previous years. The moulders', railway and other strikes rendered it impossible to remove to the new works during the year, but good progress is now being made in the new premises, where a number of departments are running satisfactorily. It is anticipated that the removal will be complete by the end of the year. The demand for the company's manufactures and supplies continues to be sustained, and the works have booked a record volume of business ahead. In order to ensure regular supplies of the internal-combustion engine sold with their "Mercure" electric lighting plants, a controlling interest has been taken in the company manufacturing these engines.

Presiding over the annual meeting of the CHILI TELEPHONE COMPANY, LTD., on Tuesday, Mr. Chas. W. Parish stated that during the past year they had built 32 new trunk and junction lines, opened four new offices, and acquired sites at three centres. They had carried out extensions of underground work in Santiago and district, as well as at Conception and Talca, and had advanced the work of reconstruction at Valparaiso. The new automatic switchboard, which was being manufactured for Valparaiso, would be installed next year. Experience had proved that wherever the automatic system had been introduced, a large influx in subscribers had resulted. They had acquired the business of the Antofagasta Telephone Company, which had 960 subscribers, and had extended its operations towards Calama, where there was a small telephone company which they had also bought. They had every expectation that the two businesses, with their connections and stock of materials, would prove a very favourable purchase. Negotiations with regard to the renewal of their concessions were being carried on. The company could not develop their business unless the Government granted them reasonable security of tenure. After transferring £10,316 to general reserve, and £12,000 to reserve for renewal of plant, they proposed to pay a final dividend of 3s. per share, making 6 per cent. for the year, and leaving £19,843 to be carried forward.

Presiding over the meeting of the PERNAMBUCO TRAMWAYS & POWER COMPANY, LTD., on the 15th inst., Mr. Wm. Higgins said there was a perceptible increase in the receipts, partly due to the higher rate of exchange. The working expenses had also risen, but the net revenue had increased by £21,500. The directors were placing £23,000 to renewal and general reserve, and, after providing for amortisation, they were paying a dividend of 3½ per cent. on the preference shares, leaving £16,909 to be carried forward. They were applying to the Government of the State for power to raise their rates, those fixed when the concession was obtained in 1912, owing to circumstances beyond the company's control, being totally inadequate. In 1914 coal delivered in Pernambuco cost £1 13s. per ton, compared with £5 per ton at the present time, and everything else had gone up from 100 to 300 per cent. The principle of the necessity of increased rates of fares was being almost universally accepted in all parts of the world. The tramway section continued to show development. The directors still believed in the great possibility of the electric lighting and power branch, and were doing all they could to meet the demand that undoubtedly existed in Pernambuco. There was a loss on their gas undertaking due to the extraordinarily high rates for coal. The Telephone Company of Pernambuco (of which the company held the bulk of the shares) continued to report an increased number of subscribers.

In the course of his speech at the annual meeting of the BIRMINGHAM DISTRICT POWER AND TRACTION COMPANY, LTD., last week, the chairman, Mr. C. S. B. Hilton, stated that they were able, after placing £10,000 to renewals and making a small allocation to reserve, to pay a dividend of 6 per cent. on the ordinary shares, and to carry forward £4,354. Last year the conditions under which business was carried on were extremely difficult, but things had not improved during the year. There was still the constantly recurring demand from the employees for increased wages, and the ever-increasing cost of materials. Those demands could not always be met, either by economies or by raising fares. Every possible economy had been exercised consistently with efficient management, and fares had been increased so far as was practicable under their Acts and Orders. Moreover, if further increases were made, it was doubtful if the results would justify them, as signs were not wanting that the economic limit had been reached. The traffic receipts of the company's and associated companies' tramways (estimated at £353,000) were £349,616, and the total expenses reached £308,465, compared with the estimated figure of £245,000. Whether or not during the current year the receipts reached the same figure was a matter which was exercising the minds of the management, but signs were not wanting that trade in the district was beginning to fall in certain industries, and when that once took place, it was certain that the receipts would be effected. Tramway receipts were a very good barometer of the condition of trade. The Birmingham and Midland Motor Omnibus Company had again paid 10 per cent. and the business was developing satisfactorily. As to the Shropshire, Worcestershire and Staffordshire Electric Power Company, on the cessation of the war Government work was suddenly withdrawn, and the business dropped in proportion, with the result that they had not been able to pay any dividend on the ordinary share capital against 6 per cent. last year. Their business had now resumed its normal state, and there would not be any difficulty in paying a substantial dividend for the current year. Applications had been been made to the Ministry of Transport for increases of fares.

The chairman of FULLER'S UNITED ELECTRIC WORKS, LTD., was able to give a good account of the progress of the company at the meeting last week. He stated that the union of the four Fuller companies was a wise step, and the year's result had shown that the action taken was fully justified. In the transition from war to peace certain difficulties had been troublesome, and had somewhat checked their progress; for instance, their requirements for electric power had increased so rapidly that the Ilford Corporation had not been able to supply them with sufficient current to keep their machinery going at full pressure. New machinery on order had been held up on account of the moulders' strike, and the difficulty in getting raw material had prevented the completion of their new buildings until a recent date. They had avoided any serious labour troubles, and the greatest good will existed between the company's employees and themselves. The profit £48,040 was quite satisfactory, especially in view of the fact that they had not been able to secure the full benefit of the new capital for the greater part of the year's trading. They were paying a dividend of 10 per cent. on the ordinary and preference shares, and £8,040 would be carried forward. The primary battery department was a very old department, and had in times past made the name of Fuller known all over the world. Their patent inert cells had been, and were being, supplied to all important countries, while they were steadily growing in favour and demand. During the year they had acquired a valuable process which made their cell the finest on the market. They had recently designed some batteries in connection with wireless sets. Their production of wire and cable had made rapid strides during the last year. The trade grew faster than they could keep pace with it, notwithstanding the fact that they were continually increasing their machinery. Their patent block accumulator had many advantages over the common plate type, and it was particularly suitable for lighting, ignition and for telegraph and telephone work. For the Sparta starting and lighting batteries, some of the largest motor firms had placed important contracts with them. They also had had large contracts from collieries for miners' lamps. The carbon department was making excellent progress, and the orders for their products were more than their machinery could produce. The ebonite department was also growing. Mr. Fuller said he had been actively engaged in the electrical business all his life, and with all the great evolutions in the science of electricity that had taken place, and he could not help thinking that the greatest development was still to come in the vast application of that science to the common wants of mankind. The demand for electrical material would increase by leaps and bounds. Their own business was well equipped to meet such a demand, and the limit to their output would be fixed only by the amount they could produce.

New Companies.

AUTO PATENT ACCESSORIES COMPANY, LTD. (168,780).—Private company. Reg. July 3, capital £1,000 in £1 shares, to take over a certain patent from F. Macdonald, and to carry on the business of manufacturers of solder under the said patent, motor-cars and cycles, dynamos, magnetos, &c. Directors: F. Macdonald and M. R. Patterson. Reg. office: 27, Hylton-street, Birmingham.

BRITISH ELECTRICAL WINDERS, LTD. (168,953)—Private company. Reg. July 12, capital £1,000 in £1 shares, to take over the business of an electrical and mechanical engineer carried on by W. A. Hymas, &c. First directors are Walter Alfred Hymas and Walter Albert Hymas. Reg. office: 17, London-road, Newbury, Berks.

DAYSOHMS, LTD. (168,786).—Private company. Reg. July 3, capital £25,000 in £1 shares (10,000 non-cumulative participating preference), to acquire and turn to account certain patents for inventions relating to electro-magnetic clutches and electric current regulating transformers, together with the trade mark "Daysohms," used in connection therewith. First directors are: Sir Philip Dawson, M.I.C.E., W. B. Esson, M.I.C.E., W. L. Davis, M.I.E.E., A. Soames, W. A. Hunter and J. Caldwell, M.I.C.E. Secretary: J. Lomax. Reg. office: 14-16, Cockspur-street, S.W. 1.

GARNET, TUCKER & COMPANY, LTD. (11,341).—Private company. Reg. in Edinburgh, July 16, capital £5,000 in £1 shares, to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical and gas apparatus, &c. First directors are: A. G. Tucker, W. Craig and S. R. Woodger. Reg. office: 133, West Campbell-street, Glasgow.

HAY, MARYON & COMPANY, LTD. (168,803).—Private company. Reg. July 5, capital £10,000 in £1 shares, to carry on the business of electrical, mechanical, mining, motor and general engineers, sundriesmen, &c. First directors are: M. Hay, A.M.I.Mech.E., J. F. Maryon and L. G. Lane. Reg. office: 14, Bride-lane, Ludgate Circus, E.C. 4.

KABLE ELECTRICAL COMPANY, LTD. (168,906).—Private company. Reg. July 9, capital £2,000 in 1,000 10 per cent cumulative preference shares of £1 each and 2,000 ordinary shares of 10s. each, to take over the business carried on by F. N. Kennett as the "Kable Electrical Company" F. N. Kennett is permanent governing director. Reg. office: 41, Jermyn-street, S.W. 1.

RICKARD, WRIGHT & DEAN, LTD. (169,029).—Private company. Reg. July 14, capital £4,500 in 4,000 10 per cent. cumulative preference shares of £1 each and 10,000 ordinary shares of 1s. each, to carry on the business of electricians, electrical and mechanical engineers, manufacturers of and dealers in electrical wires, cables and flexible cords. &c. First directors are E. Rickard, W. H. Dean and A. Wright. Reg. office: 17, Neal-street, Bradford.

ROBERT HORNBY & COMPANY, LTD. (169,003).—Private company. Reg. July 13, capital £5,000 in £1 shares, to carry on the business of civil, mechanical, electrical and general engineers, electricians, &c. Solicitor, E. Stoneham, 37 & 39, Essex-street, Strand, W.C.

STOKE NEWINGTON EX-SERVICE ENGINEERING COMPANY, LTD. (169,032).—Private company. Reg. July 14, capital £100 in 2s. 6d. shares, to carry on the business of general, electrical and mechanical engineers, tool makers, &c., and to adopt an agreement between S. C. Maxfield and D. Paisley. First directors are F. J. Billen and S. C. Maxfield. Secretary, D. Paisley. Reg office: Leswin-place, 24, Leswin-road, Stoke Newington.

TORQUE ELECTRICAL & ENGINEERING COMPANY, LTD. (168,451).—Private company. Reg. June 21, capital £5,000 in £1 shares, to take over the business carried on by C. J. Walsh, G. M. Park and W. F. Poulsen, as Park & Walsh, at Salubrious Passage, Swansea.

VULCAN ARC WELDING & TRANSPORT COMPANY, LTD. (196,005).—Private company Reg. July 13, capital £10 000 in 1,000 founders and 8,900 ordinary shares of £1 each and 2,000 employees' shares of 1s. each, to carry on the business indicated by the title. Reg. office: 2-4, Harrington-street, Liverpool.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics" (Third Show Number):—"The Aerial Derby"; "A New Theory of the Screw Propeller," by U. A. S. Riach, F.Ae.S.

"The Cabinet Maker":—"The Study of Tone Values in Furnishing"; "Practical Polishing"; and "Six-legged Tables."

"The Chemical Age":—"Society of Chemical Industry: Final Reports of Annual Meeting"; "Refractory Materials for Chemical Purposes," (II.) by A. B. Searle; "The 'Ring' in the Salt Trade."

"The Fruit Grower":—"Motor Vehicles for Fruit Industry"; "Fair Trading Council Formed"; and "Fuel Research Boards' Report."

"The Gas World":—Dr. Charles Carpenter on "Co-partnership and Trade Unionism"; "Distribution of Gas by Steel," by B. R. Parkinson; and "Progress of the Gas Regulation Bill."

"The Hardware Trade Journal":—"A Note on the Enamelling of Cast Iron"; "The Elusive Order"; and "A Trade in Tools."

"Ways and Means":—"Profit Sharing in the United Kingdom," by William Wallace; "Rhodesian Natives and the Land," by John H. Harris; and "The Fuel of the Future," by L. Brook-Partridge.

Forty Years Ago.

(THE ELECTRICIAN, JULY 24, 1880.)

AN ELECTRICAL AGE.—The eminent electrician who lately designed this "The Electricial Age," could adduce something more tangible than his own enthusiasm to make good the description. In the classic sense of the term indeed the present age is a long way short of its maturity; and we may safely predict of posterity that, following the example of their modern ancestors who have parcelled off the Dark Ages, the Age of Chivalry, and the Renaissance, they will not signalise the present for its achievements in one particular field of scientific activity.

THE ELECTRIC LIGHT IN VIENNA.—The Jablochkoff light is about to make its appearance in the Volksgarten, one of the most popular promenades in Vienna. The largest *cafe-concert* in the capital is situated in the middle of this promenade, and the proprietor has decided to illuminate it by means of the *bougies* devised by the above-mentioned inventor.

CITY AND GUILDS INSTITUTE EXAMINATION.—Mr. H. M. Sayers, of the Central Telegraphs Department, St. Martin's-le-Grand, has been awarded the first prize (£5 and a silver medal) in the honours examination for Technical Telegraphy, instituted by the City and Guilds Technical Institute.

DISTRIBUTING CURRENTS FOR ELECTRIC LAMPS.—Among the many recently-introduced improvements calculated to make electric illumination permanently practicable, says the "Mining Journal," is one by the Société Générale d'Electricité, of Paris, which is especially worthy of attention; it is a disconnecting and commutating apparatus for distributing currents to the lamp, and is so arranged that if one of a number of lamps or group of lamps should by accident become extinguished, or should its carbons break or be consumed, this lamp is automatically thrown out of circuit, and the next in order is brought into circuit. When the lamp is of the Jablochkoff kind there is attached to the clamp that holds the candle a strip made of two metals having unequal degrees of expansion. The strip is bent in U form inverted, and is attached by one of its limbs, presenting its bend near the lower end of the candle. When the candle is burnt down to this point the heat of the voltaic arc acting on the bent strip causes it to partially unbend, so that its free limb comes against a contact screw, and thus establishes a circuit of less resistance by which the electricity passes, without continuing to pass through the residuary carbons of the candle.

Prices of Metals, Chemicals, &c.

TUESDAY, July 20.

Copper—		Price.	Inc.	Dec.
Best selected.........	per ton	£106 0 0	£1 0 0	—
Electro Wirebars...	,,	£111 0 0	£1 0 0	—
H.C. wire basis......	per lb.	1s. 3¾d.	½d.	—
Sheet	,,	1s. 5$\frac{11}{16}$d.	$\frac{7}{16}$d.	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. 8¾d.	½d.	—
Brass 60/40—				
Rod, basis	,,	0s. 10½d.	—	¼d.
Sheet, basis	,,	1s. 3¾d.	—	—
Wire, basis	,,	1s. 3¾d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£37 0 0	—	—
Foreign or colonial	,,	34 5 0	—	£0 5 0
Tin—Ingot	,,	269 0 0	£4 0 0	—
Wire, basis	per lb.	0 3 6	½d.	—

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £18 10s.

,, (Roll Brimstone).—Per ton £18 10s.

Sulphuric Acid (Pyrites, 168°).—Per ton. £8 8s. 9d.

Copper Sulphate.—Per ton £43 10s.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 10d.

Sodium Chlorate.—Per lb. 5½d.

Rubber.—Para fine, 1s. 11d.: plantation 1st. latex, 1s. 10¾d. per lb.

Shellac.—T.N. Orange, 670s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

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Notes.

Nottingham Electricity Works.

AN important public inquiry (the first of its kind) was held at Nottingham last week by three of the Electricity Commissioners into the application of the Corporation for authority to erect a new generating station on the Trent, and also into a proposal of the Derbyshire & Notts Electric Power Company to equip a new power station at Colwick. The sites of the two stations are in close proximity, and are, in view of the proposals for the reorganisation of electricity supply, competitive schemes. Much technical and financial evidence was given on both sides, and ultimately the Chairman of the Commissioners (Sir JOHN SNELL) intimated that they would take time to consider their decision. At present there are in Nottingham three municipal small stations, which are totally inadequate to meet the demands for power and lighting in the area, and either a new station or an adequate bulk supply is urgently needed. Some years ago the Nottingham Corporation proposed to build a station on the banks of the river Trent; but the war intervened, and the scheme was held up. They now want to erect a large modern power station, which would ultimately become one of the proposed capital stations, and form a unit in the national scheme of supply. On the other hand, the Power Company, which is forced to build a station in the district, quite apart from the requirements of the Corporation, offer to give the latter a bulk supply to meet all their requirements at a maximum price of £6 per kilowatt per annum plus 0·45d. per unit, with a coal clause in the agreement. As will be seen from the evidence reported in another column, the witnesses were cross-examined closely as to the capital required for the equipment of the stations, the estimated generating costs and capital charges, the price at which bulk supply could be given, and other matters affecting the supply and distribution of electricity. The result of this, the first public inquiry of the Commissioners, will be awaited with interest, for it will probably give us some clue to the general policy likely to be pursued.

Reorganisation of Electricity Supply.

FOR the guidance of local authorities and persons desirous of submitting schemes for the improvement of the organisation of electricity supply, a memorandum has been issued by the Electricity Commissioners setting out the heads under which proposals should be formulated. In view of the importance of the subject, we give the document in full in another column. It will be seen that the Commissioners have speedily developed a great thirst for statistics, diagrams and large scale maps, following in this the usual official precedent. Proposals for a scheme should be submitted under three main heads—viz., administration, technical and financial. Though the majority of the questions can be answered without any great difficulty by the technical officers of an authority which is properly constituted, there are some points upon which no useful information can be given at present. For instance, we think no purpose can be served by answering the questions as to supply to railway companies for traction and the utilisation of the water power resources of the district. So much depends upon what the Ministry of Transport decides as to electric traction and upon the terms of the promised Government Bill relating to the development of water power. A clever electrical engineer could write a volume on the "potentialities of the district in regard to supply for power, traction, agriculture, domestic and general purposes"; while the "prospective demand and output for five and ten years hence," and the estimated average consumption of coal in future years can only be given very approximately. The requirement as to "estimates of capital expenditure within five years, the subsequent quinquennial period, and within such further period as may be necessary to complete the scheme" also seems to us to look too far ahead. The progress of electricity supply will depend upon industrial developments, the introduction of electric traction on the railways, upon the briskness of trade and upon other national and local factors. However, we know the Commissioners to be prudent and progressive, and no doubt each case will be judged on its local merits, and perhaps detailed information will not be expected on all the points.

Outdoor Generating Stations.

Time was when it was considered right and proper to house the generating plant of an electricity undertaking in a building which had some claim to architectural distinction. In this way not only was attention called to the fact that something new and strange had arrived in the town's midst, but the architect was enabled to display in bricks and mortar his ideas of the neo-Victorian or the futuro-Byzantine styles. That time has passed, and to-day we are all for utilitarianism, especially in America where for some time sub-station equipment of all kinds has on many systems been placed in the open with practically no protection from the weather. This arrangement for reducing building costs has now been extended to the generating plant, and as Mr. H. W. Buck describes in an article which we publish on another page of this issue, the new hydro-electric station at Muscle Shoals, Alabamba, which is eventually to contain fifteen 20,000-kw. hydro-electric units, is to be a generating station without a building.

Poetic Licence.

One reason for adopting this revolutionary design seems to be that the only way of cutting down the cost of a hydro-electric scheme is to reduce the interest charges by reducing the capital expenditure, and this policy is further simplified in the case of such a scheme by the fact that the machines can with only slight modifications in design be made practically weather proof. To say, however, that the arrangement described is a generating station without a building is to use something like poetic licence. In the first place a structure has to be erected over all the sets to carry the crane, while the crane itself is protected by movable panels that can be arranged to enclose any set over which it is operating, so that a part at least of the plant can at any time be housed in a covering of steel and corrugated iron, very much like many which we are already employing in this country. The switch-gear is also contained in a special house, while workshops, &c., are accommodated in the usual way, not so much for reasons of protection, but because walls are necessary to the efficient operation of the machines.

Possible False Economy.

Indeed, we feel that so far as this country is concerned the question is more of academical than practical interest. In the first place the arrangement is obviously more applicable to hydro-electric plant than to steam plant, and in the second place the climate is likely to impose a very definite result on any such experiments that may be conducted in this country. For in spite of Mr. H. W. Buck's airy dismissal of the difficulties that are likely to occur with an outdoor steam operated station, we feel certain that the increased maintenance costs arising from such matters as frost, damp, cold and heat and the nuisance due to breakdowns from these causes will do more than offset any possible saving in capital expenditure. At the same time there is every advantage to be gained by simplifying the structures of generating stations as much as possible, and by remembering that the first object of such a building is to house the plant and not to act as an addition to the architectural amenities of the neighbourhood. In these days of money tightness, however, perhaps this warning is not needed.

The Scientific Worker and His Methods

The address given by Dr. W. D. Coolidge before the Röntgen Society last week was interesting, not merely in the main theme (which very naturally was concerned with the construction and properties of the well-known Coolidge tube), but equally in the introductory remarks, which were of a more general character. Two points in particular impressed us. The first was the great importance which the lecturer attached to pure, as distinct from applied, science, and his admiration for the purely scientific work that has been done in this country. Such sentiments are the more valued when expressed by a man like Dr. Coolidge, who is eminent in the applications of science, and who comes from a land where such practical applications are so highly prized. Yet there is no question that purely theoretical work, carried on for its own sake, is the whole basis of the future more practical, and apparently more useful, work. The Coolidge tube itself would not have come into existence but for the work of Richardson and others on thermionic emission. It seems that in the United States the more purely physical work does not attract the younger men as it should, and Dr. Coolidge caused some amusement by asking how it was that this old country of ours had maintained such a fine record. Was it, he asked, due to the climate? The other point of interest mentioned by the lecturer was the two general methods followed by practical physicists at the laboratories of the General Electric Company (U.S.A.). There appear to be two types of such men. One of these will not tackle a problem without forming some theory, which he then proceeds to prove or disprove as the result of investigation. The other type of man tries everything he can think of as being possibly useful, and then, if still unsuccessful, he tries anything that remains. In the experience of Dr. Coolidge, both types seem to be successful. Actually, we do not doubt that it is very useful to have both types of men. Every physicist must have come across many cases of experimental work where expedients which have proved successful would never have been tried had reliance been placed on theory. This is due to the simple fact that our theories are so often too limited, even if not defective.

The Tramway Situation.

The lot of the present-day tramway manager is not a happy one. Faced with frequent demands for increased wages and with steadily advancing prices of materials for repairs and track reconstruction, he has been compelled to resort to increases of fares in order to balance his accounts. In some cases these increases have amounted to as much as 100 per cent. of the pre-war figures. Just as in taxation, there is a limit in tramway charges beyond which it is useless to go, and there are indications that this limit has been passed in some undertakings, though, unfortunately, there is no guarantee that finality has been reached in demands for advances in wages or in the upward movement of other items in the working costs. In many provincial towns the minimum fare is now 1½d., and in some cases it is 2d. The effect has been a great reduction in the number of passengers carried, and though there has been an increased gross revenue in some cases this has not been as high as was anticipated. People prefer to walk or to patronise rival motor omnibus or char-á-banc services rather than pay the higher fares. For instance, at Portsmouth there was a reduction of 1,500,000 passengers in eight weeks after the abolition of penny fares. At Glasgow, which possesses the cheapest and probably the best tramway service in the United Kingdom, the disappearance of the halfpenny stages has caused a weekly drop of over 1,100,000 passengers, but the net result is a substantial increase of revenue.

The Cult of the Penny Fare.

However, at Lancaster, where fares were advanced 50 per cent., there was only an increase of £91 in gross receipts for the past year. Even on the London County Council tramways an advance of about 100 per cent. in fares has only produced an increase of about 33 per cent. in revenue. The Metropolitan

Electric Tramways recently did away with the penny stages and substituted three-halfpenny fares, but the result was so unsatisfactory that the company had to revert to the former practice. At Wrexham the competition of motor cars and private omnibuses is so serious that the local tramway company offered to guarantee the Corporation an additional sum of £500 a year for electric current if they would stop the competition. From these and other instances which have come before us we think that the penny fare is so popular that it was a mistake to abolish it. The better way is for the stages to be reduced in length to correspond with the actual costs of working, but a penny stage should be retained on every undertaking. In London it would be advisable to restore some of the former transfer facilities and other steps taken to encourage the use of the tramcars. Indeed, the whole system of transport facilities in the Metropolitan area badly wants reorganisation by the cutting out of competitive services and by co-ordinating the working of tramcars, omnibuses and railways.

Floor Space Tariffs.

In the discussion on the Paper which Mr. J. W. Beauchamp read recently before the Incorporated Municipal Electrical Association, Major H. Richardson objected to some criticisms we made on a system of charging for electrical energy which he has recently adopted at Dundee. This system, it will be remembered, takes the floor space of the rooms occupied as the basis of the fixed charge, and, though we are interested to hear from him that it is developing satisfactorily, we reiterate that to use the size of a consumer's room for such a purpose is to employ greater expediency than science in tariff framing. Nevertheless, experience shows that this rate is both equitable and popular not only in this country but in Canada, where the Hydro-Electric Power Commission of Ontario has had a similar arrangement in use for some time. In the area of this undertaking all electrical energy used for domestic purposes is charged for at a monthly rate per 100 sq. ft. of floor area, plus a consumption rate up to 3 kw.-hr. per month for each 100 sq. ft. of floor area charged, and then presumably at quite a small flat rate for each further unit consumed. An interesting point about this tariff is that the consumer has no choice but to take it, ordinary flat rate charges and other variations being entirely omitted from the Commission's scheme of things. This must be a great assistance to the station engineer, but it would not please the consumer in this country.

The Future Domestic Electric Load.

There seems no reason to suppose that this system works less well than the one in Dundee, but the real drawback to it and to a number of other similar systems is its disregard of lines of ultimate development of the domestic electric load. We are all looking forward to the time when the use of electric heating and cooking apparatus in houses of every class will, to put it mildly, be very much greater than it is at present. And most station engineers are doing something to encourage this tendency by the offer of tariffs which have at least a suspicion of attractiveness in them. But in so doing they may cause themselves unexpected trouble. For in the majority of these more or less fancy rates the fixed charge is derived from experience with a lighting load only and may require considerable modification as "other uses" develop if the very trouble which it is intended to avoid is not to be accentuated. The "two-rate" system is one of the few now in use to which this does not apply, and if certain small difficulties which now beset it can be overcome it seems to offer the greatest advantages from most points of view.

Sheffield's Electric Supply Charges.

Another long debate on electricity supply charges has been indulged in by the Sheffield Corporation, and although nothing definite was decided upon at last week's meeting, beyond the appointment of a special committee to consider the question in all its bearings, there is evidence that the members are likely to modify their recent decision to charge a uniform flat rate for lighting and power. On the present occasion the Council had the benefit of a long report from Mr. S. E. Fedden, the general manager of the electric supply department, which clearly showed that it is far more costly to supply the lighting than the power demand, and that, therefore, it is the invariable practice, both in this country and abroad, to charge more for lighting than for power. In Sheffield only one-fifth of the total supply is used for lighting, and if it were not for the rapidly growing increase in the power and heating load the charge for lighting would have to be higher than it is. Of the 8,820 lighting consumers, 2,862 are charged 2d. a unit or under, and the average annual consumption of the remainder, who are charged at the maximum rate of 4d. a unit, is only 600 units. In other words, six-sevenths of the total estimated losses due to the proposed reduction in the lighting charges would apply to lighting consumers of one class. As the new committee has power to call in outside technical advice, the result of their deliberations will no doubt be an authoritative statement on the methods of charging for power, heating and lighting. We await the result of their investigations with interest, but we are confident that the result will be to support the original recommendation of the Electric Supply Committee.

The Design of Heating Apparatus.

About the time when the red flag ceased to be an essential part of the equipment of the mechanically-propelled vehicle travelling on the roadway, the pleasure motor car made its first shy appearance. In general design it resembled a carriage from which the horse had disappeared, taking the shafts with him. But in due course the new vehicle found itself, and, ceasing to be a horseless carriage, became a motor car. Now, from this study in evolution, electrical engineers would do well to draw a lesson, which may be conveniently stated thus: That, when a new method of doing a thing is invented, the apparatus by which that method is made applicable to general use must also be new, and not merely a modification of old apparatus. The temptation to follow the line of least resistance is strong, but it must be resisted if there is to be any new development. Such a warning is, we fear, particularly necessary to designers of electric heating apparatus, for in too many cases the temptation which we mention above has not been resisted. Electric fires are designed to imitate the cheerfulness of the coal fire, with its flickering lights, or to copy the gas stove in some details, which, while necessary in it, are an excrescence in the electric heater. This is a woeful mistake, for what we want is an electric stove and we shall certainly never get one if all the efforts of our designers are concentrated on producing poor imitations of coal fires and gas stoves. It must also be realised that the public should be educated and not pandered to.

Edinburgh Tramways.

Our readers will recall the story of the American lady who, having exhausted the usual sights of Edinburgh, was finally shown the cable tramway system, and remarked it was "the cutest thing she had seen." If, however, Mr. Pilcher is to have his way it would seem that that story will soon be told no more, for he would doom the cable system though he has not yet decided whether it would be better to replace it by electric trams or by motor buses. An argument in favour of the former suggestion is that equipment now used on the cable system and valued at some £800,000 could be used to some extent with electric trams (perhaps it is intended to install the conduit method of working), but on the other hand it is pointed out that tramways are not doing well at the moment, and this may result in a decision being given in favour of the motor bus. Whatever system is adopted, however, we agree with Mr. Pilcher that it is time what is known as the "Pilrig muddle" came to an end. This muddle, like many another, has arisen from the opposition of the adjacent communities of Edinburgh and Leith to any form of through running. This is a form of parochialism which it is very hard to justify, and while we sympathise with smaller towns in their desire to retain their individual entities it must be realised that in such matters as electricity supply and inter-communication the parish boundary must not be allowed to become an obstacle to a development which is for the good of the public generally. We are, therefore, glad for this reason to see that Mr. Pilcher insists that at least a part of the existing Edinburgh tramways should be electrified in order that a physical connection with the already existing system at Leith may be made. This, however, is a question which is likely to crop up again in the future, and the Ministry of Transport might well consider the establishment of Joint Authorities analogous to those which are coming into being in the electricity supply industry to deal with matters of this kind.

The Public and the Telephones.

"The Times" has been devoting a large amount of its valuable space to more than usually odious comparisons of the telephone systems of this country and of the United States, and has come to the conclusion that the much-needed improvement in the working of the British telephones can best be obtained by the adoption of "a root and branch" policy which will remove them from Post Office control, and place them under "a sort of telephonic equivalent of the Ministry of Munitions." To adapt Malvolio's statement, we think nobly of the idea and in no way approve the opinion.

The Wrong Remedy.

For while it is probably true, as "The Times" points out, that the daily average of telephone calls in the United States is 30,000,000, of which 1,239,000 are long-distance calls, that the telephone company has a capital of £200,000,000 and a revenue of £24,000,000, that in the last 20 years the capital expenditure on plant has been £213,000,000—that, in short, the telephone is five times more highly developed in proportion to the population in the United States than it is in this country, and that, therefore, we must take our telephone system in hand and discover some way in which its present shortcomings may be improved, we do not think the whole blame for this lack of development should be laid at the doors of the Post Office, nor do we think that the position would be improved by the creation of a sort of Ministry of Telephones, even if it is controlled by business men. In fact, we are not a little surprised to find our contemporary advocating such an arrangement, especially at the present time.

If, however, the question be examined dispassionately, it will be found that the comparisons which "The Times" has made are not altogether just. We admit that even before the war the telephone system in this country was not developing so fast as it was in America, and this fact is not disguised by talking in percentages, as Mr. Pike Pease was doing a short time ago; but, considering that for many years previous to 1914 it had been handicapped by the slowing down of effort on the part of the National Telephone Company as the time for handing over to the Post Office approached, and by the disorganisation which this handing over naturally brought with it, the development was not unsatisfactory, and would probably have improved but for the war.

The War and the Telephone System.

It is no exaggeration to say that the war wrecked the commercial telephone system of this country. Not only was material devoted to military uses for five years in a way which was not necessary in the United States, but men were drafted into the Army in a way that was also not done on the other side of the Atlantic. Notwithstanding this, a large amount of new work was carried out for both administrative and defence purposes, and it is only fair to add that this work appears in no public statistical tables.

On the other hand, it is very much to be doubted whether the telephone system in the United States is being administered and operated at quite that high pitch of efficiency which our contemporary would have us believe. An examination of both the lay and technical American Press shows us that even the much-vaunted Bell system has its weak points, while a statement recently made by a prominent American visiting this country was that telephone communication in New York was beneath contempt. The reason seems to be a disagreement between the company and the operators over wages, but the fact remains.

The Public's Power.

But, having admitted so much, we may add that we are not thick-and-thin supporters of the Post Office authorities in their relations to the telephone system. We think that both actual and prospective subscribers might be handled in a more businesslike way, that up-to-date commercial methods might be employed in developing new business, and that more capital might be expended in increasing the all too small facilities available. We hold out little hope of this being done, even if "The Times" Ministry of Telephones comes into being, unless the public realise that they are the owners of the telephones, and insist that they shall be managed in an efficient manner.

For, after all, it is the public who are really primarily to blame for the lack of telephonic development in this country. When, after many years of intrigue and negotiations, the time came in January, 1912, for the Post Office to assume the administration of the telephone system, there were many electrical engineers, a few public men and a few journals (among whom The Electrician must be numbered) who pointed out the inevitable results of this transfer; but, curiously enough, "the great organs of public opinion" were either silent or in favour of the step. Had they, on the other hand, roused the public, as they are well able to do on much less important occasions, to realise the drawbacks which must necessarily be the result of the handing over of such an important service as the telephones to a Government department, the transfer would never have taken place, and our contemporary would probably now be inveighing against the shortcomings of the privately-owned telephone company or companies.

The Public's Duty.

But the time has now come when our telephone system must be improved. And whether that improvement is carried out under the Post Office or under a new authority is unimportant. For ourselves, we prefer the old arrangement, of which at least we know the limitations, to some grandiose conception which will be no different except in the greater facility with which it will spend public money. The Post Office has great resources at its command, its engineers are second to none in technical ability, and improvements in telephone working, as we shall shortly hope to show, are going on satisfactorily. On the business side it is admittedly bad, but then its business is managed by civil servants from whom little can be expected. We very much doubt whether this would be greatly altered by the inauguration of a Ministry of Telephones, unless public opinion insists definitely, and in a non-political spirit, that the necessary improvements are made to give the country the efficient telephone system it needs. This could equally well be done under Post Office ownership.

U.S.A. Water Power Legislation.

In all industrial countries great attention is now being paid to the development of water-power owing to the increasing cost and difficulty in obtaining adequate supplies of coal. In France, Spain, Scandinavia, Italy, as well as in Germany and Austria, Government departments and private corporations are busily engaged in collecting data and preparing schemes for the erection of hydro-electric works. Even in the United States, where considerable progress has been made in the utilisation of water-power for generating electricity, it has been found necessary to pass legislation which will facilitate the rate of development.

For about eight years there have been complaints in America that money could not be attracted to the hydro-electric industry until suitable legislation was passed to ensure a fair return on the capital invested; but there was considerable opposition to any such legislation owing to the fear of the creation of a water-power trust, and to the jealousy of certain States. The lessons of the war and the advancing price of coal have, however, induced Congress to pass a Water-Power Bill, and, seeing that legislation relating to water-power in the United Kingdom may shortly be expected, an examination of the United States proposals will not be unprofitable.

Federal Power Commission.

The first proposal is that a Federal Power Commission (consisting of the Secretaries of War, Agriculture and the Interior) should be created for the purpose of making investigations and collecting data concerning the utilisation of the water-power resources of any region to be developed, the water-power industry and its relation to other industries, and to inter-State or foreign commerce, and concerning the location, capacity, development costs and relation to markets of power sites, whether the power from Government dams can be advantageously used for public purposes, what is the fair value of such power, &c. The Commission is empowered to appoint an executive secretary at an annual salary of $5,000, and the President of the U.S.A. is to appoint an officer from the Engineers Corps to serve as an engineering officer. Compared with our Electricity Commission, this staff is very small, and to us it appears inadequate for the extensive work to be done.

Licences to Develop.

The Commission is empowered to issue licences for a period not exceeding 50 years to citizens of the United States, or to any association of citizens, to any corporation organised under the laws of the United States, or any state thereof, or to any state or municipality for constructing, operating and maintaining dams, water conduits, reservoirs, power-houses, transmission lines, or other works necessary or convenient for the development and improvement of navigation, and for the transmission and utilisation of power across, along, from or in any of the navigable waters of the United States. Preliminary permits, not exceeding three years, may be issued to enable applicants for licences to obtain the technical data (maps, specifications, &c.), required by the Commission before granting licences.

Preference to States, etc.

In the issue of preliminary permits or licences, the Commission must give preference to applications by States and municipalities, provided the projected plans are equally well adapted, or are capable of being adapted, to conserve and utilise in the public interest the navigation and water resources of the region. The Commission may, in its judgment, also reserve the development of any water power project to the Federal Government.

Conditions of Licences.

No voluntary transfer of a licence, or of the rights thereunder, is permitted without the written consent of the Commission, and applicants must comply with the laws of the State or States as to the appropriation, diversion and use of water for power purposes. The project must be, in the judgment of the Commission, the best adapted to a comprehensive scheme of improvement and utilisation of water-power development for the purposes of navigation and other public uses. After 20 years of operation the licencees must, after a reasonable rate of return upon the actual amount invested, establish and maintain amortisation reserves. Provision is made for paying an annual sum to the Commission for administration purposes and for the use of land, &c. There is also a curious provision as to the expropriation to the Government of *excessive profits* until the respective States shall make provision for preventing excessive profits, or for the expropriation thereof to themselves. Clauses of the Act relate to the construction of dams, locks and other works for the extension of navigation on rivers, for the building of storage reservoirs, for equalising power production, preventing floods and for irrigation purposes, &c. Licencees must commence construction work within two years, and upon the expiration of the term of licence the Federal Government may, by giving two years' notice, take over and operate any hydro-electric works upon payment of the net sum invested by the licencee not exceeding the fair value of the property, plus reasonable damages for severance. Where a project is not taken over by the Government, a licence may be renewed. In case of war the Government reserve the right to take possession of and operate any licenced project, and there are also reservations as to regulations to be made by States in regard to rates and charges for services.

Development and Restrictions.

According to the "Electrical World," which prints the new Federal Power Act in full, the removal of restrictions will mean that developments representing a total of more than 2,000,000 h.p. will now be proceeded with, and the navigation of several rivers will be improved. As an illustration of the strictly practical, utilitarian manner in which Americans view the question, it is calculated that the labour of one man is released for other uses every time 50 hydro-electric horse power is developed, and every 150 h.p. releases one freight car from haulage. We hope it will not be long before similar developments take place in this country.

On the Energy in the Magnetic Circuit of a Magneto.*

By N. W. McLACHLAN, D.Sc.(Eng.), M.I.E.E.

INTRODUCTION.

This analysis of the energy obtainable from the primary circuit of a magneto† is merely an introduction to the subject, and is not to be regarded as approaching finality. The treatment is very approximate, but may serve as a guide to a more exact exposition. In dealing with a magnetic circuit, especially one which is very complex, it often happens that the mathematical work yields results which do not agree closely with those obtained by experiment. This is, of course, due to the assumptions which are necessary to make the mathematical work at all possible. For example, if the calculated value of the apparent permeability of 0·25 mm. iron sheet at frequencies of 10^5 ∾ per sec. is compared with that obtained by experiment, there is a difference of the order of 50 per cent. Nevertheless, one is not prepared to state that the mathematical analysis is entirely useless. In the work herein a number of assumptions regarding the permeability, loss, energy relationship and geometrical configuration of the component parts of the magnetic circuit will be made with the object of effecting simplification, and making the analysis tractable. It is highly probable that there will be considerable discrepancies between theory and practice; but in reading the Paper the above remarks must be kept in view.

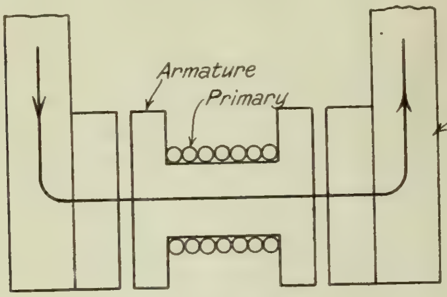

FIG. 1.

DETAILS OF THE METHOD.

The mode of treatment to be adopted is to take an armature of the form shown in Fig. 1. In this position there is no current in the armature and the mutual inductance coefficient of magnet and armature M is a maximum, since all the flux passes through the winding. The armature is rotated through 90 deg. to the position of Fig. 2. Due to rotation in the magnetic field of the magnet, an E.M.F. is induced in the windings and this causes a current to flow. If the armature rotates without loss occurring, the current will be independent of the speed of rotation, and its value will be such that the flow through the armature is the same in the positions of Figs. 1 and 2. This follows immediately from Maxwell's equations. In the position of Fig. 2 there is a certain amount of energy associated with the magnetic circuit external to the magnet, which has been derived from rotation. This energy is available for doing work (neglecting loss), and is utilised or is transformed into another form when the primary circuit is opened and the current dies away to zero. When this occurs there is a change in the magnetic conditions such that the magnetic energy associated with the system is equal to that for the conditions shown in Fig. 3. Thus the available energy is the difference in the energies of the systems shown in Figs. 2 and 3. This is not the available energy at either advance or retard break, since the armature is not then in the position shown in Fig. 3. We are not concerned, however, so much with the actual value of the energy at either advance or retard break, as with the relationship between energy and the hysteresis quadrant of the magnet. If with a magnet of given dimensions and quality there is a certain armature diameter or air gap for which the energy in the position of Fig. 2 is a maximum, then it follows from the assumptions given below, that the energy in any other position will also be a maximum.

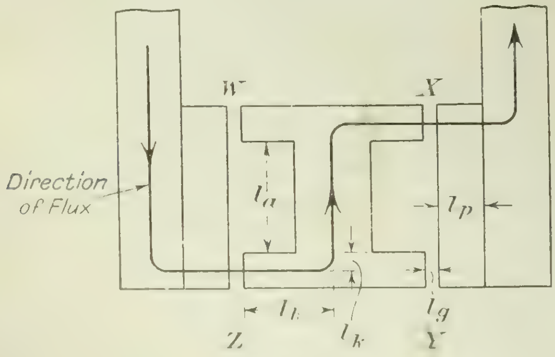

FIG. 2.

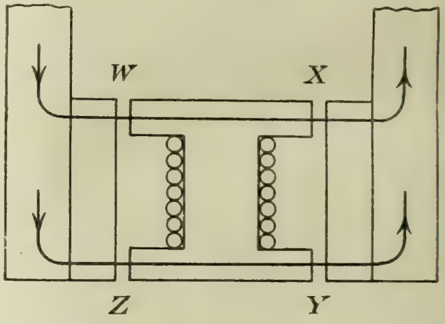

FIG. 3.

Flux in central portion of armature = 0. Flux at W, X = flux at Z, Y = ½ magnet flux, neglecting leakage.

When a piece of iron is subjected to a magnetising force H giving rise to a flux density B, the expression usually employed for the energy available on removal of the magnetising force is

$$W = \frac{BH}{8\pi} = \frac{B^2}{8\pi\mu}.$$

Sir J. Larmor and the late Lord Rayleigh have shown that this procedure is not strictly correct. This is discussed in Appendix I., from which it will be seen that another term should be included in the energy expression. In the present analysis the energy obtainable from the iron per unit volume will be taken as $QB^2/8\pi$, where Q is some constant which can only be found by experiment.

The problem resolves itself into finding mathematical expressions for the energy available, in terms of the known (and unknown, *i.e.*, Q) properties of the magnetic material of the armature, pole shoes, air gap and magnet. From these it is possible by using numerical values, to construct curves showing the variation of energy with magnet flux, armature diameter, length of air gap and the quality of the iron external to the magnet.

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* This Paper was received by the Editor on February 23, 1920.

† The Paper deals solely with the magnetic energy associated with the primary circuit. Neither the means employed to transfer the primary energy into electrostatic energy in the secondary, nor the method of utilising this energy are incorporated in the analysis.

Hypotheses.

The assumptions on which the analysis is based are stated below:—(*a*) There is no loss whatsoever in either iron or copper. (*b*) The permeability of the iron of pole shoes and armature is constant. (*c*) The geometrical configuration of the cross section of the magneto is that illustrated in Figs. 1, 2 and 3. (*d*) The reluctance of the circuit external to the magnet is the same for the positions of Figs. 1, 2 and 3, and all intermediate positions. (*e*) The flux density and the total flux at W, X is equal to that at Y, Z in Fig. 3. (*f*) The energy obtained from the iron per unit volume when the flux density diminishes from B_1 to B_2 is $Q(B_1^2-B_2^2)/8\pi$. (*g*) The primary condenser and the secondary winding have no influence on the primary current prior to the break. (*h*) Apart from armature reaction, the flux from the magnet is constant for all armature positions. There is, of course, in practice a variation due to reluctance and armature reaction.* (*j*) The flux density in the portion of the magnet external to the pole shoes is constant.

Energy Available in Magnetic Circuit due to Rotation of Armature from $M = M_{\max}$ through 90 deg.

The case to be considered first is one in which there is no armature reaction. The conditions when $M = M$ max. are shown in Fig. 1, and those when the armature has been rotated through 90 deg., the circuit having been interrupted so that the current and the flux in the armature are zero, are shown in Fig. 3. The lengths and cross-sectional areas of the component parts of the magnetic circuit are different, but the analysis can be simplified considerably by taking the "equivalent length" of each part. Assuming constant permeability of the iron external to the magnet, the equivalent length of any part is that length which has the same reluctance as the actual length, when the flux density and cross-sectional area are the same as those of the magnet. Thus, "equivalent length"

$$=\text{Actual length}\times\frac{\text{Cross-Sectional Area of Magnet}}{\text{Cross-Sectional Area of Component}}\times 1/\sigma$$

$$=l\times\frac{A_m}{A}\times\frac{1}{\sigma},\text{ where }\sigma\text{ is the leakage factor.}$$

In dealing with the leakage factor, it must be borne in mind that the leakage flux changes when the primary current is broken, and therefore contributes to the available energy. It might be advisable in the present analysis to assume $\sigma=1$, since $\sigma>1$ means a loss of energy, unless the flux is associated with some other part of the circuit. No allowance is made for the latter in Figs. 1, 2, 3. In this manner it is possible to treat the whole magnetic circuit as having a uniform cross section and one in which the flux density is constant.

In the position of Fig. 2, prior to the current being broken, the energy in the iron at X and Z *for unit area of cross section* of the magnet

$$=\frac{QB^2_m}{8\pi}\times\text{Sum of equivalent lengths of component ferric parts of magnetic circuit} \quad . \quad . \quad . \quad (1)$$

$$\text{Equivalent length of pole shoe } L_p=l_p\,.\,\frac{A_m}{A}\,.\,\frac{1}{\sigma_p},$$

$$\text{Equivalent length of armature horn } L_h=l_h\,.\,\frac{A_m}{A_h}\,.\,\frac{1}{\sigma_h},$$

with similar expressions for the other components. The axial lengths of the components will be taken as constant.

Substituting in equation (1), we have energy in iron at X and Z per unit area of cross-section of magnet (Fig. 2)

$$=2QB^2_m(L_p+L_h+L_k)/8\pi. \quad . \quad . \quad . \quad (2)$$

Energy in iron of central portion of armature per unit area (Fig. 2)

$$=QB^2_mL_a/8\pi. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Energy in iron at W and $Y=0$.

Energy in air gaps at X, Z per unit area

$$\frac{2B^2_mL_g}{8\pi}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Adding (2), (3) and (4), we obtain

Total energy in magnetic circuit per unit area (Fig. 2)

$$W=\frac{B^2_m}{8\pi}[2Q(L_p+L_h+L_k)+QL_a+2L_g]. \quad (5)$$

If it is assumed that increase in l_a, the central portion of the armature on which the primary is wound, is accompanied by a proportionate increase in l_p, l_h and l_k, the I shaped armature of Fig. 2 will always be geometrically similar. Now an increase in l_p is accompanied by a proportionate increase in the area of cross-section of the flux through the pole: similarly for l_h, l_u and l_k. Thus the equivalent lengths of these components are constant. This is only true when the permeability of the iron is unvarying. In practice with small cross-sectional areas and high flux densities, the equivalent lengths of the component parts of an armature of small diameter would be much greater than those of a geometrically similar armature of large diameter, owing to the increased permeability of the iron in the latter case, resulting from reduced flux density. Since the length of the air gap is assumed constant, the equivalent length of the gap decreases with increase in area. In fact we have *within limits* $L_g=M/l_a$, where M is a constant.

Thus equation (5) becomes

$$W=\frac{B^2_m}{8\pi}[D+2M/l_a]. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where D and M are constants.

Equation (6) will only hold when the dimensions are such that u is sensibly constant, and assumption (*e*) is applicable. This eliminates diameters which are comparatively very small or very large. Moreover, for practical purposes, it is simpler to keep the areas and lengths of all the component parts constant, excepting the length of the central portion of the armature and the armature horn which can be increased. In this case $L_h=M_1L_a$, and L_g, L_k, L_p are constant. Thus equation (5) becomes

$$W=\frac{B^2_m}{8\pi}[Q(2M_1+1)L_a+E]. \quad . \quad . \quad . \quad . \quad . \quad (7)$$

where $\quad E=2[Q(L_p+L_k)+L_g]$.

After break the available energy has disappeared, *i.e.*, has been transformed, and the condition of the circuit is that represented in Fig. 3.

Energy in iron at W, X, Y, Z per unit area of cross-section of magnet (Fig. 3)

$$=\frac{4Q}{8\pi}\left(\frac{B_m}{2}\right)^2[L_p+L_h]$$

$$=\frac{QB^2_m}{8\pi}[L_p+M_1L_a] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

when the latter condition specified above is taken.

Energy in air gaps at W, X, Y, Z (Fig. 3)

$$=4\left(\frac{B_m}{2}\right)^2.\,L_g/8\pi$$

$$=B^2_mL_g/8\pi. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Total energy in magnetic circuit external to magnet per unit area after break (Fig. 3)

$$=\frac{B^2_m}{8\pi}[(QL_p+L_g)+QM_1L_a]$$

$$=\frac{B^2_m}{8\pi}[F+QM_1L_a] \quad . \quad . \quad . \quad . \quad . \quad (10)$$

where F is constant.

If the former assumption respecting equivalent lengths being constant is taken, (10) becomes

$$\frac{B^2_m}{8\pi}\left(G+\frac{M}{l_a}\right). \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

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* See "Criteria for Testing of Magnets," by J. D. Morgan, The Electrician, Jan. 2, 1920.

Energy per unit area available for external work in absence of loss

= Difference between (6) and (11)

or ,, ,, (7) ,, (10)

$$= \frac{B^2{}_m}{8\pi}[D - G + M/l_a] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

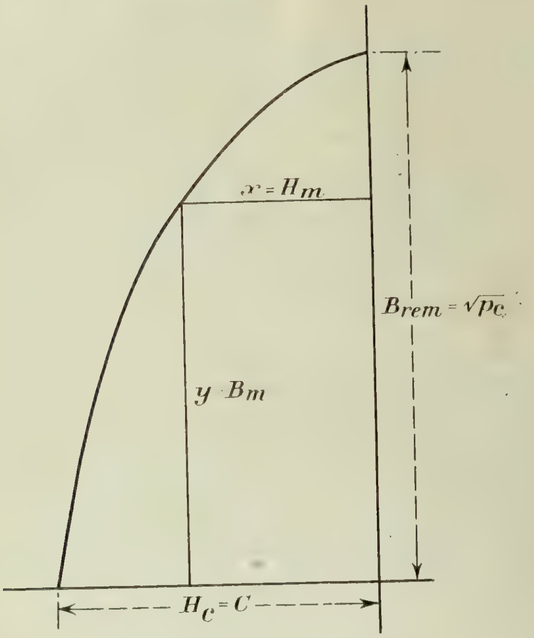
(equivalent lengths of ferric components are constant and the air gap variable)

or

$$= \frac{B^2{}_m}{8\pi}[Q(M_1+1)L_a + (E - F)] \quad . \quad . \quad . \quad (13)$$

(armature horn and central portion variable)

We have now to find L_a or l_a in terms of H_m and B_m on the hysteresis quadrant, and also in terms of L_p, L_h, &c. From assumption (*d*), the reluctance is constant for all armature positions. Neglecting armature reaction, the required relationship can be ascertained from the well-known equation of the magnetic circuit. The configuration adopted will be that shown in Fig. 3. Taking first the case in which the equivalent lengths are constant, we have the following relationship :—



Equation to curve is $y^2 = p(c - x)$.

FIG. 4.

$$4\pi \text{ ampere turns} = \frac{(B_m/2)}{\mu}.[2(\mu L_g + L_p + L_h)],$$

$$= \frac{B_m}{\mu}(\mu L_g + L_p + L_h)$$

$$\therefore \qquad H_m l_m = \frac{B_m}{\mu}(\mu L_g + L_p + L_h), \quad . \quad . \quad . \quad (13a)^*$$

or

$$\frac{H_m}{B_m}.l_m.\mu = (\mu L_g + L_p + L_h)$$

$$= \frac{\mu M}{l_a} + D_1, \quad \text{where } D_1 = L_p + L_h$$

$$\therefore \qquad \frac{M}{l_a} = L_g = \frac{H_m}{B_m}.l_m - \frac{D_1}{\mu} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

Substituting the value of M/l_a from (14) in (12), we get

$$\text{Available energy} = \frac{B^2{}_m}{8\pi}\left[(D - G) + \frac{H_m}{B_m}.l_m - \frac{D_1}{\mu}\right]$$

$$= \frac{B^2{}_m}{8\pi}\left[F_1 + \frac{H_m}{B_m}l_m\right], \quad . \quad . \quad . \quad (15)$$

where F_1 is a constant $= D - (G + D_1/\mu)$.

---

* l_m = mean length of magnet taken to middle of outside of pole shoes.

Putting $B_m = y$ and $H_m = x$ (assume x positive for convenience) equation (15) becomes

$$W = a(by^2 + xy), \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

where $a = \frac{l_m}{8\pi}$, and $b = \frac{F_1}{l_m}$.

If we assume the hysteresis quadrant to be parabolic then its equation is

$$y^2 = p(c - x),$$

or

$$x = c - y^2/p, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

where $B_{rem.} = \sqrt{pc}$ and $C = H_c$ (see Fig. 4).

Substituting for x from (17) in (16), we obtain

$$W = a(by^2 + cy - y^3/p). \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

Differentiating (18) we have

$$\frac{dw}{dy} = -a/p[3y^2 - 2bpy - cp]. \quad . \quad . \quad . \quad (18a)$$

For a maximum we have $3y^2 - 2bpy - cp = 0$. This equation has two real roots, since $4b^2p^2 + 3cp$ is positive. One root is positive and the other is negative. The positive value is that for which the available energy is a maximum. This is obtained by varying the magnet flux B_m, and since we assumed that the equivalent lengths of the ferric parts were constant, the maximum can only be obtained by varying the length of the air gap.

Thus in a magneto when (*a*) there is no armature reaction, (*b*) the equivalent or the actual lengths of the ferric components of the circuit external to the magnet are constant, (*c*) the length of the magnet and its cross-sectional area are fixed, (*d*) the axial lengths of all the components are constant; there is a certain length of air gap for which the available energy is a maximum.

(*To be concluded.*)

The Electric Locomotive as a Contractor.

Our attention has been called to an interesting extension of the uses to which the electric locomotive is now being put by Messrs. British Electric Vehicles, Ltd. The illustration published herewith shows one of their locomotives employed by the Bradford Corporation in conjunction with the construction of the new main sewer in that city. The loco is shown bringing out a train of filled trucks, and we understand it is used both for removing "dirt" and for carrying the bricks and cement necessary in the constructional work. The general features of the British Electric Vehicles electric industrial trucks are too well known to require reiteration in these columns, but this forms an interesting development in materials handling in which it is obvious electrically-driven vehicles should play an important part.

THE ELECTRIC LOCOMOTIVE AS A CONTRACTOR.

The Outdoor Generating Station.*

By H. W. BUCK.

The installation of electrical apparatus in the open air without the protection of a housing structure is of increasing importance, due to the constantly increasing cost of building. In recent years transformer switches, lightning arresters, 'bus bars and other sub-station apparatus have been thus forced out of doors. Little progress has, however, been made on the outdoor installation of rotating electrical machinery, for such apparatus has been regarded as more or less perishable. The question has been under discussion for a number of years, but prejudice has worked against it. That a power house must have a "house" in order to be a workable combination has become a habit of mind in engineering design.

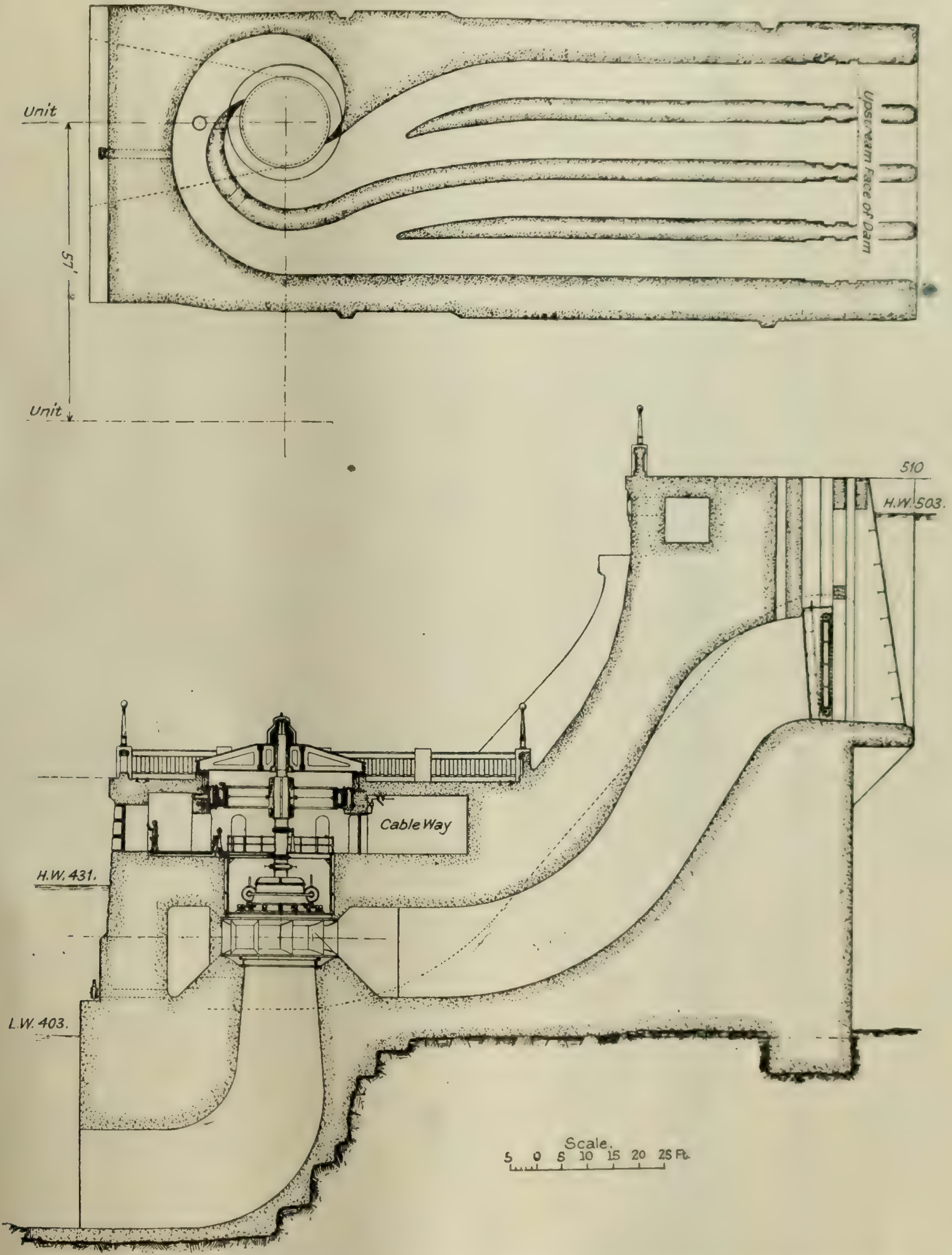


FIG. 1.—CROSS-SECTION OF A GENERATING UNIT IN THE OUTDOOR STATION PROPOSED FOR THE MUSCLE SHOALS DEVELOPMENT IN ALABAMA.

The time has now come to analyse the situation and to determine whether there is justification for the large investment required in the construction of the modern and expensive power-house superstructure. In the steam-driven generating plant the annual cost of power is largely a matter of operating expense and thermo-dynamic efficiency. In this respect there is still hope for improved economy and lower generating cost. In the hydro-electric plant, however, there is little to be expected in the way of lower operating expense. The large item of annual cost of power from the water-power plant is the interest charge, and this can only be reduced by reducing the capital cost of construction. The most hopeful field for saving in this part of the account lies in simplifying the power-house construction, particularly by eliminating the costly superstructure now universally built to house the hydro-electric generators.

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* From the "General Electric Review."

The modern vertical shaft internal revolving field generator is essentially a waterproof structure. The vital parts of the machine are all on the inside protected by a massive casing of cast-iron, and the openings in the upper spider are usually plated with steel for purposes of ventilation, so that the top is naturally protected. With slight modifications in its design, the standard vertical shaft alternator can be made absolutely proof against all stresses of weather. The water-wheels themselves naturally need no housing, since they are imbedded in the concrete substructure of the power house, and are designed to run in water.

Thrust bearings are housed in heavy steel or iron casing, and need little protection from weather. The various auxiliaries, including governors, connected with an hydro-electric plant can easily and advantageously be installed under the main generator floor, in the various compartments naturally existing in the substructure of such a plant. It is therefore interesting to inquire why millions of dollars are expended to house machinery which really does not need housing at all.

Figs. 1 and 2 show a general design of the Muscle Shoals Development, prepared for the War Department by Viele, Blackwell & Buck in August, 1918. The design comprises the outdoor installation of 15 20,000-kw. generating units. The situation at Muscle Shoals is very favourable for such an outdoor generating station. The climate in Alabama is mild, and the number of generating units in the plant is large, which gives a maximum of saving from eliminating the superstructure. It was proposed to install within the generating structure itself only the water turbines, generators, exciters, governors and the various pumps. The switchboard panels were to be located in a relatively small "pilot house" on the bluff overlooking the generating structure, which would also contain the low-voltage oil switches and 'bus bars. All the transformers and high-tension equipment would be installed in the open, adjacent to the pilot house. In this arrangement, the switchboard operators would be housed and the generator attendants also protected in the substructure. The plant auxiliaries would also be housed. All the vital parts of the alternators could be inspected from below the machines. Only the occasional inspection of thrust bearings would have to be made in the open. In this connection it should be remembered that sailors are not housed in the work which they are obliged to do, and there is no reason why some of the operators of a power plant should not perform some of their duties in the open air.

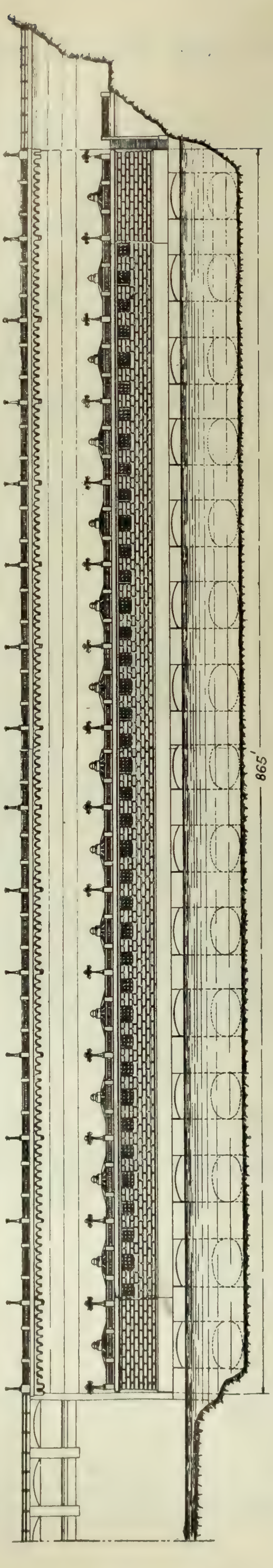

Fig. 2.—General Design of the Outdoor Generating Station proposed for the Muscle Shoals Development.

In order to perform, under protection from the weather, the work of installation and repair on the generating units of this outdoor Muscle Shoals plant, it was planned to install a housed-in travelling gantry crane of sufficient length to cover a single unit, which would travel on rails the total length of the generator structure. In this way it would be available for any one of the units. The crane could be placed over any desired unit, and, with the various openings in the ends and sides of the gantry closed with adjustable panels, the unit could be completely protected from the weather for handling and repair work.

In the case of this Muscle Shoals plan, the saving in construction cost by omitting the superstructure was very large. Approximately 3,000 tons of steel for superstructure columns and roof trusses would be saved, and after paying for the "pilot house" and gantry crane the net saving would amount to over $700,000.

It will be noted from the cross-section of the plant (Fig. 1) that the generator assembly is of a somewhat novel type. The usual iron frame of the stationary armature is omitted, and the armature laminations and coils are attached to the surrounding concrete. The only function of the armature frame of a standard generator is to provide general stability, and this can be provided by the surrounding concrete, which must be there in any case for supporting the weight of the machine. By this arrangement approximately 70,000 lb. of iron per generator can be saved in the plan shown. It is also possible by this design to save a large amount of boring mill work on the armature frame at the factory, which is apt to be the limiting element in production in most machine shops.

It may be argued that an outdoor generating station, which would be successful in the mild climate of Alabama, would not be practicable in an installation where severe winters are experienced. There does not appear, however, to be much weight in this argument. An outdoor generator can be made snow-proof as well as rain-proof. The operator would be normally housed, in any case, in the pilot house or between decks in the substructure, and would be required to go on deck at occasional intervals only.

In cold climates it would probably be necessary to make some special provision against freezing, where water-cooled bearings are used, and it might be necessary to use a specially light oil in the upper bearings in cold weather on an outdoor machine.

The saving in the construction cost of a power house superstructure is not the only saving resulting from the outdoor construction. The annual maintenance of such a building is a considerable item, which would be entirely eliminated.

The advantage in cost of eliminating the power house superstructure will increase, of course, in proportion to the number of generating units in the plant. In a single unit plant, for instance, it might be a fact that a housed crane for handling the unit would prove almost as expensive as an enclosed fixed superstructure; but, with, say three or more units installed, there should be no doubt of a large saving in cost of plant construction. In such plants as Muscle Shoals, Keokuk, Cedars and Niagara Falls, where there are large numbers of units installed, the possible saving is very large.

Whether the outdoor plan can be applied to steam turbine driven plants must be decided by future development. Some complications might be encountered from freezing in idle steam pipes, valves, water pipes, &c. It does not appear impossible, however, to install turbo-generator units, and also the boilers, &c., in the open, if special protection can be worked out for certain parts of the equipment. Such an installation would afford an opportunity for a very large saving in the construction cost of such plants.

An Alternative for Outdoor Generators.*

By H. G. REIST.

One of the methods of saving expense in the construction of power plant installations is in the omission of the power-house, utilising outdoor generators in the same manner as transformers and switches are used in outdoor sub-stations. We should, however, not deceive ourselves and assume that power stations are built wholly to protect the generators. They also generally contain transformers, switchboards, 'bus-bars, switches, exciters, repair shops, offices and other conveniences. Since we have learned to put many of these things out of doors, especially transformers and high potential switches and 'bus-bars, which take a good deal of room, no doubt power-houses can be built very much smaller along the lines of present construction. These buildings will still need to have considerable height to give head-room for erecting and dismantling the generating unit, and for the travelling crane. The walls must also be heavy to carry the load put on the crane.

Outdoor generators have been proposed frequently, and I believe a few machines have been installed in this way. An article on the subject by Mr. H. W. Buck, recently published, in which the advantage of such construction is clearly pointed out. That both sides may be presented I wish to call attention to a few of the difficulties encountered in such construction. We have always assumed and believed it to be desirable to keep the windings of electric machines dry. It is difficult to maintain this condition and get proper ventilation in a generator exposed to the weather, without special construction and additional expense. If the generator is allowed to become cold when not in use there is likely to be condensation of moisture on coils under certain atmospheric conditions. To prevent this, many pieces of electric apparatus are provided with special heaters of some sort to keep the machine warm when it is idle.

In case machines are exposed in very cold weather there is danger of difficulty from the oil becoming too thick. This danger would apply especially to self-oiling thrust bearings placed at the top of the machines, since these might heat at starting before the oil became sufficiently thin to circulate freely.

Automatic stations, which operate without an attendant, should be inspected from time to time by a patrol. In case of very cold or disagreeable weather it is probable that such inspection would be superficial.

On synchronous machines placed out of doors the installation of exciter units presents difficulties. In small machines exciters are frequently belted, and on larger machines they are either direct connected or driven by motors. Whatever arrangement is used considerable inconvenience will be caused by lack of a protecting roof. In some installations these parts, together with the governing mechanism, can be placed in chambers in the masonry below the generator floor; but in other cases, due to danger from high water, this could not be done, and with small low head machines such masonry construction would add considerably to the expense.

I would suggest that instead of building special weather-proof out-of-door generators, standard generators be used, and that simple inexpensive semi-portable shelters be erected over them. In the case of several machines in one installation it will be desirable to have a low house extending over the line of machines, with a gantry crane bridging the house—the house, or at least its roof, to be made in sections which can be moved on a track parallel with the line of generators to telescope with the roof over the adjacent generator, or a unit roof over each generator may be lifted bodily from its place by means of a crane. The crane can, with advantage, be enclosed, as suggested by Mr. Buck in his article referred to. There would be sufficient heat generated to keep such a power-house comfortable, and by suitably arranging the ventilators, warm air could be passed over any generator that was not in use, thus overcoming the difficulties which might be experienced with the generators out of doors.

The simple house suggested would provide a shelter for the exciters, waterwheel governors, and the patrol on his visits, and would seem to offer all the advantages of a more expensive power-house.

It is probable that a protecting house, as described, could be constructed for little more than the extra cost of a generator exposed to the weather

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Wireless Telephone Transmitter for Seaplanes.

Marked progress in the perfection of aeroplane wireless telegraph and telephone apparatus has been made during the past two years. Light-weight transmitters having a sending range of 150 miles or more have been developed. Spark apparatus has been largely employed in aeroplane communication, but transmitters utilising the vacuum tube oscillator have the advantage of permitting either speech transmission or telegraphic signals by damped or undamped oscillations at the will of the operator. Practical wireless telephone apparatus of the vacuum tube type is illustrated by the following description of the Marconi type S.E. 1,100 set—a comparatively high-power bulb transmitter—developed by the Marconi Wireless Telegraph Company of America.

The set was designed primarily for the large flying boats, the H-16 class, of the U.S. Navy, and has enabled transmission of speech over a distance of 150 miles to be attained. The transmitter radiates at two wave-lengths, 1,600 and 600 metres. For the former wave-length a trailing wire antenna of 0·0004 mfd. is employed; for the latter, an emergency aerial of 0·00026 mfd. The transmitter is supplied with two three-electrode tubes of the pliotron type. One tube is employed as an oscillator for the production of radio-frequency currents, and the other as a modulator and amplifier of the voice currents communicated to it by the microphone.

The fundamental circuits of the set are shown in Fig. 1, the actual circuit is shown in Fig. 2, and a wiring diagram showing the function of the change-over switches in Fig. 3. An installation sketch is shown in Fig. 4.

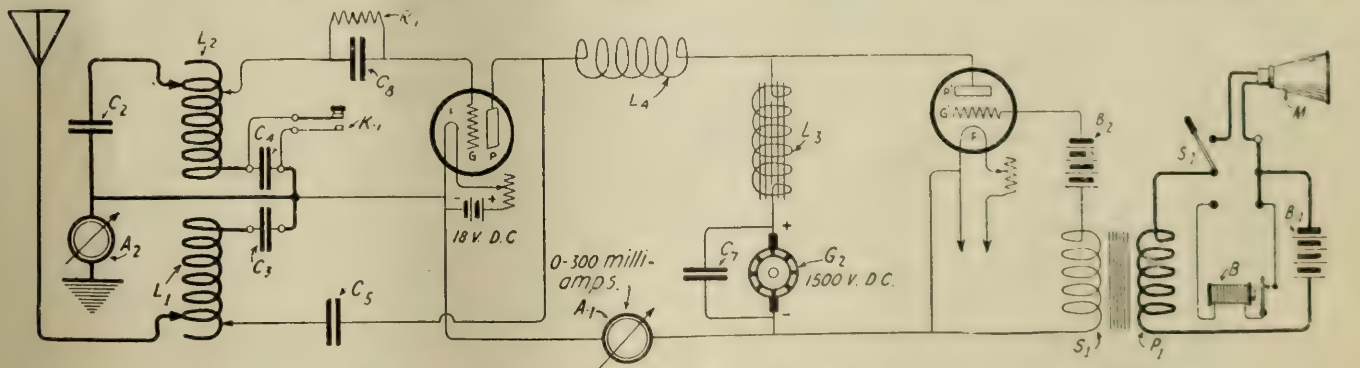

Fig. 1.—Fundamental Circuits of the Wireless Telephone Transmitter for Seaplanes.

Description of the Circuits.

In order to understand the operation of the apparatus, it should be appreciated that if the grid and plate circuits of a vacuum tube include radio-frequency circuits coupled inductively, conductively or electrostatically, alternating currents of any desired frequency may be generated. Other problems, such as rapid change of wave-length, satisfactory modulation and the elimination of disturbing capacities between circuits arise in the practical set, and are of equal importance.

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* From the "General Electric Review."

In order to set valve circuits into a state of radio-frequency oscillation the connections must be so made that the grid end of the grid inductance will be alternately negative and positive as the plate end of the plate inductance is positive and negative. When the grid and plat radio-frequency circuits are coupled with the proper phase relation, any variation of voltage in either the grid or plate circuits causes minute disturbances in the oscillation circuits, setting them into oscillation at whatever frequency they happen to be adjusted to.

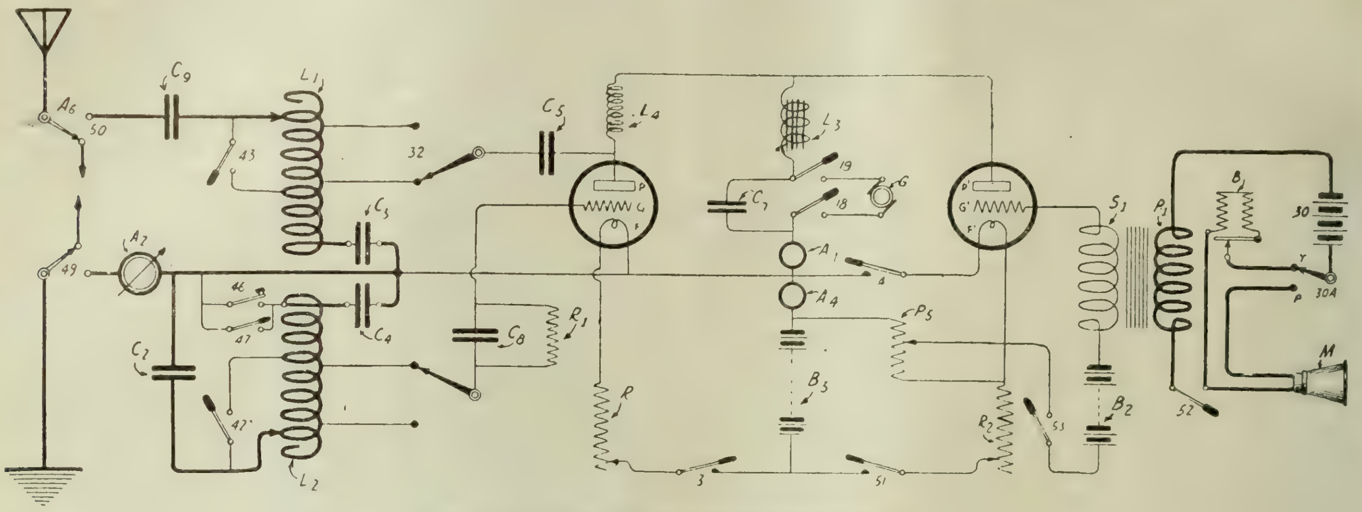


Fig. 2.—The Actual Circuit used in Practice.

For example, a slight variation of voltage in the plate circuit will cause its resonant circuit to oscillate at radio frequency, and the resultant currents will act upon the grid circuit, setting it into oscillation at the same frequency. The resulting radio-frequency fluctuations of the grid potential will also keep the plate resonance circuit in a state of oscillation. This condition will continue so long as the proper supply of voltage and filament current is maintained, but not otherwise. The tube is able to generate alternating currents because of its amplifying properties. The energy delivered to the grid circuit outlined will gradually increase in value up to the maximum output the valve is capable of delivering.

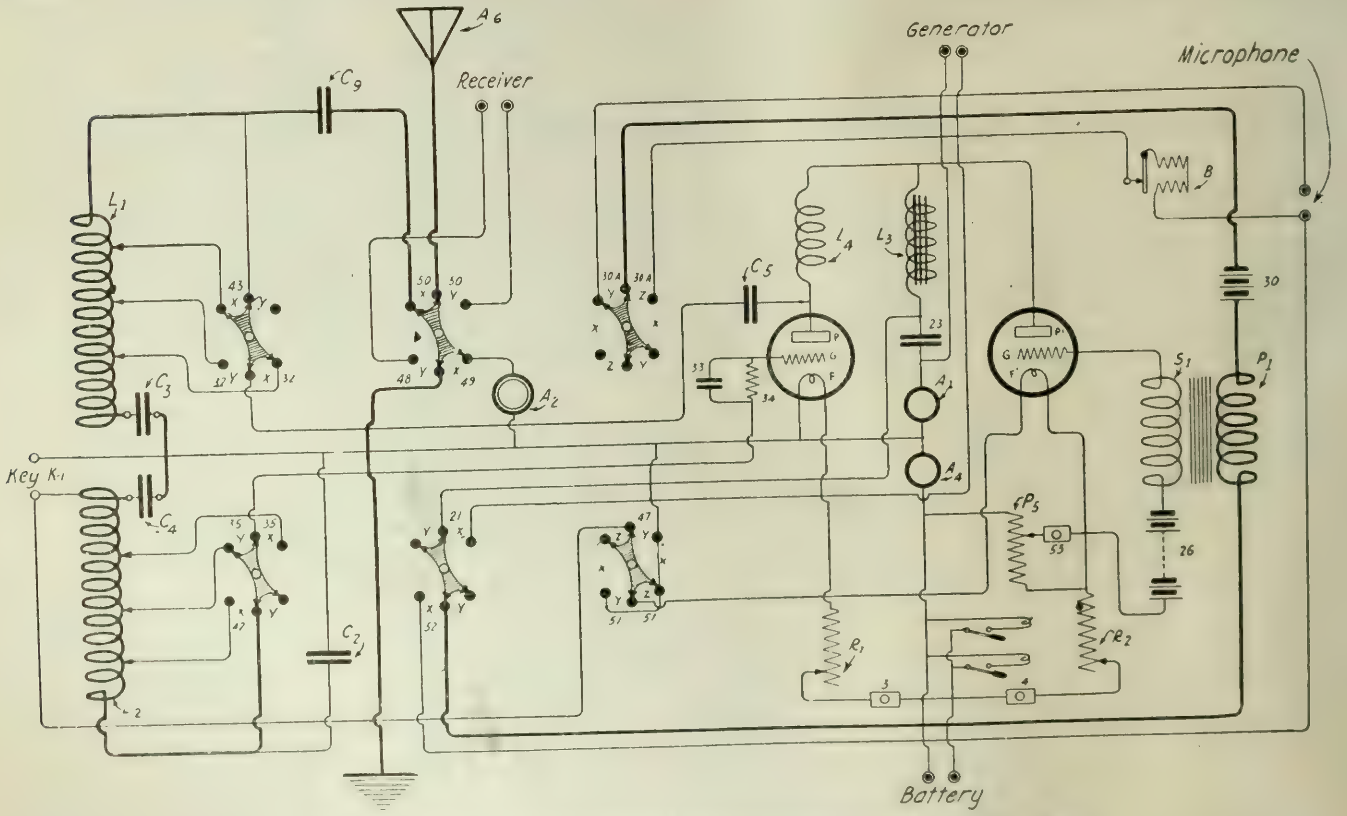


Fig. 3.—Wiring Diagram showing the Function of the Change-over Switches.

Referring to Fig. 1, the plate and grid circuits of the tube contain the coils L-1 and L-2 in inductive relation, each connected through the condensers C-3 and C-4 to the negative side of the filament. The grid oscillating circuit comprises the coil L-2, the condenser C-2 and a protective condenser C-4. The plate oscillating circuit includes the condenser C-3, a part of the coil L-1 and the series condenser C-5. The antenna and earth connections tapped off from the coil L-1 take the place of the condenser C-2 in the grid oscillating circuit. C-2 is called the balancing condenser. In series with the grid is another condenser, C-8, shunted by a leak resistance, R-1, which maintains the grid at a negative potential. The system further includes a three-electrode tube, F', G', P', which amplifies the output of the microphone circuit and modulates the output currents of the oscillating bulb. The plate circuit is fed by a 1,500-volt direct-current generator, G-2, the positive terminal of which connects to the plate P of the oscillating tube through the audio-frequency inductance or transformer L-3 and the radio-frequency inductance L-4. The negative side of the generator connects through the milli-ammeter A-1 to the negative side of the filament F. The protective condenser C-5 is generally employed in tube oscillating circuits when the source to the plate circuit is connected in shunt to the plate and to the filament. The modulating circuit shown to the right of the drawing permits either voice transmission or telegraphy by damped oscillations.

Circuits for Wireless Telephony.

For telephony, the microphone M is placed in series with the telephone induction coil P-1, S-1 and the battery B-1 by means of the switch S-1. The coil S-1 is connected to the grid and filament of the modulating tube, and includes in its circuit the battery B-2, through which the grid is held at a suitable negative potential for maximum magnification. The filament and plate of the modulating tube are shunted across the plate circuit of the oscillating tube. The audio-frequency choke L-1 acts as a transformer. The radio-frequency choke L-4 prevents the radio-frequency currents developed by the oscillator from flowing back to the plate-circuit generator G. C-7 is a protective condenser for the plate circuit generator.

When the transmitter M is spoken into, speech currents of variable frequencies generated by the microphone are impressed upon the grid circuit of the modulating tube, and, through the medium of the auto-tranformer L-3, alternating currents are superposed upon the plate circuit of the oscillator. This in turn varies the amplitude of the oscillator currents at speech frequencies, and, accordingly, the amplitude of the radio-frequency oscillations flowing in the antenna circuit. It is essential that the key K-1 of Fig. 1 be closed for the production of undamped oscillations, for when it is open the tube stops oscillating. Manipulation of this key permits telegraphic signalling by the undamped oscillations produced by the tube.

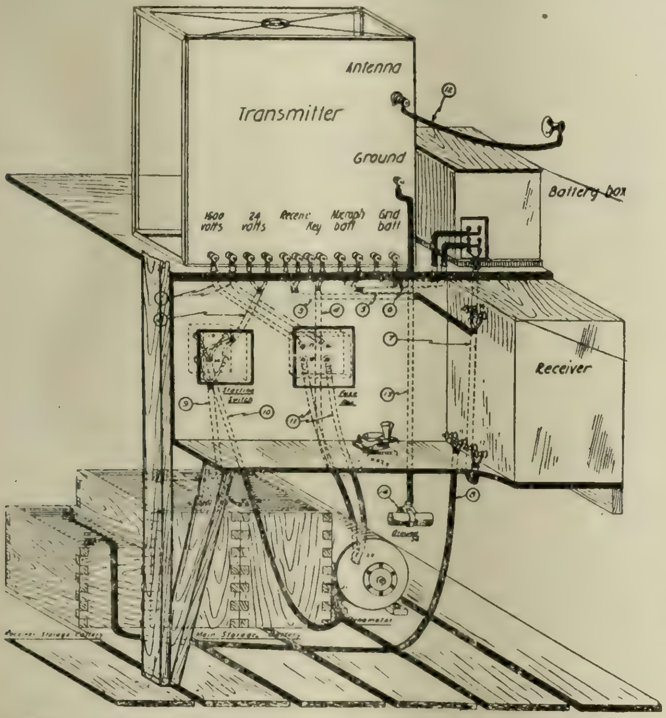


Fig. 4.—Sketch showing the Installation of the Complete Set.

Telegraphy by Damped Oscillations.

When it is desired to telegraph by damped oscillations, the change-over switch S-1 is thrown from the microphone to the buzzer B, which is energised by the battery B-1. The interrupted currents fed by the buzzer through the primary P-1 of the induction coil produce alternating currents of higher voltages in the coil S-1, which in turn are magnified by the modulating tube, the latter varying the radio-frequency currents in the oscillator tube at the frequency of the buzzer. In this way the antenna radiates *damped oscillations* in groups, the frequency of the groups varying as the number of interruptions of the buzzer.

A more detailed circuit of the Marconi aircraft set appears in Fig. 2. This diagram not only includes the fundamental connections of Fig. 1, but also the necessary switches for the three different signalling functions on the 600 and 1,600 meter wave, and a detailed wiring diagram of the filament circuits.

Details of the Filament Circuit.

The filament circuit divides at the positive terminal of the 24-volt storage battery B-3, one branch going through the rheostat R-1 to the filament F of the oscillating valve, and the other going through the rheostat R-2 to the filament F' of the modulating valve. The negative sides of the two filaments are connected together and to ground. In addition, there is provided a potentiometer P-5 connected across the battery B-3, with a tap leading to the negative potential battery B-2, and on through the secondary of the microphone transformer S-1 to the grid G'. The object of the potentiometer is to compensate for any loss of negative potential in the grid circuit G', which may be occasioned by the lowering of the voltage of the filament battery B-1.

The switches for shifting the connections from one system of signalling to the other are enclosed in drums, and are shown in Fig. 3. The inside and outside rows of jaws on each set are represented by the upper and lower group of dots in Fig. 3. In that figure the left-hand pair constitute the *wave-length changing switch*, the middle pair the *sending and receiving switch*, and the right-hand pair the *signal switch.* The first, second and third positions of each switch are indicated by the letters X, Y and Z, these letters being placed between the two points which the blades of the switch short-circuit in that position.

Regarding the action of the oscillating valve itself: When the grid is negative in respect to the filament, no current passes between the grid and filament; but, when it is positive, considerable current passes, which constitutes a loss in the circuit; but if the grid is held at a constant negative potential this energy loss is reduced, and a more effective transmitter is obtained. The grid potential may be held at a negative value by the insertion of a grid battery; but this can be done equally effectively by inserting a condenser in the grid circuit, which rectifies the grid currents and holds the grid at a negative potential. If the leak were not provided, the potential of the grid would rise to such a high negative value that all action would be stopped. A leak of proper value definitely limits the maximum negative potential of the grid and removes with the necessity for a special grid battery.

Change-Over Switches.

The numbers on the separate single-pole switches in Fig. 3 correspond with those shown in Fig. 2. The *outside row* of studs on the wave-length changing switch perform the following functions: In the 600 meter position (X at 32 in Fig. 2) the first tap on the upper section of the loading coil L-1 is connected to the plate series condenser C-5, and at 43 short-circuits the end portion of the same coil. In the 1,600 meter position, Y, it connects at 32 the second tap of the coil to the condenser, and opens the short-circuit.

The *inside row* of studs on the wave-length changing switch performs the same functions for the coil L-2, which is the lower portion of the long single coil mounted in the middle of the rear of the panel in the accompanying photograph. In Fig. 3 the blade marked 35 is shown connecting to the first tap of the lower portion of the coil in the 600 meter position, and to the second tap in the 1,600 meter position to the grid condenser C-8, with its leak resistance R-1. It was, however, found that the same tap of the coil was correct for both wave-lengths; accordingly there are but two taps on the lower portion of the coil. The first of these is coupled directly to the grid condenser C-8, and does not go through the wave-length switch. The blade marked 42 short-circuits one end of the coil L-2 in the 600 meter position and removes the short-circuit in the 1,600 meter position.

The outside portion of the switch marked "send-receive" (in the upper central position of Fig. 3) serves to connect the antenna A-6 to the transmitter in the "send" position (X) and to the receiver in the "receive" position (Y). In the "send" position the circuit of the antenna at 50 is through the series condenser C-9 to the top of the loading coil L-1 and to the ground. The latter is connected at 49 through the antenna ammeter A-2 to the main ground 'bus of the set which is the frame. The inside portion of the "send-receive" switch is idle in the receive position Y, but in the "send" position X at 21, it completes the 1,500-volt direct-current supply current to the plates P and P-1 of the pliotrons. At 52 ,it connects the primary of the microphone transformer P-1 to the microphone terminals 28 and to the buzzer B. These connections are opened in the "receive" position.

There are three positions for the signal switch. The first, X, is for *continuous wave telegraphy.* In this position the connections made in the second and third positions are opened. The second position, Y is for telephony; the inside portion of the switch (the upper part in Fig. 3) connects the microphone to the microphone battery, and at 51 the outside portion (in the lower part of Fig. 3) completes the filament circuit for the modulating valve and short-circuits the key at 47. In the third position, the switch connects at 30 A the buzzer to the microphone battery and at 51 keeps the filament of the modulating valve lighted, removing the short circuit from the key.

The position of the switches in Fig. 3 does not correspond with their location on the set. All three switches are built to stand a maximum of 10,000 volts high frequency potential, although the potentials developed in the apparatus are considerably lower.

Meters and their Functions.

Considerations of space and weight demand the fewest possible measuring instruments. A direct-current ammeter *A*-4 is connected in series with two filaments and reads the total current taken by both of them. The instruments' scale registers from zero to 10 amperes; to read the current in either filament it is merely necessary to cut out the other one. This may be done by means of two small switches marked on the set "oscillator filament" and "modulator filament."

The principal indicator for checking up the proper operating conditions of the set is the plate current drawn by each of the valves from the dynamotor, the voltage of which, as already mentioned, is 1,500 volts. This reading is obtained from the plate current ammeter *A*-1 of Fig. 2, connected in the ground leg of the supply circuit. This instrument reads from zero to 300 milliamperes and measures the total plate current taken by the oscillator and modulator. The maximum voltage developed by the dynamotor is 1,600 volts, and the vacuum tube generally will cease to operate when it falls below 1,100 volts. The generating tube will oscillate over a wide range of plate voltages if the filament current is kept below a certain critical value. The filaments of the pliotrons are designed to operate on 18 volts.

Wiring.

The entire set is wired with No. 12 B. & S. bare soft copper wire with empire cloth tubing slipped over it as insulation. No terminal lugs are used; the ends of the wires are bent in the shape of an eye which fits the stud terminal, and is passed around it in a direction that tends to make the wire grip the stud when the nut is tightened.

The wiring has been so located that small or disturbing capacities between the wires are avoided.

Structural Considerations.

Owing to the vibration of the aeroplane every possible precaution has been taken to prevent the fastenings working loose. Special steel lock washers are used throughout the set. The scheme of construction is such that the main supports and fastenings will bend before they break, wood or any material which splits or fractures, having been eliminated. The steel wire cross braces make the structure an extremely light and rigid unit.

Power Supply.

The primary source of energy is two 12-volt 50-ampere-hour batteries of the Willard lead type similar to those used in automobile starters. The filaments of the two pliotrons are operated through a rheostat directly from the 24-volt storage battery. Since the tubes require a plate E.M.F. of 1,500 volts direct current, a small dynamotor, driven by the 24-volt storage battery, is supplied. The armature has two windings in the same slots, one connected to the 24-volt commutator at one end, and the other to the 1,500-volt commutator at the opposite end. It is a two-pole machine excited from the 24-volt source. The armature, which runs on ball bearings at 5,000 revs. per min. and draws about 30 amperes on its full-load at 450 watts, weighs approximately 30 lb.

In addition to the 24 volt storage battery, three other batteries are required; two for the transmitter and one for the receiver. These three sets are known as the *microphone battery*, *grid battery* and *receiver battery*. The voltage of the first is 5; of the second 60, and of the third 40. The 60 and 40-volt sets consist of 20-volt units connected in series. They are arranged in a wooden box screwed to the operating shelf. A dilecto terminal block is supplied.

The Support of the Pliotrons.

To insure against breakage, the best position for the pliotrons is vertical with the large neck at the bottom. This brings the *plate terminal cap* at the top and the *filament and grid terminal cap* at the bottom. In each of the two dilecto rings shown at the top of the photograph, three spiral springs placed 120 deg. apart support a spring cap which fits over the plate terminal cap of the pliotrons. The mechanical period of vibration of the vacuum tubes in this spring mounting is considerably below that of any vibration that will occur in the seaplane itself. Sudden shocks in any but a horizontal direction are not transmitted through these springs with sufficient violence to injure the tubes. A small sub-panel on the main panel board is mounted immediately to the rear of the frame.

Reel Antenna and Accessories.

The antenna reel group consists of the reel mechanism, a removable drum with antenna wire and spare drums with complete antennæ on them. The wire from the reel runs through a take-off pulley and passes through the lead-in insulator in the side of the hull of the boat. It then passes through either a strut pulley or wing pulley, depending upon the type of the boat.

Fig. 4 shows the position of the receiving storage battery, the main storage battery transmitter, transmitting key, receiver and battery box. The maximum antenna current is 2·5 amperes, which answers all ordinary distance requirements.

Reviews.

The Principles of Electrical Engineering and their Application
By Gisbert Kapp. Vol. II., Application. (London: Edward Arnold.) Pp. viii.+387. 18s. net.

It is with a certain amount of hesitation that the present writer undertakes to review this work of Prof. Kapp. His great appreciation of Prof. Kapp's earlier work, of his sincerity in encouraging obscure beginners, of his generous hospitality, of his hatred of what is usually understood as Prussianism, would seem to make impartiality impossible and criticism unkind.

The first volume dealt with "Principles"; it was reviewed in The Electrician in 1916 (Vol. LXXVIII., p 187). Probably we should not be far wrong if we described volume II. as a work on "Electrical Technology," a subject on which Prof. Kapp may be considered especially well qualified to speak. The reviewer must therefore bear in mind that he has not before him an exhaustive treatise on the various topics discussed. Even so, it is a matter for regret that the superficial treatment of certain subjects is not compensated for by ample references. Again, too great economy in footlines to the figures necessitates a rather laborious wading through the text.

The book contains 15 chapters, six of which deal with continuous-current machines, three with alternators, one with converters, two with transformers; the last three deal with induction motors, alternating-current commutators motors, and phase advancers.

Our first criticism is directed against Prof. Kapp's discussion of series-parallel windings; we find no mention of the great objection raised by many makers to these windings, nor of the reasons for these objections and the remedies proposed. To illustrate the utility of these windings, a 16-pole machine is given with a 6-circuit winding—*i.e.*, $p/a \doteq 8/3$—a fraction. Now, whilst it would be going too far to say that such a machine could not be made to work, we can safely state that few manufacturers with experience of these windings would risk building this machine. A four or an eight-circuit winding would be chosen, and care would be taken to have such number of slots and such number of conductors per slot as would make the winding perfectly symmetrical. Though we cannot ask of the author that he should enter the province of design proper, we can expect that his examples be sound in principle. When discussing equi-potential connectors, Prof. Kapp rightly emphasises the rectifying effect of equalising currents which has been demonstrated by Lulofs and by Hawkins; he does not, however, make it clear that the effect is not dependent on the existence of equalising rings—if we remember rightly, the only equalisers considered by the writers just mentioned were formed by the brushes and the brush-leads.

In a long section on unbalanced magnetic attraction, the effect of saturation is considered. There is also a brief section on the critical speed in turbo-dynamos, but we doubt whether many draughtsmen would view with satisfaction the author's treatment for practical cases. The output co-efficient is dealt with in a very practical manner and its scientific basis is clearly shown; we are glad to find the average magnetic induction reckoned over the whole armature surface. The figures given for the electric loading, 200-250 ampere-conductors per centimetre, are too low, since values twice as great would be reached in limiting cases. The section on temperature rise is good, as might be expected from this author; two points call for comment: (1) In the statement "1 cubic metre of air weighs about 1 kg.," the word "about" implies a wide margin; (2) when speaking of the Rules of the British Engineering Standards Association it is incorrect to say that "the temperature of the field coils is always to be taken by resistance," for Rule 68 defines the conditions under which a thermometer may be used for this purpose.

An interesting account is given of commutation; we should have preferred to see references to other writers besides Lamme (the reference to Lamme's Paper is, by the way, wrongly quoted). Resistance, fringe and interpole commutation are clearly explained; in our opinion, the author might have stated more definitely that brush shifting is seldom tolerated in 1920 A.D. Fig. 22, suitably touched up, would make a good lantern slide. At the end of the paragraph on reactance voltage, the author acknowledges his indebtedness to the G.E.C of Witton for a formula quoted by him. Possibly neither the G.E.C. nor Prof. Kapp is aware of the origin of this formula, which was taken by the present writer, when chief designer at the G.E.C., from Ossanna's article in the first edition of "Starkstromtechnik." The formula proved very useful, although for machines with commutating poles, few designers concern themselves much with the calculation of the reactance voltage. Instead of admitting the practice of providing a diverter for the interpole winding, we should have liked to see Prof. Kapp condemn it outright and insist on the necessity of designing machines correctly, in order that no alterations may be required when the testing stage is reached. The action of Prof. Walker's split brush is clearly explained, and special train and car lighting dynamos are dealt with. The chapter on the working conditions of dynamos contains much standard book-work and some very good remarks on starting as well as on coupled machines. There is also a good chapter on dynamos in conjunction with batteries and boosters.

Notwithstanding the overwhelming importance, at the present day, of alternators with cylindrical rotors, the fact remains that writers still base most of their discussions on the older salient-pole type, and Prof. Kapp forms no exception to this rule. When advocating the provision of a rectangular window in pole punchings, the author appears to have overlooked the fact that it is almost imperative to use a reamered round hole into which the steel piece is driven, so as to reduce magnetic reluctance to a minimum. The references to the methods used in the construction of non-salient pole rotors fail to convey a fair idea of modern practice in this country. Adequate attention is paid to the wave-form, and the author shows that he is quite alive to the importance of disturbance to telephonic systems. After the characteristics of single machines have been discussed, coupled alternators are considered in a chapter that well repays study.

The chapter on rotary converters contains mostly standard material, but can scarcely be regarded as sufficient in view of the great importance of these machines. The author is not correct in stating that all methods of varying the voltage on the direct-current side involve the principle of adjusting the alternating-current voltage supplied to the converter proper, because neither the split-pole nor the brush shifting device does so. The chapters on transformers are very good. We are told that transformers for different powers can be made out of the same stampings merely by varying the depth to which core and yoke are built up. Our own opinion on this point, at least as regards the core-type, was that the output was varied by altering the core length whilst retaining its square section. Insufficient emphasis is laid both here and elsewhere on the importance of suppressing eddy currents in the windings. Many designers will agree with Prof. Kapp that the manifold lengthy mathematical formulæ for the determination of the best proportions have not much practical value. On p. 264 occurs one of the very few misprints in the book—viz., e_i instead of *ei*.

It is only possible to mention the remaining chapters. After the induction motor, single and three-phase commutator motors having series characteristics are discussed, the author devotes a long chapter to phase advancing—a subject to which he has made invaluable contributions.

It has been our desire to convey to the reader of this review the impression that Prof. Kapp's book is a very sound and useful work on electrical technology; it is well written, remarkably free from errors, and no attempt has been made to exclude the discussion of difficult parts of the subject. Our own practical experience has led us to express disagreement on points of detail; at the same time, we congratulate the author on his choice of material and his treatment of it. We recommend the book heartily to our fellow-engineers.

S. P. SMITH.

Electrical Developments at Ilford.

We are so used to reading and hearing tell of the large additions to electricity supply loads caused by the establishment of munition works during the war and by the revival of trade after the war, that it comes somewhat as a shock to learn of an undertaking where the war had an almost disastrous effect. However, on reflection, it is obvious that in cases where the main load consisted of lighting, and where it was not possible for various reasons to establish a remunerative munition load this must have been so. Conditions in these areas were only made worse by the increasing costs and by the withdrawal of the majority of unskilled men either to the Army or to other work, while another factor in the sorry story was the forced reduction in both public and private lighting. One of the places which thus suffered was Ilford, where the war caused the undertaking a great set back after a very satisfactory period of development right away from the time when Mr. Arthur Shaw took charge of it in January, 1901.

RECENT EXTENSIONS.

Fortunately, however, the conditions which we have mentioned above changed after the Armistice, with the result that Ilford has been having its plant running up to capacity and no spare plant to fall back upon in case of need. To counteract this and to allow of fresh expansion permission was obtained to purchase a 2,000 kw. alternator, with transformer and switchboard, a 1,000 kw. rotary converter, and an induced draught fan plant, and contracts were placed with the following firms for the supply of this equipment: With the General Electric Company, for the turbo-alternator set, comprising a Fraser & Chalmers' G.E.C. turbine and a Siemens alternator; with Worthington-Simpson, Ltd., for condensing plant; with the Brush Electrical Engineering Company, for transformers; and with Messrs. Davidson & Company, Ltd., for a 60 in. Sirocco fan.

When these contracts were placed it was hoped that the plant would be available for dealing with last winter's load, but owing to the moulders' strike this anticipation was not fulfilled, and, as a matter of fact, the plant was only formally started last Saturday, with the exception of the induced draught fan, which was put into operation in September last.

2,000 KW. TURBO-ALTERNATOR.

The new 2,000 kw. turbo-alternator has been erected at the east end of the original engine room in the position previously occupied by the first two generators installed—namely, one 100 kw. and one 200 kw. Willans-G.E.C. sets,

It comprises a Fraser & Chalmers high-pressure impulse type turbine, direct coupled to a Siemens alternator, and has been erected on a platform beneath which is the condensing plant. The motors driving the pumps of the latter were supplied by the General Electric Company. The set is designed for a continuous output of 2,000 kw. when running at a speed of 3,000 revs. per min., with a steam pressure of 170 lb. per square inch, but has an overload capacity of 25 per cent. for two hours. The alternator generates three-phase current at a pressure of 2,000 volts. This is stepped up to 6,600 volts, by three Brush transformers adjacent to the turbine. Underneath the transformers is a dry air filter.

In connection with the condensing plant a Lea recorder is fitted on the turbine platform adjacent to the turbine. This instrument keeps a continuous record of the steam consumption of the turbine, so that the efficiency of the plant can be ascertained daily. On the wall adjoining the switchboard for the pump motors is a kinotometer, for indicating the vacuum and the efficiency of the condensing plant.

The 6,600-volt three-phase current is taken from the transformers to the e.h.t. switchboard located on a gallery in the new engine room. This switchboard is of the truck type, and consists of five totally-enclosed cubicles controlling the generator, rotary converters, &c. The two G.E.C. rotary converters are also located in this engine room, the smaller one having been in use since May, 1918, and the larger one of 1,000 kw. capacity having been supplied in connection with the new generator.

FUTURE EXTENSIONS.

In consequence of the continued increase in the demand for the supply of current, it was necessary at the end of 1919 to consider the question of future requirements, and the sanction was accordingly sought from the Electricity Commissioners for the following further extensions: One 1,000 kw. turbo-alternator with condensing plant and switch cubicles; one forced draught cooling tower; one 1,000 kw. rotary converter and switch cubicle.

A contract for the supply of the above plant has been put in hand with the General Electric Company, and it is anticipated that the whole of this plant will be completed and in commission by the end of December, 1920.

New Tramcars.

At the same time as we visited the Ilford station to see these extensions we had the opportunity of inspecting six new tramway cars which have been designed by Mr. L. C. Harvey, the tramways manager and engineer of the Ilford Tramways Department, and have been built by the Brush Electrical Engineering Company with electrical equipment by the British Thomson-Houston Company, to deal with the extra traffic which is now being met with on the Ilford tramways.

We are glad to see that this tramway system, unlike many others in the country, seems to be developing at a satisfactory rate. It was first opened in March, 1903, the traffic receipts having increased from about £22,000 in the first full year to about £62,000 last year, the net profit for the year ending March, 1919, being the record sum of £6,793.

The new cars are built to seat 64 passengers, an increase of eight seats over those available in the cars now in use. The trucks have an 8 in. wheel base, and are of Peckham pendulum type, which gives steadier riding. 35 h.p. B.T.-H. motors, air-cooled by a fan on the shaft, are employed, and drive the road wheels through gears and pinions of tool steel. Peacock's patent brakes are used, which are fitted with Thomas' spring shoe adjusters. A particularly interesting feature is the lighting, Holophane shades being used throughout, and each lamp being controlled by its own switch, while two dummy lamp-holders are provided for carrying the spare lamps. The general layout and arrangements of these cars are of the highest class, and they presented on Saturday a very tasteful and comfortable appearance.

"Pontelec" Welding Equipment.

The processes employed in present-day electric welding may be classed under three headings. One is the Lagrange and Hohos method, which is not very widely used, while the second, known as the Bernados, though it includes various forms of arc welding, has the disadvantage that it requires for its proper employment specially trained highly skilled labour. For this reason the third system which is known as the Thomson or resistance welding method is receiving the widest application. Among the pioneers of this class of work was Mr. S. Jevons, who, a good many years ago, was appointed Midland Agent for the Thomson patents, in addition to which he patented several methods of welding chains and tubes and for manufacturing switches for electric welding machines.

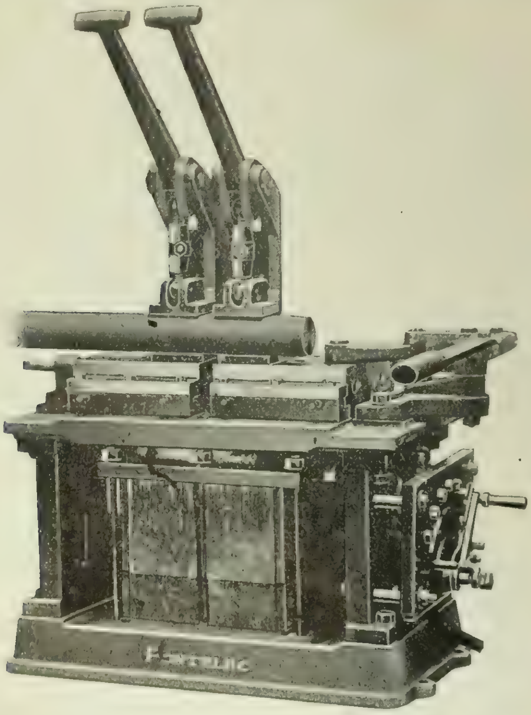


Fig. 1.—"Pontelec" Butt Welding Machine.

This pioneer business has now been taken over by Messrs. Pontelec Welding Patents, Ltd., who have introduced some interesting improvements in the designs, and are now manufacturing some exceedingly workmanlike electric welding machines, of which examples are shown in the accompanying illustrations. An interesting point about these machines is that copper is largely used in their construction, experience proving that the higher initial cost of this metal is more than justified in the greater output and higher efficiency obtained.

In carrying out welding processes by their machines this Company adopt one of three methods. The first is known as the "disc" and consists of super-imposing small pieces of suitable material at the points where welding is to be carried out, so that the current is localised at such points, and whilst under pressure the added part is forced into the body of the work. The electrodes being of large surface and water-cooled are little affected, whilst a new point is provided at each weld, and thus it is claimed more uniform results are obtained. The method can easily be adapted to special processes. For instance, rivet heads can be used with suitably formed electrodes with recesses of the desired shape and the resulting weld has a diameter equal to such head and an

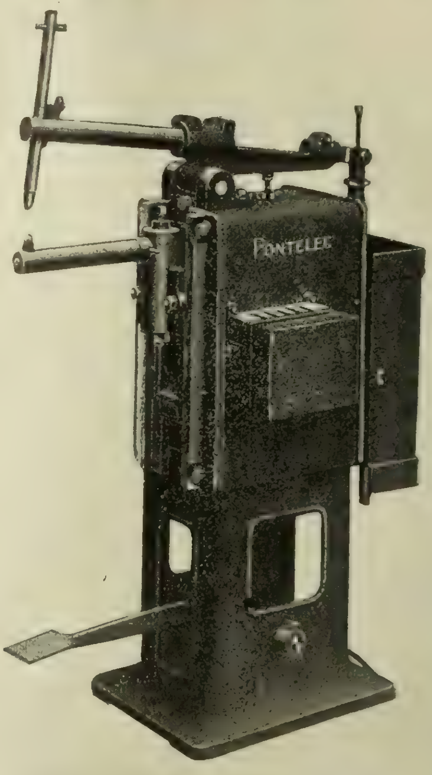


Fig. 2.—Light Spot Welding Machine.

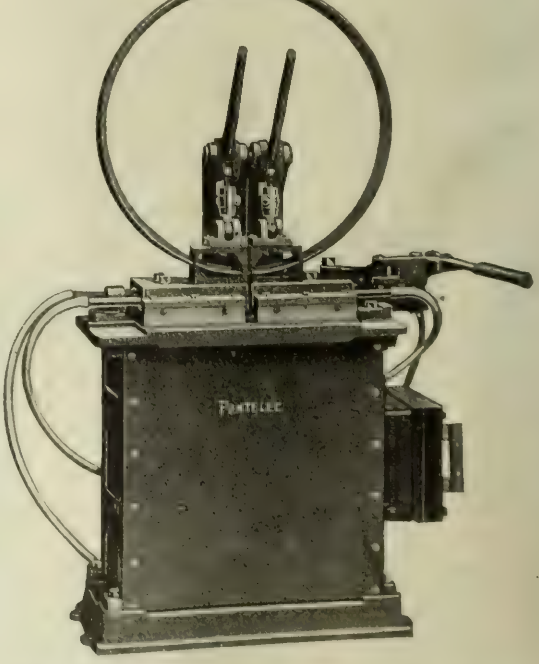


Fig. 3.—A Butt Machine for Welding Cycle Rims.

area about four times a rivet with the same size head. This process, we understand, has been particularly useful in constructional work.

The "ridge" process consists in providing narrow ridges on the material during rolling, so that on the parts being brought together the area of contact is restricted to the desired amount. These points are electrically heated and the parts are then brought together under pressure.

In the "multiple point" process a number of projections are formed in articles stamped from thin sheet metal, so that on the parts being brought together contact is confined to such points, as many as 20 being in some cases thus welded at one operation.

It should be noted that in all these processes the electrodes themselves are not brought directly in contact with the parts at maximum temperatures, whereas in ordinary spot welding the points, even when water-cooled as efficiently as possible, tend to become flattened and require constant attention. Moreover, the articles welded, on account of the plastic condition of the metal, when heated are liable to become indented and disfigured. In the Pontelec process, on the contrary, it is claimed this is entirely avoided, since with a disc of suitable thickness slight projection can be left which will leave a bright clean surface after grinding down.

Fig. 1 shows a type of butt welding machine manufactured by the company in four sizes up to 30 kw. The sliding blocks being of copper and flat on the top, any form of tool can be attached in accordance with the special work which it is desired to carry out. Fig. 2 shows a type of light spot welding machine which has been specially designed for welding hollow ware. The arms are fitted with universal movement and can, if necessary, also be provided with telescopic attachment up to 22 in. with a vertical adjustment of 18 in. This enables works as small as 2½ in. internal diameter to be taken. All the movements are controlled by a foot lever which gives the very important advantage that the operator has both hands at liberty. Fig. 3 shows a type of butt machine which has been designed for welding cycle rims. It has a capacity of 150 per hour and is made in sizes up to 30 kw.

International Telegraph Facilities.

At the instance of the Communications Section of the Supreme Economic Council, a conference has just been held of postal, telegraph, radio-telegraph and railway experts of various European countries for the purpose of improving communications. Brigadier-General H. O. Mance, C.B., C.M.G., D.S.O., chairman of the Communications Section of the Supreme Economic Council, presided over the first meeting of the conference, which was held in Paris on the 7th inst. Twenty-two countries were represented, and three sub-committees were appointed to deal with postal and railway facilities, telegraph matters and radio-telegraphic questions respectively.

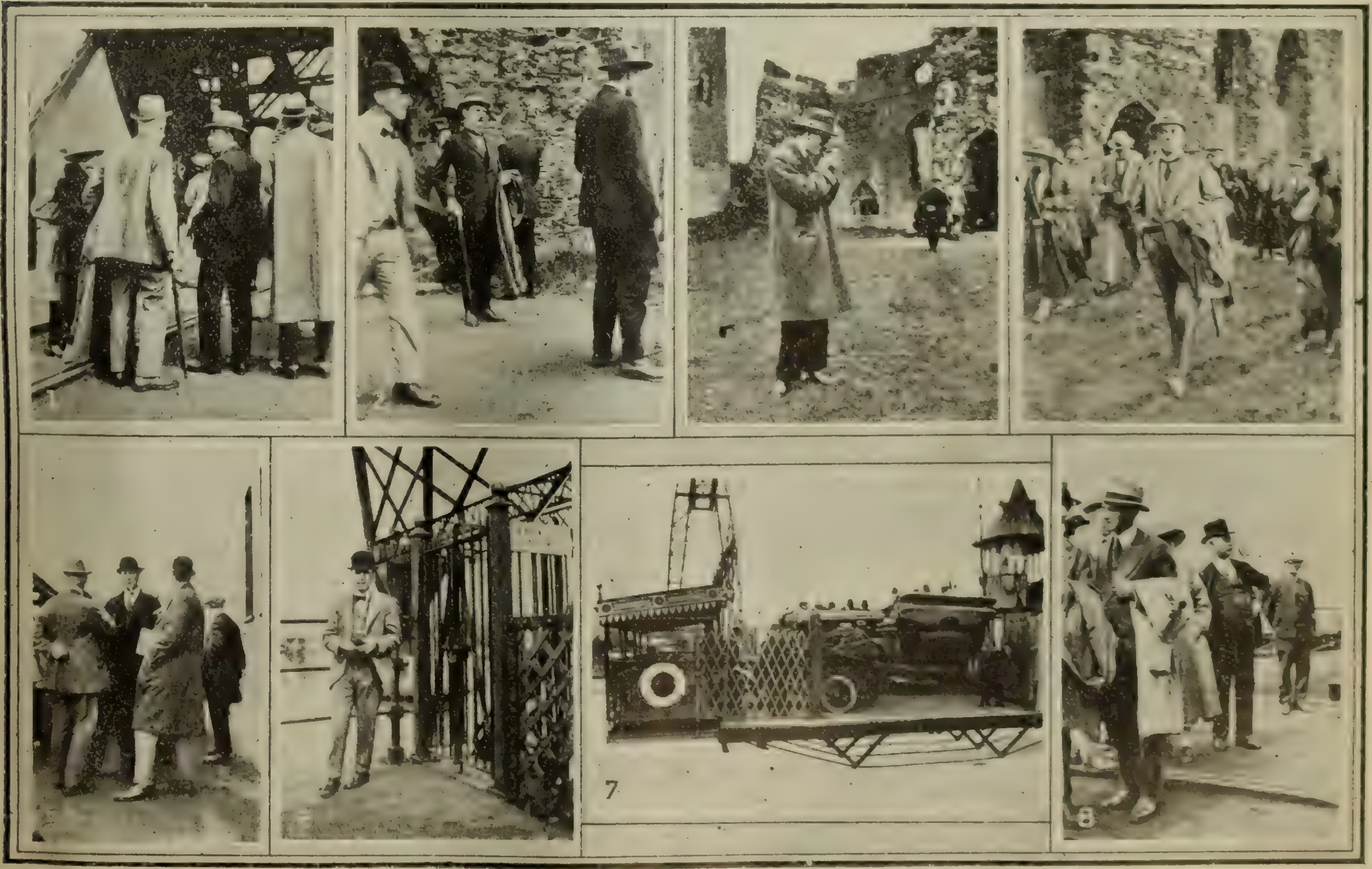
The Telegraph Sub-committee drew up a list of additional international telegraph lines required to give adequate communication with Central Europe, and agreement was reached as to the degree of urgency attaching to each of them. These arrangements should result in an improvement in the telegraph service between Western Europe and the countries of Central and South-Eastern Europe.

The Radio-telegraph Sub-committee expressed the opinion that, within the limits of Europe, radio-telegraphy should be regarded as an extension of the ordinary telegraph system, and used interchangeably with that system according to the needs of the moment and at the same rates, the senders of telegrams being given the option of declaring which system should be employed. The right was reserved to any two centres to make other arrangements in regard to wireless communication between themselves when this could be done without affecting other administrations.

At the final meeting of the conference a resolution was adopted declaring that further conferences of the kind were desirable, and asking the Organisation of Communications and Transit Department to undertake the convening of similar conferences in future.

Snapshots from the Western Centre.

It has been said that the attainment of success depends more on what a man is than what he does, and to extend the idea it may be added that what he looks like is also not an unimportant factor in his upward movement. This being so, we are glad, owing to the kindness of Mr. C. H. Wordingham, C.B.E., to be able to reproduce some snapshots which he took during the course of the recent visit of the Institution of Electrical Engineers to the Western Centre. The careless grace and unstudied poses of many of those portrayed will specially appeal to those who are not the victims of Mr. Wordingham's Kodak, and will make the victims themselves certain that there are occasions when the camera, if it does not actually leave the strict paths of truth, shows a decided wobble. As will be seen, the subjects range from those who are famous to those who are less famous (not necessarily infamous).



1. The President. 2. "Wireless." 3. "The Electrical Review." 4. Chairman of the Centre. 5. The President Elect and the Souvenir he pinched. 6. The Chief Organiser. 7. The Bridge that carried us over. 8. A genial host.

Midland Electricity Schemes.

Three of the Electricity Commissioners (Sir John Snell, Sir H. Haward and Mr. H. Booth) opened an important inquiry at Nottingham on the 21st inst. into the application of the Corporation for power to erect an electricity generating station on land adjoining Clifton Colliery, at a cost of £800,000, and into a rival application by the Derbyshire & Notts Electric Power Company to establish a generating station at Colwick.

The company's scheme was taken first, and in support Mr. Macmorran, K.C., explained that the company had power to supply electricity for the whole of Notts, and part of Derbyshire, including Derby, Chesterfield, Long Eaton, Mansfield and Nottingham, but in those boroughs they could not do so without the consent of the respective Corporations. The company had an authorised capital of £1,800,000 in £1 shares. They were already supplying electricity in Ilkeston, Heanor, Ripley, Sandiacre, Sawley, Beeston, Eastwood Chilwell, Stapleford, Kimberley, Nuttall, Cossall and Annesley, and they had laid cables and were ready to supply Belper and Heage. The units supplied in 1912 were 1,839,899, and for the current year they were estimated at 10 millions. The Colwick site was very suitable, there being good water and rail facilities. Their proposal was to provide a central supply for all purposes, and the company were in a position to supply energy in bulk to all of them, including Nottingham. They could do this on reasonable terms and within a shorter time than could be done by any of the public undertakings. They anticipated being in a position to acquire works at Spondon, which would enable them to supply a large amount of electricity in a very short time. Nottingham, however, had power to supply electricity in the city alone. Even if a district were made of the other six boroughs, the result would merely be that while they could supply to each of them they could not do so en route, and that was the most important part of the work which the company sought to carry out. The Leicestershire and Warwickshire Electric Company and the Derby & Notts Company were practically under one management, and it might be possible to link them up in such a way that there would be an enormous saving to both companies and much to the advantage of the public. He contended that the generating station which Nottingham sought to set up was entirely unnecessary, as they could supply the Corporation.

EVIDENCE FOR THE COMPANY.

Mr. A. R. Holland, chairman of the Derbyshire & Notts Company, and a director of the Leicestershire & Warwickshire Electric Power and other electrical companies, said that since 1913 the company had spent £190,500 in that area. The company had always had in view the erection of a station at Colwick and would have built it before but for the war. The Midland Coal Products Company had selected a site at Colwick, adjacent to the proposed station, mainly because they anticipated being able to dispose of their waste heat and gas to the Derbyshire & Notts Electric Power Company. The estimated revenue of the company for this year was £63,000, and there would be a surplus of £17,000.

Mr. H. L. Williams, engineer for Messrs. Balfour, Beatty & Company, estimated the cost of the company's proposed station at £840,000. They would take a maximum load of 15,000 kw. in two years. They could start on the erection of the station in three months.

Mr. J. S. Highfield said the total immediate estimated demand was 194,000 kw. in the district, while including the railway supply it was 264,000 kw. Any station built to-day on modern lines ought to be used for the supply of the district that could be economically reached. He thought the company's scheme a sound one.

In reply to the Town Clerk, Mr. Highfield said that unless Nottingham was going to supply the power company, which was the only authority that had power to distribute in the county, he did not see how the city could ever require a 240,000 kw. station. The supply of Nottingham to-day was only 12,000 kw.

Mr. Arthur Green, general manager and secretary of the Midland Coal Products Company, said his firm intended to open a large experimental station at Kirkby, and a large works at Colwick was under contemplation. The erection of the Colwick works would depend upon the construction of a power station adjoining. Nottingham was an excellent centre for bituminous material, over 5,000 tons of which would be consumed a day, and they would need an outlet for superfluous gas products.

Mr. A. R. Atkey, M.P., thought that the Corporation's scheme did not receive sufficient consideration. He had no financial interest whatever in the Derbyshire & Notts Power Company. In cross-examination he said he thought the Corporation had not given sufficiently serious attention to alternative proposals. The company possessed statutory powers for the supply of electricity over a large area and the Corporation had not taken the same steps which most business men would have taken; the whole thing was rushed through the Council.

Mr. George Balfour, M.P., said that it had for some years been the intention of the Derbyshire & Notts Company to erect a power station on the banks of the Trent, but the project had been held up by the war and subsequently delayed by Government restrictions. There was a very big field for electric development in the north-easterly area of Nottinghamshire, owing to colliery workings. He had no doubt that the difficulties as to capital would easily be overcome. During the last 10 or 11 years he had been instrumental in raising over £4,000,000 for electrical development, and during the past 12 months he had raised £1,432,000. His company had approached the Corporation and pointed out that they held powers for the supply for a large area, but the Corporation refused to enter into any negotiations.

In reply to the Town Clerk, Mr. Balfour said that on a basis of a consumption of 256,000,000 units and a 10 per cent. return on capital, the cost would work out at 0·5d. per unit. The approximate capital needed would be 2½ millions. About £400,000 would have to be raised in the first six months, and the remainder could be spread over about 27 months. The area of the company was 1,570 square miles, and that was sufficiently large to merit such a scheme being undertaken.

Replying to the Commission, Mr. Balfour said that even if the Corporation's scheme was carried out, the company would have to go on with their constructional work.

Sir JOHN SNELL: If it is clearly demonstrated that it is for the benefit of the consumers in the area that you and the Corporation should join forces, would you desire to stand aloof?

Mr. BALFOUR: If it were so demonstrated, I am sure we should not desire to do so, but it would have to be very clearly shown. He went on to say that his experience had shown that the interests of the consumer were best met by sound commercial undertakings, run on the most modern lines. He expressed the opinion that it was not advisable to erect any power station of 200,000 kw. capacity. It had been found that there was no real economy much beyond 120,000 kw. Then they had to consider the fact that they were by no means certain there would not be another war some time, and it was just as well not to have all the plant in one spot, especially when bombs were dropped.

A question arose as to whether, if the company were given permission to erect their station, a joint authority would have power, under the 1919 Act, to take it over. Considerable discussion ensued, Mr. Macmorran maintaining that no acquisition could be made compulsorily by a joint authority.

Sir John Snell pointed out that it was a legal matter, but the Commissioners did possess the power of making certain reservations when they gave their consent.

On Thursday it was stated, in reply to a question by Sir John Snell, that for a load of not less than 6,000 kw., with coal at 20s. a ton, the company's maximum price to the Corporation would be £6 plus 45d. per unit. The company would provide the high tension cable to Nottingham.

For the Corporation, Mr. John H. Rider, consulting engineer, said he had no objection to the company's site so far as obtaining coal was concerned, but he criticised the arrangements for handling the coal. The Corporation site had more direct access to the coalfields than Colwick. The design of the company's power station had not been made by people with experience in such stations.

CASE FOR THE CORPORATION.

In presenting the case for the Corporation, the Town Clerk said it was desired to borrow £868,000 to erect a modern station near Clifton Colliery. The site was a good one, and in many respects better than that of the company. He gave a history of the municipal undertaking and of the various extensions of plant made. A year or two before the war they came to the conclusion that a new station was necessary. In 1914 Sir Alex. Kennedy advised the erection of a station on the Trent, and but for the war it would have been built years ago. It was now felt that a station of the most modern design should be built which would fit in with any larger scheme when a joint electricity authority was set up.

Ald. E. Huntsman, chairman of the Nottingham Electricity Committee gave evidence of the progress of the municipal undertaking, and of the purchase of the site near Clifton Colliery. He was quite satisfied that the scheme was in the best in the interests of the city. The municipal authority could do all that the company could do, and he believed that they could do it better and with greater regard for the interests of the consumer. He admitted that there was a deficit of £8,000 on the electricity undertaking in 1919. During the past few years they had not been able to supply the demands of some important consumers.

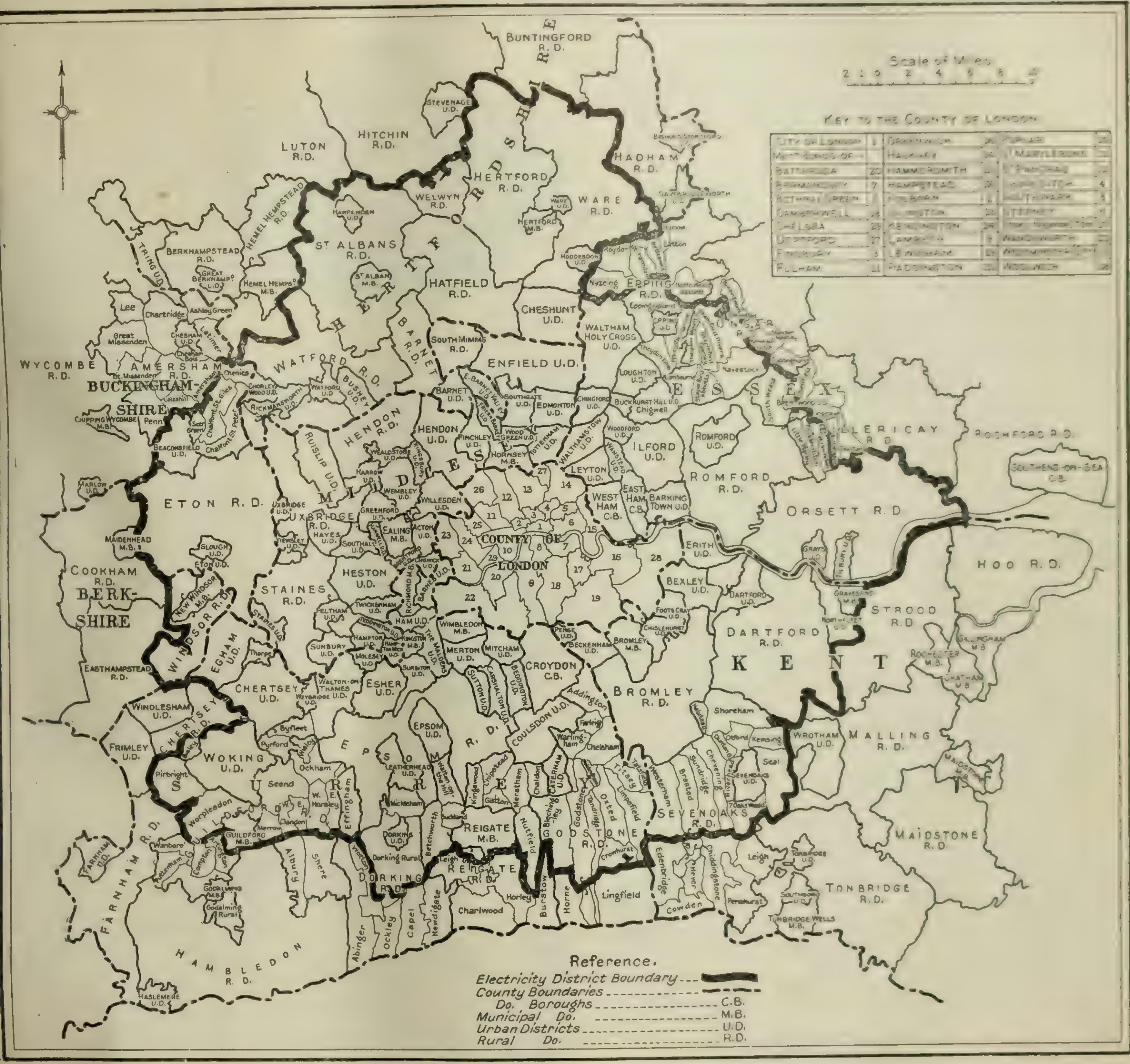
Mr. Rider also supplied details of the progress of the present undertaking. The total units sold during the first year was 62,000 and this had grown to 17 millions during the present year. The expenditure up to July, 1920, was £565,431, and further capital of £22,004 had been sanctioned. The capital debt was £257,029. The whole of the present plant was run non-condensing, except two turbines at St. Ann's Well-road, where cooling towers were used. The Corporation were unable to meet the demands upon it. Applications and promises had been made for a further load of 5,000 kw. above the present maximum demand. By the time the new station was ready there would be a demand of at least 16,000 kw. There was no room either at Talbot-street or St. Ann's Well-road for further plant. The new station ought to have been built years ago, and any new power house must be on the banks of the Trent. From information received from the colliery owners he understood that the cost of delivering coal to the Clifton site would be sixpence a ton less than to the Colwick site. If they took into consideration wagon hire and other charges the cost of coal at Clifton would be 2s. a ton less than at Colwick. The station was not a scheme for the East Midlands, but for Nottingham alone. It was so planned, however, that it could be added to, section by section, so as to be able to meet the needs of the larger area, and to make it a super-power station. What was proposed was to erect the first stage of the first section, which provided for 20,000 kw. The estimated cost of the first stage was £750,000, or £27·5 per kw. It was proposed to shut down the Talbot-street station as soon as the new station was ready and to use it as a sub-station. If consent were given work could be started on the new station in a fortnight.

Mr. Lee strongly supported the Corporation's case on behalf of the associated Corporations. He said that the scheme formed an essential part of the plans of the other Corporations.

After the Town Clerk and Mr. Macmoran had summed up their respective cases, the inquiry closed, Sir John Snell announcing that the Commissioners would give their decision later.

London Electricity District.

In our last issue we gave particulars of three additional districts, the London and Home Counties, the Mersey and W. Lancashire, and the North Wales and Chester areas, which have recently been provisionally determined by the Electricity Commissioners. In view of its importance we give a map of the London and Home Counties district, so that our readers may see at a glance the boundaries of the area included in it.



Electricity Supply Reorganisation.

The following memorandum has been prepared by the Electricity Commission for the guidance of bodies or persons desiring to submit a scheme for effecting an improvement in the organisation of the supply of electricity in a district, and indicates the heads under which proposals should (if possible) be formulated and the particulars which should be given in support thereof. The scheme should contain proposals under the following heads :—

ADMINISTRATION.

1. The modifications (if any) in the district provisionally determined by the Commissioners, described in terms of Local Government Boundaries.

2. A description of the proposed constitution of a Joint Electricity Authority : (*a*) the number of representatives on the authority, (*b*) basis of representation, (*c*) method of election, (*d*) tenure of office, (*e*) disqualification, (*f*) method of filling casual vacancies, (*g*) appointment of chairman, (*h*) proceedings at meetings and (*i*) other incidental matters.

3. The method of delegation (if any) to Committees of the authority.

4. A description of the powers to be exercised by the authority as to the generation and supply of electricity, and, in particular, the proposals in regard to : (*a*) mode of exercise of powers ; (*b*) the transfer of existing undertakings (in whole or in part) to the authority, and the terms of any such proposed transfer ; (*c*) nature of the control to be exercised over generating stations and main transmission lines not transferred to the authority ; (*d*) method of dealing with the purchase powers of Local authorities in the district ; (*e*) the nature of the relationship between the authority and authorised distributors as regards standardisation of system, methods of charge to consumers, and otherwise ; (*f*) distribution in areas within the district not forming part of the area of supply of any authorised distributors ; and (*g*) any other matter to be included in the Order to be made by the Commissioners.

TECHNICAL.

5. A general description of the system of supply to be adopted, *i.e.*, frequency, main transmission pressure, local secondary transmission pressure and a schedule of sizes of main transmission cables or lines.

6. The arrangements proposed as regards existing generating stations, indicating (*a*) those proposed to be utilised in connection with a new capital station or stations, and any proposed extensions at such stations, and (*b*) those proposed to be discarded and the arrangements under which they will be shut down.

7. Proposals for any new generating station or stations.

8. Proposals in regard to any works constructed, or to be constructed, by the Minister of Transport under sec. 18 of the Act of 1919.

9. Proposals in regard to any existing generating station used solely for (*a*) railways, or (*b*) tramways.

10. Proposals in regard to supply to railway companies for traction.

11. Proposals (if any) for the utilisation of the water power resources.

Financial.

12. A description of the financial provisions to be inserted in the Order, including powers to borrow, methods of raising money and the security on which money is to be raised, application of moneys borrowed and of revenue, and method of disposing of surplus or meeting deficiency on revenue account.

13. The nature of the financial asssitance to be given by any County Council, Local Authority or Company (if so authorised).

Statistics.

Particulars should be supplied as follows :—

(*a*) Statistics of present plant installed (including extensions authorised), maximum demand in kilowatts, output in units, and prospective demand and output five and 10 years hence respectively ; such statistics also to be shown diagrammatically.

(*b*) The potentialities of the district in regard to supply for power, traction, agriculture, domestic and general purposes.

(*c*) Tables showing present coal consumption per unit generated at each of the existing generating stations, together with the average consumption for all the stations ; also the estimated average consumption in future years, and the total tonnage estimated to be saved as a consequence of the operation of the scheme.

(*d*) A map on the scale of 1 in. to the mile, showing the generating stations proposed to be retained and those to be discarded, the approximate position of new stations contemplated, and the general direction of main transmission lines, differentiating between underground cables and overhead lines, and between those existing and those proposed ; also the approximate position of the larger sub-stations proposed.

(*e*) A general description of any new generating station or stations proposed.

(*f*) Estimates of capital expenditure, (*a*) for immediate requirements within, say, the first five years, (*b*) within the next quinquennial period, and (*c*) within such further period (if any) as may be necessary to complete the scheme.

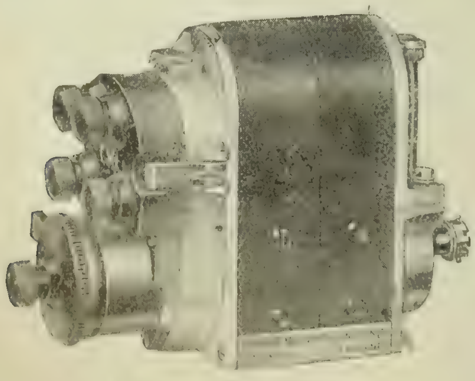
(*g*) Estimates of (*a*) revenue obtainable, (*b*) working costs under main heads, (*c*) capital charges, and (*d*) available surplus ; together with a forecast of the average charge for bulk supplies at each of the stages mentioned in the last-mentioned paragraph.

(*h*) Financial statistics with regard to existing undertakings, showing in particular the generating costs for the last completed year.

The scheme should be printed and accompanied by a list of the authorised undertakers, county councils, local authorities and others supporting the scheme. Twelve copies of the scheme and particulars should be lodged with the Secretary of the Commission.

C.M.I. Magnetos.

In a pamphlet recently issued by the General Electric Company, Ltd., details are given of the construction of the C. M. I. magnetos. These are made in both four and six cylinder types, and large numbers have been used with great success on motor cars of all sizes, on motor omnibuses and on heavy lorries. The contact breaker is of standard construction. The contacts are made of an alloy of 75 per cent. platinum and 25 per cent. iridium, this proportion having been found to be the best for long life and low contact resistance. The condensers are of mica interleaved with tin foil. Each condenser before being assembled into the armature is carefully tested on a 500-volt alternating-current circuit. The field magnets are of special composition, and retain their magnetism throughout a most arduous life. It is claimed that the manufacturing resources available enable an accumulated knowledge of permanent magnet manufacture to be utilised to the best advantage in the manufacture of the C. M. I. magneto. The ebonite and stabilite parts used are manufactured by the company after their own formulæ. All parts are extremely well finished, and are made between very fine limits, so that there is no difficulty with regard to interchangeability of parts. An elaborate system of routine inspection during manufacture and assembly is carried out.


A Typical C.M.I. Magneto.

Shop Window Lighting.

Most large towns are able to produce examples of both how shop lighting should and how it should not be done, though we are glad to say the number in the former class is increasing, although those in the latter class are still distressingly many. Put in its broadest way it does not seem to be realised that efficient lighting, and by efficient is meant lighting which does its duty properly and does not cause eye strain to the onlooker, is one of the first essentials of good salesmanship.

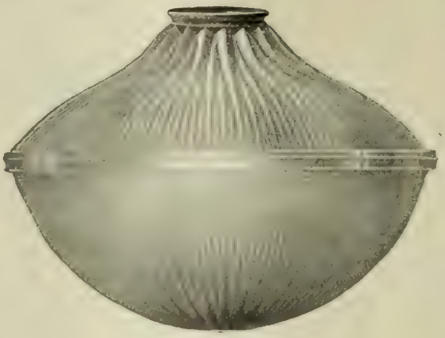


Fig. 1.

One of the many ways of providing illumination of this kind is by the use of Holophane window reflectors, an example of which is shown in Fig. 1. These reflectors it is claimed direct the light on to the goods in the most advantageous way, and by preventing waste give a more economical and better light. The comparison of the distribution obtained by the use of a bare lamp and using the same lamp in a Holophane reflector is given in Figs. 2 and 3. Fig. 2 also shows in a striking manner the amount of light wasted by using the older arrangement in an average shop window. It is, of course, obvious that in lighting such a window the light source should be so arranged as not to be visible to the onlooker, and that the window should stand out as a bright picture in a dark frame.

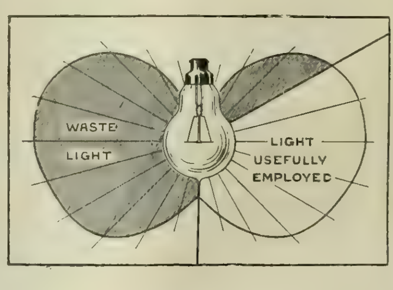


Fig. 2.

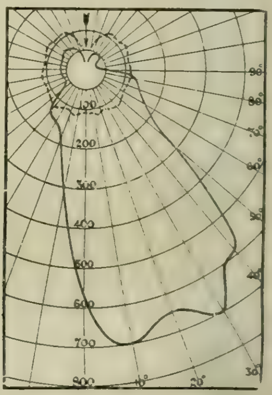
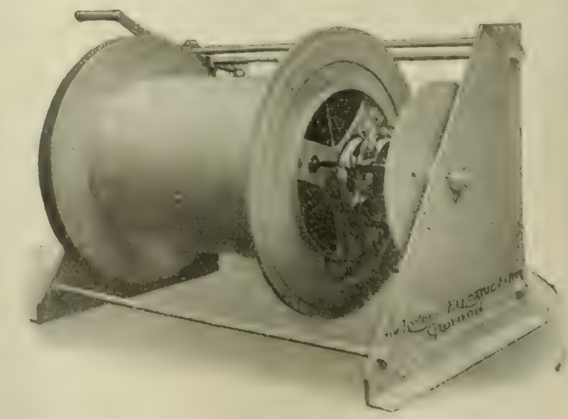


Fig. 3.

Cable Winding Drum.

The London Electric Firm, of Croydon, have put on the market a cable-winding drum, which carries the cable used in connection with a three-phase A.C. motor operated mine sinking pump, and in the example shown in the illustration the three sets of slip-rings and brushes are insulated for 3,000 volts. The brush gear is totally enclosed and weatherproof. It will be seen that the rings are fixed (the incoming cables being coupled thereto), while the brushes revolve with the drum, suitable connecting clamps being provided for a three-core cable, which is led from the barrel over a guide pulley to the pump. The drum accommodates a long length of heavy cable, and is spur-geared to give easy winding, provision being made to prevent rotation when desired. The firm also make cable drums for all purposes, including spring or other automatically wound drums for cranes, and light drums for telephone cables, &c.



Commercial Topics.

Catalogues for Riga.

H. M. Consul at Riga (Mr. E. F. Cable) intends to establish at the Consulate a collection of British catalogues and trade journals for inspection by callers, and distribution among local traders. British firms, who are interested in the matter are accordingly invited to forward a copy of any catalogues or other trade literature (in English or German) they have issued and, if desired, small samples of their products, direct to the British Consulate, Riga, for inclusion in the collection.

* * * *

Electrical Supplies in British East Africa.

H.M. Trade Commissioner in Nairobi, East Africa, reports that there is a reasonably good demand in that country for small electrical power sets with battery. One popular make, of American manufacture, has a power of ¾ kw., with a battery of cells of 60 ampere-hours capacity, and retails at 2,000 rupees (10 rupees=£1). Another quoted c.i.f. Nairobi at 1,800 rupees, has a paraffin air-cooled engine and generator of 1·5 kw. with 16 cells of two capacities, 90 and 180 ampere hours respectively, control panel, and an arrangement whereby the engine can, when desired, supply power direct instead of generating current.

* * * *

Belgian Tariff Charges.

By the Belgian Law of June 10 new, and in most cases increased, tariff duties were imposed for one year. On machine belting of leather or rubber the duty is 30 fr. per 100 kilog., on aluminium machines and implements 40 fr., iron and steel machines and tools, 4 fr., and on cast-iron machines and tools 2 fr. per 100 kilog. Scientific instruments and unmanufactured copper, nickel and aluminium are admitted free. Component parts of machines are dutiable as machines, and electric, submarine and underground cables and railway and tramway carriages are classed as machines.

* * * *

Porcelain Insulators for U.S.A.

The Department of Overseas Trade states that it has received from the office of H.M. Consul-General at Boston samples of three types of porcelain insulators of small size used in the bases of electric bulb fittings, which are required by a firm in Massachusetts. It is stated that 50 million of these articles in assorted types according to the specimens are required, and that early delivery is of importance. The colour is immaterial so long as the type is the same. British firms interested in the inquiry can obtain address of the firm from the Department, 35, Old Queen-street, S.W.1.

* * * *

British Manufactures in South Africa.

The South African Association of British Manufacturers and their Agents was recently formed in Johannesburg for safeguarding the interests of United Kingdom manufacturers in South Africa, and generally of promoting British trade interests in the Union. At present the only office is in Johannesburg, but it is proposed to open a branch at Cape Town and also to form a considerable number of trade sections. Membership is confined to United Kingdom manufacturers and their South African agents. The Secretary is Mr. B. Silcock, Goldfields Building, Eloff-street (P.O. Box 5,644), Johannesburg.

* * * *

The Chinese Market for Electrical Supplies.

Notwithstanding political and other troubles important industrial developments are reported to be taking place in various parts of China. According to the "China Mail," there has been a remarkable increase in the imports of electrical machinery and apparatus into South China, principally through the agency of Hong Kong firms. One firm (Messrs. Gerin, Druard & Company) is reported to have sold several Westinghouse motors, transformers, small generating sets, switchboards, fans, lamps, &c. There appears to be a great demand for small electric fans, lamps, electric irons, cooking apparatus, heaters, coffee percolators and storage batteries, The Chinese are becoming very much interested in electrical products, and shops are constantly springing up in the Colony which deal exclusively in these articles. We hope, therefore, that British firms will pay closer attention to the great possibilities of the China market and make preparations for meeting the growing demand.

* * * *

The Corporation Tax.

On the Report stage of the Finance Bill on Tuesday an important concession was made in regard to the incidence of the new Corporation Tax. A clause was inserted to provide that "this part of the Act shall not during the period of Jan. 1, 1920, and Dec. 31, 1922, apply to the profits of a company which carries on wholly in the United Kingdom any gas, water, electricity, tramway, hydraulic power, canal, or railway undertaking, and which by, or by virtue of any Act is precluded either from charging any higher price or from distributing any higher rate of dividend than that authorised by or by virtue of the Act."

An unsuccessful attempt was made by Mr. Geo. Balfour to exempt English companies operating public utility properties abroad from the tax. The profits of subsidiary companies will be treated as those of the principal company if the latter so desire, and the subsidiary company will not be separately assessed.

For this part of the tax a company is defined as "any body corporate so constituted that the liability of its members is limited, but does not include a company whose assets consist wholly of stock or other securities issued by any public authority and formally held by the person by whom the company was formed."

Electricity Supply.

Oban Town Council has increased the charges for electric current as from the 15th prox.

Bridgwater Council has decided to adopt electric lighting at the Town Hall and Municipal Buildings.

A sum of £12,500 will be expended by Bury St. Edmunds Corporation on additional generating plant and mains.

Loughborough Corporation has fixed the salary of the electrical engineer (Mr. R. B. Leach) at £500 per annum.

Hornsey Town Council has received sanction to borrow £50,000 for extensions of its electric supply undertaking.

Grimsby Corporation has applied for sanction to borrow £9,500 for the purchase of six electrically-driven 2-ton vehicles.

Maidstone Corporation has been authorised to borrow £1,000 for the purchase of heating and cooking apparatus to be let on hire.

Carnforth Urban Council is negotiating with the Thrislington Colliery Company for a supply of electricity for public lighting.

Sanction has been received by Burnley Electricity Committee to borrow £95,200 for extensions of the electric supply undertaking.

Application has been made by Spenborough Council for sanction to borrow £9,000 for the extension of the electric supply cables to Moorend.

Owing to the poor quality of gas supplied to Oldham cotton mills last winter many firms are adopting electric lighting for the coming winter.

The Alderley & Wilmslow Electric Supply Co., Ltd., has applied for an order to increase the maximum charge for electric current from 9d. to 1s. per unit.

Hammersmith (London) Borough Council has agreed to furnish Chiswick Electricity Supply Corporation with an additional supply of electricity in bulk.

Liverpool City Council has applied for authority to borrow £115,000 for additional plant for the Lister-drive power station and £200,000 for mains extensions.

The Bury (Lancs.) Electricity Committee are increasing the price of electricity from October by 20 per cent. for lighting and power, and 10 per cent. for tramways.

Leicester City Council decided on Tuesday to apply for sanction to borrow £723,000 for the erection and equipment of a new generating station on the Freemen's Meadow site.

Penzance Corporation has lodged an objection to the application of Edmundsons Electricity Corporation for power to increase the maximum charge for electric current to 1s. 2d. a unit.

A large conger eel, which got into the force pump at Plymouth electricity works one day last week, is reported to have caused a failure of the electric current to the tramcars for an hour.

The Northern Counties Electricity Supply Company has applied to Thirsk Rural Council for consent to change the system of supply from continuous to alternating current at a periodicity of 40.

Owing to the high cost of gas, 6s. per 1,000, Sabden (Lancs.) Parish Council has decided to get a report from an electrical engineer as to the possibility of utilising local water power for generating electric current.

The conference of local authorities owning electricity undertakings in the Greater London Area have appointed Mr. C. H. Wordingham, consulting engineer, to prepare a scheme for the London and Greater London Electricity area.

An application is being made by Radcliffe Council for sanction to borrow £1,725 to cover their share of the cost of providing the necessary sub-station and equipment for the the inter-connection of the systems of the Lancashire Electric Power Company and Bury Corporation at the Radcliffe electricity works.

Barnsley Corporation has adopted a revised scale of charges for electric current, which represents an average advance of about 14 per cent. The new scale is a flat rate of 8d. per unit for private lighting, 6·35d. per unit for theatres and cinemas, and 3½d. to 2d. per unit for mall power consumers and 2d. per unit. cooking and heating.

A conference of representatives of the Torquay Town Council, and the Councils at Paignton, Newton Abbot and Teignmouth has approved a scheme for the supply of electricity in bulk to the district. The scheme has been prepared by Mr. H. F. Woods, borough electrical engineer of Torquay, and the estimated cost of the proposed station is £230,000.

Gravesend Council has obtained sanction to a loan of £25,000 for extensions of the electricity undertaking. Owing to recent demands for electricity supply (including 700 kw. by W. T. Henley's Telegraph Works Company and 50 kw. by the Thames Metal Company) it has been decided to install another generating set of 2,000 kw., in addition to the set on order.

The accounts of the Wolverhampton electricity department for the year ended March 31, show a gross profit of £53,435. After paying interest (£14,708) and providing £24,541 for repayment of capital the net profit is £14,186. The total revenue was £147,462, compared with £171,278 last year, the falling off being due to the diminished demand from large munition works.

All the unskilled labourers at the Newport (Mon.) electricity works came out on strike on Tuesday evening. There was no light or power available for general use, but arrangements were made for the supply to hospitals.

Rochdale Electricity Committee consider the proposed Scale of Salary Increase of the National Joint Board, as well as conditions of employment and holidays for technical members of staffs of electricity undertakings to be exhorbitant, and their protest against the scale is being sent to all undertakings represented on the Lancashire and Cheshire Federation of Authorities.

Messrs. D. R. Llewellyn and H. Seymour Berry recently acquired the mineral area underlying the Aberpergwm estate in the Glyn Neath and Dulais Valleys, including a number of collieries. It is proposed to utilise the present power station at Aberpergwm for supplying power to the whole undertaking and to make it a central station for the whole of the collieries.

The income of the Yarmouth Electricity Department for the year ended March 31 was £40,461 (compared with £24,272 in 1918-19), and working expenses, including depreciation, were £31,895 (£19,915). Interest, sinking fund and income tax required £9,276 (£6,487), discounts and rebate amounted to £951 (£687), the net result being a deficit of £1,661 (£2,817). Maximum demand was 1,518 kw. Units generated were 2,332,724 and sold 1,949,877.

Lancaster Corporation are supporting resolutions from the Incorporated Municipal Electrical Association expressing the view that no efficient progress can be made by Joint Electricity Authorities formed under the Electricity (Supply) Act of 1919, unless there are incorporated in the scheme satisfactory financial arrangements. Therefore, it is of paramount importance that the financial clauses of the 1920 Bill be passed into law at the earliest possible date.

The accounts of the Paisley electricity department were submitted to the Corporation last week and showed a credit balance of £746. Treasurer MacKean said the result was due to good management and reflected credit on the convener of the Committee, Bailie Glasgow, and Mr. Blair Smith, the manager. The rates for electricity were too high, but he could not promise any reduction this year. The question as to how industries were to continue to prosper with coal at such a famine price was a serious one. The surplus on last year's working would form a working capital account for the department.

The East Midlands District Council for the Electricity Supply Industry (No. 7 district) has been enlarged to 28 (14 representatives of employers and 14 of employees) by the inclusion of Burton-on-Trent and Mansfield. In fixing the rates and conditions the area was divided into two grades. Undertakings of over 5,000 kw. are in one class and those under in the second. The draft of the rates and conditions has been sent to the National Industrial Council for approval, and will, it is expected, come into operation as from Aug. 1. An "Anamolies" Committee has also been appointed.

Beckenham electricity department sold 1,224,433 units of energy during the year ended March, compared with 959,000 in 1919. The deficit was £5,000, although a loss of £8,000 was anticipated. There was a gross profit of £3,141, and the receipts from the sale of free wiring installations were £1,128. The interest and sinking fund charges were responsible for the deficit. The total capital debt is £162,000, but more than half (£94,000) has been repaid. There is an increasing demand for electricity, and a good number of new consumers were connected during the past year.

We are glad to see that the Incorporated Municipal Electrical Association has sent a formal letter of Protest to Wrexham Corporation against the proposal to appoint a borough electrical engineer at a salary of £450 a year. We referred to this matter in our issue of July 2.

A local inquiry was held on Tuesday into the application of the Council for sanction to borrow £17,260 for the electricity undertaking. Evidence in support of the application having been given, the inspector (Col. Ekin) said he thought that the Corporation had made out their case, especially in regard to the provision of a new boiler.

Steps are being taken to establish electricity works at Sudbury for the purpose of supplying current for public and private lighting and power, and at a meeting of tradesmen on Friday, over which the Mayor (Ald. H. Alston) presided, the project received unanimous support. Mr. Napier Prentice, A.I.E.E., attended, and said cheap power was essential if they were to carry on their present industries with success. In the past the want of electric power had driven many industries to the north. Given the goodwill of the townspeople, the scheme would prove a great success. Mr. C. H. Wordingham, a past president of the I.E.E., supported the movement, and said that in competition electricity would win every time on its merits.

For the year ended March 31 the gross income of the Hampstead Borough Council electricity department was £123,752, and after meeting all charges (£81,464), the gross profit was £42,288. Interest and repayment of principal absorbed £29,325, leaving a net profit of £12,963. This sum has been employed in wiping out last year's deficit of £3,821, in contributing £6,081 towards purchase of meters and new services, and in writing down investments to market value, leaving £551 to be carried forward. Units generated were 7,484,600 (5,676,420), and sold to private consumers 5,102,648 (3,946,079); there are 10,312 consumers (9,036) and the load factor was 20·79 (20·09) per cent.; total cost per unit sold was 4·44d. (4·64d.), and total income 4·98d. (3·95d.).

Electric Traction.

King's Lynn Corporation has been authorised to borrow money for the purchase of two electric vehicles.

Liverpool Corporation has been authorised to borrow £18,350 for the purchase of the Liverpool and Prescot light railway.

An inquiry was held at Wallasey last week into the application of the Council for sanction to borrow £2,976 for the purchase of two electric vehicles.

Successful trial trips have been made on Shepherd's Bush-Ealing extension of the Central London Railway, and it will be opened for traffic on Monday. A full description of the equipment will appear in The Electrician for August 6

Newport (Mon.) Tramways Committee recommend that the wages of all male employees over 21 years of age on the traffic staff be increased by 1d. per hour from the 1st inst.

Middlesbrough Corporation is asking the Ministry of Health for sanction to issue £1,250,000 stock, of which £150,000 is for the purchase of the tramways, and £22,100 for the electrical transporter bridge.

Sunderland electricity department will purchase two 3½-ton electric battery vehicles for conveying coal and ashes. It is anticipated that a saving of about £1,500 per annum will be effected on the present cost of carting.

The London County Council has decided to apply to the Ministry of Transport for sanction to make variations in the statutory tramway fare limits. The average distance for a penny will now be three-fifths of a mile, against one mile and one-fifth at present and two miles in 1917. For 2d. a passenger will be carried 1·8 miles, against 2·5 miles now and 4½ miles three years ago. In regard to workmen's fares a 2d. return for three sections will approximate to 3·6 miles total journey, and a 4d. return will cover a 7·2 total journey. It was also announced that in consequence of the tramways deficit the special County Rate will go up by 2½d.

As the outcome of the recent deputation from the L.C.C. to the Minister of Transport it is announced that the Minister arranged a conference between representatives of the L.C.C. of the Underground group of companies to discuss the relationship between the London County Council tramways and the other forms of London traffic, with the object of Co-ordinating and Improving Transport Facilities in London. As a result of the conference it was decided to set up a committee on which representatives of both sides will sit, with the object of discussing the subject in its widest aspect. Sir Alex. Gibb, who has acted as chairman of the Technical Sub-Committee of the Advisory Committee on London Traffic, will act as chairman of the new committee.

A second report on transport facilities in Edinburgh and Leith and on the conversion of the cable lines to electric traction has been prepared by Mr. R. S. Pilcher, manager of the Edinburgh tramways. The proposed scheme of electrification will require £695,700, and this will be expended in three or four years. The dominating factor regarding the future mode of transit between Edinburgh and Leith is to be found at Pilrig, and through running facilities between Leith and Edinburgh should now be provided by the same form of traction. Hitherto over seven million passengers per annum changed from one vehicle to another, and any future system of transport must provide between these two communities through facilities. The Leith tramways are in good condition, the traffic is heavy, and the cars, which have a larger seating capacity than 'buses, can be run cheaper per car mile. In those circumstances there should not raise the question of discontinuing the operation of the tramways, or of permitting a motor bus system to compete. As the connection between Leith and Edinburgh must be by means of electric traction, and the first section of the tramways to be converted should be the Pilrig to Liberton route, and for the same reasons it will be absolutely necessary to provide through-running over an electric tramway running from Joppa to Waterloo-place.

The motor omnibuses in Edinburgh seat 32 passengers and cost 21·41d. for working expenses, whereas electric cars to seat 52 passengers could be operated at 18·12d. per car mile. Taking account of "rush traffic periods," Mr. Pilcher's estimate of the total operating costs is as follows:—Electric cars, 20·33d. per car mile; motor 'buses, 23·29d. per bus mile. These figures are confirmed by all municipal authorities operating both electric cars and motor buses. The motor 'bus has the advantage of being an independent unit; it is not dependent upon other vehicles, such as tramcars, where the speed of the lowest becomes the speed of the whole service. The bus also has the advantage of being able to draw up to the side of the pavement, whereas passengers have to cross half the street to reach the tramcar, and further the bus is not confined to particular streets, and can be diverted in case of street blockage. The mobility of the bus is perhaps one of its greatest features; it can create traffic by its mobility; a route may be tested, varied, and, if not remunerative, can be abandoned. On the other hand, the bus suffers serious disadvantages compared with a modern electric car. The cost of operation per passenger carried is distinctly in favour of the electric car. The limited seating capacity of the 'bus is its greatest handicap. There is little doubt that a motor vehicle will always be more restricted in its passenger-carrying capacity than a vehicle on rails. The motor 'bus will undoubtedly be enlarged, and its seating capacity increased, but it will have its limits, whereas the electric car can be made much larger without materially increasing the working costs. With regard to the "rush" hours, one of the most difficult of transport problems, Mr. Pilcher says experts pronounce in favour of the electric car. For the main lines of traffic, where the passenger traffic is assured and where it is dense, the electric car will be used; but where an infrequent service is sufficient, such as on a suburban route, or where the traffic is not fully developed, the motor 'bus will be used.

Miscellaneous.

Mr. F. C. McQuown, Secretary of the County of London Electric Supply Company, Ltd., has been presented with a silver rose bowl and salver by the staff on the completion of 21 years' service with the company. Mr. McQuown has, therefore, been with the Company during the period of its growth and extensive developments.

The EDISWAN STAFF ASSOCIATION CONCERT PARTY, under the direction of Mr. F. H. Holyday, gave selections from their extensive repertoire at a fete and pageant given on Saturday last in Bruce Castle Park, Tottenham, in aid of funds for the extension of the Prince of Wales's Hospital. The afternoon and evening performances were well supported and appreciated.

We regret to announce the death, which took place at Glasgow on the 22nd inst. of Mr. JOHN STEEL NICHOLSON, O.B.E, D.S.C., Whit. Sch., M.I.E.E. Dr. Nicholson, who was only 40 years of age, was lecturer in electrical engineering at Glasgow University since 1906, and during the war he rendered good service in connection with aeronautics for which he received the honour of O.B.E.

The METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., of Trafford Park, Manchester, whose works are closed from the 23rd inst. until Tuesday next, opened a booking office in the works for their employees. That these facilities were much appreciated is proved by the fact that the takings were over £2,000. Arrangements were made for two special trains from the Central Station, Manchester, to Liverpool, one from Victoria Station, Manchester, to Fleetwood; and one from Victoria to Blackpool. The bookings to Douglas (I.O.M.) were £1,050, and to Blackpool £600.

POPE'S SOCIAL AND ENTERTAINMENT CLUB held their first sports on the 17th inst. at Gunnersbury Park, Acton (by kind permission of Mrs. Leopold de Rothschild). A long programme of events, with over 400 entries, was most successfully carried through. At the close, Mrs. Pope presented the prizes to the winners. Mr. Morris, on behalf of the club, thanked Mrs. Pope, for whom three hearty cheers were given. Mrs. Pope replied, saying that she hoped this meeting would be an annual one, and congratulated the officials on the splendid way in which the sports had been organised. The St. Pancras Silver Band (Comrades of the Great War) played selections during the afternoon and in the evening for dancing.

One of the greatest difficulties in the organisation of the MACHINE TOOL and ENGINEERING EXHIBITION in September will be the transport and the erection o f the exhibits. In the course of 14 days at least 3,000 tons of machinery will have to be delivered at Olympia and erected in running order, and the Ministry of Transport has promised to afford every assistance to the Machine Tool Trades Association to ensure speedy conveyance. Six entrances will be used, and the exhibits will be labelled with labels in six different colours to ensure that the vehicles carrying exhibitors' machines shall enter by the gate appropriate to the position in the hall in which the exhibits are to be installed. It is impossible to provide overhead travelling cranes, and therefore a special instalment of cranes and lifting devices will have to be arranged.

This month's issue of the "Industrial League and Council Journal" is a special convention number and emphasises conclusively that the League and Council is gradually assuming a position of significant importance among the various industrial educative factors of this country. In an article entitled "Is Democracy Making Good?" the Rt. Hon. G. N. Barnes, M.P., severely trounces his labour colleagues. "The Labour 'leader,'" he says, "is afraid to lead, and sometimes he is even afraid to follow. . . . But the chief yearning of the British Trade Union 'leader' is for conferences. I wonder sometimes if the rank and file of the Trade Unionists will ever be able to stop these machine-made fantastic gatherings for fantastic purposes which have now become so common." The major portion of the "Journal," however, is taken up with the report of the two days Convention held at Manchester. The *resume* of the discussions which took place there typifies the comprehensive conception the League and Council holds of its duty towards all phases of the industrial community of Great Britain in relation to its activities to promote industrial harmony.

Institution Notes.

The autumn meeting of the IRON AND STEEL INSTITUTE will be held in Cardiff from September 21 to 24th next. Papers will be read, and various works visited, including the Dowlais Cardiff Works of Messrs. Guest, Keen & Nettlefolds, and the Bute Docks; Alexandra Docks, Newport, Barry Docks, Ebbw Vale Steel, Iron and Coal Co., Ltd., works, Chepstow Shipyards, and the Margam Iron and Steel Works of Messrs. Baldwins, Ltd.

A Students' Section of the SOUTH MIDLAND CENTRE OF THE INSTITUTION OF ELECTRICAL ENGINEERS has recently been formed, and full particulars of this may be obtained from the hon. secretary, Mr. J. Wallis Bailey (14, Carlyle-road, Edgbaston, Birmingham), who will also be pleased to hear from student members who are prepared to read a Paper during the session. The first session will open on Oct. 12, 1920, and meetings will be held monthly thereafter during the session.

The Executive Council of the ELECTRICAL POWER ENGINEERS' ASSOCIATION have resolved to raise the boycott on the electricity undertakings of the Yorkshire Electric Power Company, and no objections will now be raised to engineers accepting positions with the company. The Council also expressed its satisfaction with the decision of the company to apply the schedule of salaries to the members of the technical staff in the service of the company, and also with the active interest shown by the engineer and manager of the company in connection with the National Joint Board.

Imperial and Foreign Notes.

The SOUTH AFRICAN Government will proceed with the electrification of the first section of the railways without delay.

The ONTARIO Government will not take over any more hydro-electric radial extensions until a Commission, to be appointed immediately, has made its report; and after that only if any railways proposed to be taken over are self-supporting.

In association with Messrs. F. Tate, S. Tate and F. [illegible], of Nairobi, British East Africa, Barimar, Ltd., has arranged to open a chain of welding factories to cover German East Africa as well as British East Africa, to be known in future as Kenya Colony, Uganda, Zanzibar and Nyassaland.

The Government of the UGANDA Protectorate invite applications for a concession for the development of power from 4,000 c.f. of water per second from a portion of the Ripon Falls on the Nile and the distribution of electricity in the surrounding district and to the townships of Jinja and Kampala, &c. Particulars may be obtained from the Crown Agents for the Colonies, 4, Millbank, London, S.W. 1, to whom tenders are to be delivered by Dec. 20.

The BOULOGNE Chamber of Commerce has been authorised to raise a loan for 3½ million francs for the construction of an underground railway, connecting the Loubet Dock with the Nord Railway.

According to the "Manchester Guardian Commercial," the JAPANESE RAILWAY AUTHORITIES have decided to SUBSTITUTE ELECTRIC TRACTION for steam on all lines. A bill will be brought forward during the present session of the Diet. The estimated cost of the scheme is 200,000,000 yen.

By the General Finance Bill the FRENCH MINISTER OF PUBLIC WORKS is authorised to grant permission to the Southern railways to proceed with the ELECTRIFICATION of THEIR SYSTEMS and to generate the necessary power from the water power of the Dordogne. The lines to be electrified comprise about 5,600 miles of the Orleans, Midi and P.L.M. systems.

The L. M. Ericsson Telephone, of Sweden, has secured a contract for the equipment of an AUTOMATIC TELEPHONE EXCHANGE AT ROTTERDAM for 5,000 subscribers. The Dutch State Telegraphs also propose to erect a long-distance call exchange at Rotterdam. For carrying out this work and other orders a subsidiary company has been formed, named the Nederlandsche Ericsson Telefoon Fabricken, with a capital of 3,000,000fl., of which the Swedish company will hold about 2,000,000.

Telegraph and Telephone Notes.

The engineer-in-chief of the NEW ZEALAND GOVERNMENT TELEGRAPH DEPARTMENT is coming to London shortly in order to make arrangements for the laying of a submarine cable to connect the North and South Islands by telephone. The cost of the work will exceed £100,000.

At Monday's sitting of the SELECT COMMITTEE on TELEPHONE CHARGES, Mr. Thos. Holme, manager and engineer of the Hull telephone department, stated that the Hull Corporation telephone service was established under the powers of the Telegraph Act, 1899. In 1905-6 the capital cost was £28, the income £4 4s., and expenditure £2 7s., the gross profit being £1 7s., and the percentage of gross profit to capital £6 3s. In 1913-14 the respective figures were £18, £4 10s., £2 4s., £1 7s. and £9 7s. On May 6, 1914, the Corporation purchased from the Post Office the ex-national service in the Hull area for £192,423, and the Postmaster-General granted a license to Dec. 31, 1932. Under the license the Corporation paid the Post Office 10 per cent.

A new sea distance WIRELESS TELEPHONE RECORD was established on Saturday, when the passengers on board the C.P.O.S. liner "Victorian," although separated by 300 land miles and 1,550 miles of sea, were able to enjoy a concert given by the Marconi station at Chelmsford. The concert was so much appreciated by the passengers that Chelmsford was asked to continue them daily until the ship reached Sydney, Nova Scotia, on Tuesday. Telephonic communication between Newfoundland and the "Victorian" was established on Sunday over a distance of about 650 miles, when prominent officials on the island, including Mr. R. A. Squires, the Premier of Newfoundland, exchanged greetings with the Empire Press Union delegates on board the ship.

Educational.

Generous gifts continue to be made for UNIVERSITY EDUCATION. Sir Jesse Boot has given £50,000 to the proposed new university at Nottingham—£30,000 for building and £20,000 for a chair of chemistry; and a gift of £15,000 has been made to Liverpool University by Ald. L. S. Cohen.

The British Thomson-Houston Company proposes to establish two ENGINEERING SCHOLARSHIPS, one of which will be allotted to Cambridge University. It is proposed to select from the engineering graduates of that university who have worked with the firm for not less than six months a scholar who will be sent to their American associates, the International General Electric Company, with which is associated the General Electric Company of New York. The company proposes to allow for the student's expenses $1,800 (about £470) in gold, and after a year's study in America he will be expected to return to the British company strengthened by the experience he has gained on the other side of the Atlantic.

Personal and Appointments.

Dr. W. Mason has been appointed professor of engineering at Liverpool University.

Dr. R. B. Wheeler has been elected to the new chair of fuel technology at Sheffield University.

Dundee tramway staff have presented a wallet of Treasury notes to Mr. Menzies, on his departure to become tramway manager at Kilmarnock.

Mr. T. G. Richardson, manager of Colne Corporation light railways, has been appointed general manager of the West Hartlepool Corporation tramways and omnibus undertaking.

Mr. W. G. Turner, chief assistant engineer of the Newcastle & District Electric Lighting Company, has been appointed borough electrical engineer at Southampton, at a salary of £1,000 per annum.

Aylesbury Council has appointed Mr. C. H. Wordingham as consulting electrical engineer. The salary of Mr. W. A. Turnbull, borough electrical engineer, has been increased from £400 to £485 per annum; and that of his assistant, Mr. West, from £130 to £155.

In recognition of his work during the war as Director-General of Explosive Supplies, Lord Moulton was entertained to dinner on the 21st inst. by a number of the leading chemists and chemical technologists of the country and a silver loving cup was presented to him by Dr. Emil Mond.

Mr. J. Higham, B.Sc., late R.E., formerly senior lecturer in electrotechnics at the South African School of Mines and Technology (University of South Africa), and Hon. Secretary to the South African Engineering Standards Committee, has been appointed lecturer in electrotechnics at the University of Manchester.

The following appointments have been made by the Council of the University College, Swansea: Prof. C. A. Edwards, D.Sc., professor of metallurgy; Mr. J. E. Coates, O.B.E., M.Sc., F.I.C., professor of Chemistry; Mr. E. A. Evans, D.Sc., A.R.C.S., professor of physics; Lieut.-Col. A. R. Richardson, D.S.O., B.Sc., A.R.C.S., professor of mathematics.

Mr. E. T. Ruthven Murray has resigned his appointment as general manager and engineer to the North Metropolitan Electric Power Supply Company to engage in private practice as a consulting engineer. He continues his connection with the North Metropolitan Company as construction engineer. His address will still be Manor House Offices, Finsbury Park, N.4.

Catalogues, Price Lists, &c.

Messrs. Dalton Downes & Company have issued a leaflet containing particulars of the "Dainty" electric suction cleaner.

A nicely printed and well illustrated catalogue of a.c. squirrel-cage and slip-ring induction motors has been issued by the British Electric Plant Company, of Glasgow. Particulars of the design and construction of several standard types of machine are given, and there are also tables of dimensions and output, diagrams of connections, shipping specifications and other technical data. The tables are in the metric system, but owing to the uncertainty at the date of going to press no prices are included. These can, however, be obtained on application to the company.

The Electric Lamp Manufacturers' Association has prepared a neat booklet of 16 pages entitled "My Electric Home," which should prove very effective for propaganda purposes by electric supply authorities and electrical engineers. Neatly printed in colours and well illustrated, the pamphlet points out in concise and clear language the advantages of electric lighting in the various parts of a house, and also shows how electricity may be used for heating, cooking and other domestic purposes. The Association will supply quantities to central station engineers and electrical contractors for canvassing, and for circulation in their districts among prospective consumers.

Business Items, &c.

The works and offices of the Benjamin Electric, Ltd., are closed from the 30th inst. until the 9th prox. for the annual holidays.

Wm. Geo. Parkes and John O'Sullivan, electric welders, &c., trading as Parkes & O'Sullivan, at Union-street, Newport, Mon., have dissolved partnership. Debts by Mr. Parkes.

Jas. Copland and Wm. Alex. McGuire, makers and repairers of electric motors and dynamos, and trading as the Armature Repair Company, at Llanrwst-street, Liverpool, have dissolved partnership. Debts by Mr. Copland, who continues.

Messrs. Clifford Butler and Thomas L. Hancock, electrical engineers, &c., 7 & 9, St. Peter's Gate, Nottingham, trading as Clifford, Butler & Company, have dissolved partnership. Debts by Mr. Butler, who continues the business.

The head office of Messrs. Newton & Wright, Ltd., electro-medical instrument makers, has been removed to the works at 471-77, Hornsey-road, N.19, and Messrs. Allen & Hanburys, who take over the electro-medical show-room at 72, Wigmore-street, W.1, are selling agents for the firm in the London area.

It is interesting to learn that the engines of the aeroplanes that secured the first and second places in the Hendon Aerial Derby on the 24th inst. were equipped with B.T.H. magnetos, as were those which secured the first and second places in the 1919 Derby. B.T.H. magnetos were also fitted on the R.34 and on the aeroplanes which secured some 28 aerial records.

Tenders Invited and Accepted.

Fife Education Authority invite tenders (by Aug. 4) for electric lighting and other work at the Cowdenbeath School.

Manchester Electricity Committee require tenders by Aug. 6 for low-pressure water pipes, supports, &c., and low-pressure water valves. Specification from Mr. F. E. Hughes, Town Hall, Manchester.

Tenders are invited for the equipment and running of electricity supply works at Cape Coast and tramways at Coomassie (Gold Coast). Further information from the Secretary for Works, Accra. Tenders to the Colonial Secretary, Victoriaborg, Accra, by Sept. 1.

Grimsby Corporation invite tenders (by August 12) for the supply and erection of two water tube boilers, with economisers, fans, chimney, &c., a 3,000 kw. high pressure turbo-alternator and condenser plant. Specifications from the borough electrical engineer, Lieut.-Col. W. A. Vignoles.

Tenders are invited (by Sept. 7) for the supply to the Postmaster-General's Department of the Commonwealth of Australia of telephones and cable, Schedules 1,634 and 1,635. Tender forms from the Office of the High Commissioner, Room 406, Australia House, Strand, W.C. 2.

The Salvage Committee of the city of Birmingham invite tenders for the supply of two 100 kw. 440-volts d.c. compound-wound steam-driven generating sets, with surface condenser and switchboard. Specifications from the superintendent, Mr. Jas. Jackson, Council House, Birmingham, to whom tenders are to be delivered by Sept. 1.

Manchester Electricity Committee invite tenders for supply and erection of one 75-ton and one 15-ton electric crane at the Barton power station. Specifications from the Secretary, Mr. F. E. Hughes, and further particulars may be obtained from the chief engineer and manager, Mr. S. L. Pearce. Tenders to chairman of Committee by August 13.

Blackpool Corporation invite tenders for the supply and erection of two water-tube boilers, superheaters, economisers and mechanical stokers, &c.; two induced draught plants with steel chimneys, fans, &c., and coal hoppers and coal and ash elevators and conveyors. Specifications from the borough electrical engineer (Mr. Charles Furness), and tenders to the chairman of the Electricity Committee by Aug. 27

Tenders are invited for the utilisation of the hydraulic power of the river Jacuhy, estimated at 30,000 h.p., in the Fifth district of the municipality of Soledale. The term of the concession is 30 years, when the works will pass to the State. Tenders to the Director of Lands and Colonisations, Department of Public Works, Porto Alegre, Rio Grande do Sul, Brazil. Particulars may be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

Leeds Electricity Committee has accepted the tender of the British Thomson-Houston Company for the supply and erection of a 12,000 kw. turbo-alternator, condensing plant and accessories, at £134,450.

Hammersmith (London) Borough Council has purchased 140 time switches from the Venner Time Switches, Ltd., and a CO_2 recorder is to be hired from the W. R. Patents, Ltd., with the option of purchase at the end of a year.

Bradford Tramways Committee has placed the following contracts: Cammel, Laird & Company, 50 nickel chrome-steel axles, £516; J. Brown & Company, 200 steel tramway tyres, £1,666; National Rail & Tramway Appliances Company, 6 tons c.i. brake shoes, £162.

The following tenders have been accepted by Bedford Corporation: British Electric Transformer Company, 150 k.v.a. transformer, £302; Babcock & Wilcox, steam pipework, £4,525; Bedford Engineering Company, steam crane with grab and rails, £2,022.

Manchester Electricity Committee has accepted the following tenders: Carrick & Sons, 40-ton crane for Barton power station; W. T. Glover & Company, supply and laying of a new 33,000 v. feeder from Stuart-street to Droylesden; Ferranti Ltd., 12 months' supply of static transformers; Twiss Engineering & Electrical Transmission Company, first section of overhead work for supply of electricity to Blackley estate.

Hackney (London) Borough Council has accepted the following tenders:—Babcock & Wilcox, boiler house and induced draught plant (Davidson fans) at £61,340 and economisers £12,116; C. A. Parsons & Company, 8,000-10,000-kw. turbo-alternator, exciter and air filter, £50,000; Hick, Hargreaves & Company, condensing plant, £17,700; A. Reyrolle & Company, switchgear, £18,274; Rees Roturbo Mfg. Company, circulating water pumps, £6,110.

Bankruptcies and Liquidations.

Albert Rowland Meggett, electrical engineer, 45, Thrumpton-lane, East Retford, Notts, has been adjudicated bankrupt.

Bernard Esmond Thomas, electrical engineer, 12, Castle Meadow, Norwich, has been adjudicated bankrupt. Public examination at Shire Hall, Norwich, on Sept. 13.

London Engineering Company, Ltd., is being wound up voluntarily, with Mr. S. Ward as liquidator.

Johnson Jagger, electrical engineer and contractor, trading as J. Jagger & Company, 28, Northgate, Halifax, has been adjudicated bankrupt. First meeting of creditors at County Court, Halifax, on Aug. 5, and public examination at same place on Sept. 24.

Pearson's Electric Miners' Lamp Company, Ltd., has gone into voluntary liquidation, with Mr. A. E. Green, 100-104, Moorgate Station-chambers, London, E.C. 2, as liquidator.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919 Specifications

124,216 Grimnes. Heating or cooking by means of electric energy. (9/3/18.)
124,432 Baule. Electric-impulse motor. (16/5/17.)
128,190 Splitdorf Electrical Co. Apparatus for generating electric currents. (8/6/18.)
132,234 Mancha Storage Battery Locomotive Co. Storage battery locomotives. (31/8/18.)
132,257 Scintilla. Magneto-electric ignition machines. (2/9/18.)
133,293 Scintilla. High-tension distributors in magneto-electric ignition machines (28/9/18.)
134,517 Dubilier. Method of making electrical condensers. (30/10/18.)

Consists in assembling alternate layers of conducting elements and non-impregnated sheet insulation and subjecting same to high pressure to effect intimate contact and absolute union of the adjacent surfaces. In a modification the layers are impregnated with paraffin wax before being subjected to pressure.

135,480 Siemens-Schuckertwerke Ges. Control of asynchronous electric motors. (31/8/18.)
138,593 Allmanna Telefonaktiebolaget & Ericsson. Selective electric switching devices. (11/12/18.)
142,665 Offord & Parker. Electric horns. (14/5/19.)
142,673 Field. Means for measuring electric currents. (23/5/19.)
142,674 Cooke. Electric terminal connections. (24/5/19.)
142,680 Igranic Electric Co. & Wright. Coil-winding machines. (29/5/19.)
142,681 Igranic Electric Co. & Wright. Method of and means for applying the insulation of high-tension coils. (29/5/19.)
142,717 Benjamin Electric, Ltd., Fowler & Ives. Incandescent electric lamp sockets or holders. (7/8/19.)
142,719 Sanders. Electrical apparatus for heating liquids. (8/8/19.)
142,744 B.T.-H. Co. & Young. Magneto-electric machines. (23/10/19.)
142,754 Barber & Hoyle. Electric couplings. (17/11/19.)
143,292 Moore. Electric furnaces. (14/2/19.)143,308 Gibson. Couplings for protected or armoured electric cables for use under water and elsewhere. (18/2/19.)
143,309 Western Electric Co. (Western Electric Co.) Reduction of distortion of high-frequency currents, particularly applicable to wireless telephony. (18/2/19.)
143,322 London Battery Co. & Clarke. Assembling of electric batteries. (21/2/19.)
143,327 Worsnop. Electrical accumulators. (24/2/19.)
143,328 Mollerhoj. Arrangement and connector for jointing of electrical wires. (24/2/19.)

1920 Specifications.

139,198 Perego. Arrangement for protecting telephone installations from currents of dangerously high tension. (23/11/18.)
144,220 Imray (Bosch Akt-Ges.). Electric starting devices for internal combustion engines. (16/1/20.)
144,234 Fairweather (Aktiebolaget Svenska Elektromagneter. Magneto-electric ignition apparatus. (10/3/20.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

February 19, 1920.

4,991 Turner. Magneto-electric machines.
5,007 Brighouse. Incandescent lamps.
5,024 Midland electric Mfg. Co. & Sutherland. Fuses, switches, &c.
5,025 Midland Electric Mfg. Co. & Sutherland. Distribution fuse boards, fuse boxes, &c.
5,051 Bygrave. Intercommunication telephone systems.
5,066 Sunderland Forge & Engineering Co. & Blair. Electrode holders for weld-&c., metals.
5,072 Favre-Bull & Lavat. Electrical apparatus for transmitting indications to a distance.
5,097 Grimaud. Dynamos for lighting and starting devices on motor vehicles. (13/6/19 France.)

February 20, 1920.

5,125 Booth. Incandescent electric lamp projectors.
5,136 Crabtree. Switches.
5,144 Macdonald. Generators and motors.
5,161 Pyne. Switches.
5,172 B.T.-H. Co. (G. E. Co.) Signalling systems.
5,173 Wilson. Transmitters for electrical recorders.
5,190 Nobbs. Electric immersion heaters.
5,208 Gerbech & Knispel. Electric door-opening device.
5,216 Bastian & Hunter. Magnetically-operated apparatus.
5,233 Amberton. Circuit controllers.

February 21. 1920.

4.959 Harman. Dynamo-electric machines.
5,244 Bethenod. Synchronising variable-speed electric motors.
5,253 Taylor, Tunnicliff & Co. & Scrivener. Flexible insulators for electric wires, cables, &c.
5,297 Henley's Telegraph Works Co., Dunsheath & Grover. High-tension cables.
5,298 Henley's Telegraph Works Co. & Nichols. Electric fuse carriers.
5,301 Vandervell & Midgley. Dynamo-electric machines.
5,310 Le Bas. Dynamo-electric machines.

February 23.

5340 Ross & Young. Arc lamp electrodes for production of violet and ultra violet light.
5384 Dimitrievitch. Arrangement for printing telegraphy.
5388 Chamberlain. Electric signs, &c.
5389 Chamberlain. Thermal electric swtches.
5423 Whittaker-Swinton, Buydon, Cusen's & Johnston. Thermionic tubes.
5424 Whittaker-Swinton, Buydon, Cusen's & Johnston. Vacuum tubes, &c.
5429 Davies. Device for replacing fuse wire, &c.
5431 Marks (Landers Frary & Clark). Circuit breaker for electrically heated utensil.
5432 Marks (Landers, Frary & Clark). Electrically heated utensil.
5433 Landers, Frary & Clark. Electrically heated device. (11/6/19, U.S.)
5434 Landers, Frary & Clark. Electrically heated device. (11/8/19, U.S.)
5437 Landers, Frary & Clark. Controling device for electrically heated utensils. (29/5/19, U.S.)
5438 Landers, Frary & Clark. Electrically heated utensils. (18/8/19, U.S.)
5440 Siemens & Halske, A. G. Contact devices. (9/3/18, Germany.)
5442 Morgan Crucible Co. & Jarvis. Carbon brushes for electric machines.
5467 Kobzy. Switches.
5476 Myers & Nicholls. Securing lamps in holders.

February 24.

5485 Electrical Apparatus Co. & Martin. Electrical integrating meters.
5534 Stols Electrophone Co. & Saxby. Instrument for transmitting and receiving telephone communications on aeroplanes, &c.
5549 Cowper Coles. Electrodisposition of alloys of copper and zinc.
5555 Dixie & Smith. Electrical operation of tipping gear.
5566 Panza & Zeachini. Electric foot warmer, &c. (13/5/19, Italy.)
5578 Schroader. Field systems of dynamo electric machines.
5585 Benjamin Electric Mnfg. Co. Switches. (26/12/14, U.S.)
5586 Benjamin Electric Mnfg. Co. Circuit closer. (3/3/15, U.S.)
5609 Morris-Airey, Gandell, Macrorie & Dorling. Electrically controlled steering gear for ships.

Companies' Reports, &c.

The directors of the Brush Electrical Engineering Company, Ltd., invite applications for 339,512 £1 ordinary shares at par.

The Electrical Utilities Corporation, Ltd., has declared a dividend of 1¾ per cent. on the preferred stock for the quarter ended June 30.

The Metropolitan Railway Company has declared an interim dividend of 1 per cent. per annum on the ordinary stock for the half-year ended June 30.

The Chatham and District Light Railways Company has declared an interim dividend of five per cent. per annum on the ordinary capital for the past half-year.

The directors of Mather & Platt, Ltd., have declared an interim dividend on the ordinary shares for the half-year ended June 30 of 5 per cent., tax free.

The directors of the Bournemouth and Poole Electricity Supply Company, Ltd., have declared an interim dividend on the ordinary shares at the rate of 5 per cent. per annum, less tax.

The accounts of the Marconi Wireless Telegraph Company of Canada for 1919 show a net profit of $102,130, increasing the surplus to $395,918, which has been carried forward.

In order to provide money for the new works at Milton and for working capital, applications are invited for £250,000 first mortgage six per cent. redeemable debentures issued by Bullers, Ltd.

The directors of the Kensington and Knightsbrilge Electric Lighting Company, Ltd., have declared a dividend of 4 per cent. on the ordinary shares for the half-year ended June 30.

The South Wales Electrical Power Distribution Company has created and proposes to issue £95,000 5 per cent. debenture stock, ranking pari passu with the existing £200,000 of the same stock.

Mr. L.G.Caunter has retired from the Board of Baxter & Caunter, Ltd., owing to ill health. Mr. G. W. Kettlewell has again taken up his duties as director of the company after an absence of three years on war work.

The directors of the Chelsea Electricity Company, Ltd., have declared an interim dividend of five per cent. per annum (2s. 6d. per share) on the ordinary shares for the past half-year, payable Sept. 15.

The directors of the Liverpool Overhead Railway Company have declared interim dividends for the half-year ended June 30 at the rate of 5 per cent. per annum on the preference shares, and 2½ per cent. per annum on the ordinary shares, less tax.

Sir H. J. Mackinder, M.P., chairman of Electro-Bleach and By-Products, Ltd., and Mr. E. G. Cubitt, J.P., have retired from the board of that company, the exchange of shares with Brunner, Mond & Co., Ltd., having been carried through.

At the recent meeting of the Worcester Electric Traction Company, Ltd., it was reported that the revenue for 1919 was £23,076. After meeting expenses and placing £2,500 to renewals account, the balance was £3,771. With the amount from 1918 the sum available was £4,347. A dividend of 2 per cent. on the ordinary shares was declared, £2,000 was placed to reserve and £439 carried forward.

The gross profit of the electric supply department of the Bulawayo Waterworks Company, Ltd., during the past year was £10,993, compared with £10,847 in the previous year. Fifty-four new connections were made. The revenue for the current year is showing a satisfactory increase over that of 1919, after taking into account the increased cost of wages, stores and machinery. The Bulawayo Municipality has the right to take over the whole of the undertaking, but up to the present the municipality have not given notice of their intention to expropriate.

Last week Mr. Justice Astbury sanctioned a scheme of arrangement by the Bombay Electric Supply and Tramways Company, Ltd. It was stated that for economic reasons, including the incidence of the excess profits and double income-tax, it was to everybody's benefit that the company should cease to be incorporated in England and become an Indian incorporated company. For each preference share of £10 three preference shares of 50 rupees in the Indian company are to be issued, and for each ordinary share of £10 five of 50 rupees. Nine-tenths of the shareholders are in Bombay, and meetings are held there and supplemental meetings in England, the minutes of which were telegraphed to Bombay and incorporated in the Bombay minutes, and proxies were deposited in England so as to enable English shareholders to vote at the Indian meetings.

The revenue of the Electric Light & Power Supply Corpn., Ltd. (Sydney, N.S.W.), for the year ended April 30 was £80,496, and the working expenses were £34,224. There were 7,596 consumers, an increase of 1,415. The capital expended on power house and substation equipment, &c., was £32,250. The profit was £49,040, and after paying debenture interest, placing £8,454 to reserve for depreciation of plant, and £13,730 to reserve fund, a dividend at rate of 8 per cent. for the year was paid. The large increase in new applications for electricity in conjunction with the shortage of meter supplies caused considerable anxiety to the directors, but the difficulties were met in a large measure by the exercise of discrimination in erecting meters only where their use was likely to be fully availed of. Leichhardt Municipal Council have accepted the company's offer for electric lighting of the streets, and the necessary work will be completed by Dec. 31 next. When this is completed, the whole of the districts covered by the company's operations will have their streets entirely lit by electricity. To meet the rapid growth of the business, various extensions are being made

Mr. F. T. Jackson presided over the statutory meeting of Telephone Mfg. Company (1920), Ltd., on Monday, and stated that, although they were a new company so far as registration went, they were not new in business, as they took over the old company as a going concern, and acquired the whole of the share capital of 13 companies, who were bound by contract to buy the telephones they required from the Telephone Mfg. Company. Their total rental received under contract to June 30, 1920, amounted to over £750,000. It was their constant aim to extend the selling organisation of the business throughout the world in such a manner that, even during periods of trade depression in some countries, they shall not suffer from it. Apart from the installation companies operating in this country, they controlled one in Belgium and one in France. They had also contracts with firms in Spain and Egypt for a term of years who were developing the installation side of the business. They were starting a company in Australia, and as soon as factory extensions were completed they should be developing their business in practically every civilised country. It was not their intention to confine themselves solely to the manufacture of works telephone systems for their own rental business. They had designed and protected a telephone which combined the functions of direct intercommunication within a building with that of a direct connection to the public exchanges. That type of telephone was only allowed in some Continental countries, but it had been approved by the Dutch Government and the Spanish Telephone Service. The British Post Office Telephone Service had not yet been awakened to its possibilities. Their laryngaphone had the advantage of cutting out all extraneous noises, and was particularly adapted for use under noisy conditions. It could also be used when wearing gas masks in warfare and for mine rescue sets, aeroplanes and divers. The Government proposal to increase their telephone rates would increase the demand for their apparatus. It was necessary to obtain further capital, and they were inviting applications for 100,000 ordinary shares of £1 each.

New Companies.

ALKALINE MINERS' LAMP, LTD. (169,139).—Private company. Reg. July 20, capital £10,000 in £1 shares, to carry on the business of manufacturers of miners' electric lamps, electrical and mechanical engineers, &c., and to adopt an agreement with G. Pearson. First directors are: J. A. Taylor, F. N. Ellis and G. Pearson. Secretary: F. H. Ellis, Reg. office: 14, Fletcher-gate, Nottingham.

BRISTOL AND SOUTH WALES ELECTRIC WELDING COMPANY, LTD. (169,144).—Private company. Reg. July 20, capital £5,000 in £1 shares, to carry on the business indicated by title. Reg. office: 236, Bute-street, Cardiff.

HOUGH ELECTRIC MOTOR COMPANY, LTD. (168,963).—Private company. Reg. July 12, capital £2,000 in £1 shares, to carry on the business of electrical engineers, dynamo and electric motor makers, &c. First directors are J. E. Hough, J. K. Cotton and R. Ramsden.

HYDRO-ELECTRIC DEVELOPMENT COMPANY, LTD. (169,240).—Private company, registered July 23, capital £50,000 in £100 shares. To investigate, develop or assist propositions or schemes for the utilisation of water power in the generation or production of electricity for power, lighting, &c., in the United Kingdom or elsewhere. First directors are: Sir Henry Babington Smith, G.B.E., K.C.B., C.S.I., and G. Manzi Fe. Secretary: J. S. Barnes. Reg. office: 12, Nicholas-lane, Lombard-street, E.C.

LONDON FACTORS AND AGENTS, LTD. (169,125).—Private company. Reg. July 19, capital £200 in 5s. shares, to take over the business of an electrical and general merchant carried on by F. P. Sexton at 30, Parliament-street, as the "London Factors and Agents." F. P. Sexton is permanent governing director.

MAGNESIUM COMPANY, LTD. (168,971).—Private company. Reg. July 12, capital £75,000 in £1 shares (60,000 "A" and 15,000 "B"), to carry on the business of chemical manufacturers, metallurgical, manufacturing and consulting chemists, manufacturers of magnesium and its alloys, metal manufacturers and workers, &c. First directors are P. St. Clair Matthey, R. P. Sellon, E. Caillard, A. H. Barker and E. A. Ashcroft.

MARINE & MECHANICAL ELECTRIC WELDING COMPANY (CARDIFF), LTD. (169,074). Private company. Reg. July 16, capital £20,000 in £1 shares, to carry on the business indicated by the title, and to adopt an agreement with the Marine & Mechanical Electric Welding Company. First directors are; C. M. Burls, T. McLellan, A. Woodward, and W. Pollock. Secretary: W. S. Keith. Reg. office: 3, Lloyds-avenue, E.C.3.

MITCHELL'S ELECTRICAL & WIRELESS, LTD. (168,754).—Private company. Reg. July 2, capital £5,000 in £1 shares, to take over the retail and electrical contracting branch of the business of F. L. Mitchell & Company, Ltd. First directors: F. L. Mitchell and A. W. Knight. Reg. office: 188, Rye-lane, Peckham, S.E.

MOUNTRATH ELECTRICITY SUPPLY COMPANY, LTD. (5,024).—Reg. in Dublin, July 6, capital £6,000 in £1 shares, to carry on the business indicated by the title. Secretary: T. Moloney. Reg. office: Market Square, Mountrath.

F. A. NORRIS & DUTTON, LTD. (168,936).—Private company. Reg July 10, capital £40,000 in £1 shares (20,000 preference), to carry on the business of mechanical, heating, lighting and power plant engineers, &c. First directors are F. A. Norris (chairman and permanent controlling director) and H. W. Dutton. Reg. office: 11-12, St. Andrews Hill, E.C. 4.

Forty Years Ago.

(The Electrician, July 31, 1880.)

"The Universal Engineer."—The issue of this paper for July 16 contains a portrait and a sketch of the life of C. William Siemens, D.C.L., LL.D., F.R.S.

Electricity and Railways.—At East Oakland, California, the train is caused to run over an insulated rail, and thereby automatically display a red signal at the end of the trestlework viaduct.

The Telephone Exchange.—The fusion of the late Bell and Edison companies is complete, and henceforth the Metropolitan Exchange stations will be open from 9 a.m. to 7 p.m., except Saturdays, when the hours will be from nine to five.

Telegraphic News in the House.—On Monday, in reply to Mr. M. Guest, Mr. Adam said the question of having telegraphic instruments placed in the library, cloak-room, smoking-room, or any other part of the House for the convenience of hon. members involved consultation with the Speaker, the Postmaster-General, and the Treasury. He could not promise more at present than that the subject should be fully considered.

Australian Telegraphy. — The Postmaster-General of South Australia has received a letter from the Deputy Postmaster of Victoria, acknowledging the receipt of a letter, notifying the approaching completion of the proposed new telegraph line between Adelaide and Melbourne, and stating in reply to Mr. Todd's inquiry respecting the progress made in Victoria with the line to connect therewith, that directions have been given for a survey of a line from Dimboola to be proceeded with immediately, with a view to establish the necessary connection at as early a date as possible.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics":—"Air Mail Policy, Inland and Foreign"; "The New Wing"; and "A New Theory of the Screw Propeller," by M. A. S. Riach.

"The Cabinet Maker":—"Seven-Legged Tables"; "Furniture at the Disabled Men's Exhibition"; and "Hampton's New Offices in Famous Adam House."

"The Chemical Age":—"Refractory Materials for Chemical Purposes" (II.), by A. B. Searle; "The Dinner to Lord Moulton"; and "Chief Inspectors' Annual Report on British Alkali Works."

"Ways and Means":—"Upon the Temptations of Politics and Politicians," by John Murray, M.P.; "Civil Aviation: Its Present Position," by Major P. L. Holmes; and "The Organisation of Agricultural Workers," by Mr. A. Alban Parker.

Prices of Metals, Chemicals, &c.

Tuesday, July 27.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£107 0 0	£1 0 0	—
Electro Wirebars...	,,	£114 0 0	£3 0 0	—
H.C. wire basis......	per lb.	1s. $4\frac{1}{8}$d.	$\frac{3}{8}$d.	—
Sheet	,,	1s. $5\frac{5}{8}$d.	—	$\frac{1}{16}$d.
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. $9\frac{1}{8}$d.	$\frac{3}{8}$d.	—
Brass 60/40—				
Rod, basis	,,	0s. $10\frac{7}{8}$d.	$\frac{3}{8}$d.	—
Sheet, basis	,,	1s. $3\frac{3}{4}$d.	—	—
Wire, basis	,,	1s. $3\frac{3}{4}$d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£39 10 0	£2 10 0	—
Foreign or colonial	,,	37 5 0	3 0 0	—
Tin—Ingot	,,	270 10 0	1 10 0	—
Wire, basis	per lb.	0 3 6	—	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 10s.

,, (Roll Brimstone).—Per ton £18 10s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £43 10s.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 10d.

Sodium Chlorate.—Per lb. $5\frac{1}{2}$d.

Rubber.—Para fine, 1s. $10\frac{3}{4}$d.; plantation 1st. latex, 1s. $10\frac{3}{4}$d. per lb.

Shellac.—T.N. Orange, 680s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co.

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Notes.

1914-1920.

IT is just over six years ago since the British Government declared war on Germany, and the nation was plunged into a desperate struggle, not only on questions of the highest moral character, but for mere existence. In commenting in THE ELECTRICIAN of August 7, 1914, on the crisis which had so suddenly arisen, we said, "there is no doubt that the work of the engineer will be supremely important." Events justified that view. The whole ingenuity, enterprise and endeavour of our engineers were not only turned to the invention of more efficient apparatus of slaughter, but to the devising of new methods for maintaining the *materiel* and the well-being of our armies in the field. In this work, the results of which are well known to our readers, the electrical engineer played a splendid part. And while profoundly regretting the waste of life, money and energy which this struggle has caused, we may congratulate ourselves on the development in electrical progress which has been possible as the result of the happenings in these last six years.

1920 and After.

AN upheaval such as a world war must inevitably bring in its train after-effects as paralysing as those which result from the primary explosion. It has been truly said that to-day the condition of Europe and of a large portion of the world is scarcely less critical than it was six years ago. We are not sure that the difficulties connected with present conditions are not greater than those which had to be met in 1914. For six years ago, though everyone did not realise the exact nature and magnitude of the dangers to be faced, there was at least practical unanimity that they had to be faced with all the resources at our command. To-day matters are, unfortunately, otherwise. Instead of unity there is a dissension, both as to object, as well as to method. Instead of harmony there is discord. Instead of a fixity of purpose there is indecision. But it must be realised that there are certain fundamental questions that have got to be solved, equally in electrical engineering as in world-politics, before we can settle down to the Peace which we have so long desired, and which is now becoming a necessity to our well-being. To do this there must be a co-ordination of effort and a determination to remove all obstacles which are hindering our progress towards better things.

The Ealing & Shepherd's Bush Railway.

THE Ealing and Shepherd's Bush Railway, which was opened for passenger traffic on Tuesday in this week, will form a useful additional link in the London's traffic network. Not only will it relieve to some extent the existing congestion on the District line to Ealing, but it will give easy access to a district which has been peculiarly sparsely inhabited until recently, but in which several housing schemes are now being developed. The new line is, of course virtually an extension of the Central London Railway, and, though built by the Great Western Railway on the system now used on the former line, will be operated by the Central London Company with their own rolling stock. It is further interesting from the fact that the opportunity has been taken to make physical connections with the West London Railway at Wood-lane, with the Great Western Birmingham line at North Acton, and with the Great Western main line near the terminus at Ealing Broadway. For the moment, of course, it is not proposed to run "tube" trains over any of these lines; but the connections have already been found useful for freight traffic, and may be a great advantage in the future when electrification is more developed, especially for through traffic from the Great Western to the south and *vice versa* via the West London Railway. The lay-out at the place where the two lines join is also peculiar, owing to right-hand running being the practice on the Central London Railway. This has necessitated passing the up line under the down line at Wood-lane junction. For the present, a ten-minute service will be run on week days and a fifteen-minute service on Sundays.

The Ministry of Transport and Electrification.

IT would be interesting to know whether some remarks made by Sir PHILIP NASH at a luncheon to inaugurate the new Ealing–Shepherds Bush Railway simply represented his own personal opinion, or were to some extent a reflection of the policy of the Ministry of Transport regarding electrification. He said in effect that, while the adoption of electric working on railways would bring with it some advantages, yet there was something in steam traction still, and it behoved us to move warily and do nothing rash. In support of this argument he gave some account of an investigation which had been undertaken on the Chingford–Enfield–Palace Gates sections of the Great Eastern Railway with the existing steam trains, in which every possible source of delay was examined and eliminated, with the result that a 50 per cent. saving on the schedule had been effected. He admitted, however, that this result had only been made possible by a fixed determination on the part of the officials to make the trials a success, and by the assistance of the public. In a word, by inaugurating a competition to see who could work the trains in and out of the station the fastest, in which railway servants, public, and, we suppose also, the directors, joined.

A Curious Policy.

We are afraid that if Sir Philip Nash is hoping permanently to improve the present London suburban service by such means, and so to avoid electrification, he will be disappointed. Such efforts on the part of the public are at best ephemeral, and, even were they not, it is clear that with traffic growing at the present rate such a solution could at best be a temporary one. We are a little at a loss to know why Sir Philip Nash wishes to postpone or to avoid electrification. Surely it cannot be to save money! But, even if it were, it would at best be a short-sighted policy, for true economy is not saving on every account, but curtailing expenditure on objects which are useless or on accounts which bring no adequate return. As Sir John Aspinall rightly pointed out some years ago, electrification does not save money, but rather allows more money to be earned by enabling a larger traffic to be carried over the same sections more quickly, more comfortably and more efficiently than is possible with steam working. Though we welcome any signs of economy from a Ministry whose very existence is a monument of a spendthrift policy, we hope they will not inaugurate their conversion by saving on the wrong things.

Formation of Joint Electricity Authorities.

Fairly good progress has been made by the Electricity Commissioners with the work of provisionally determining the areas of Electricity Districts. Up to the present some seven districts have been mapped out, and notice of intention to hold a local inquiry has been given in each case. The problem of creating a Joint Electricity Authority is not, however, so easy to solve as the delimitation of an area, and so far as we are aware only one draft scheme—that of the Severn Valley—has been settled. Naturally, the preparation of a scheme for the co-ordination of all the supply authorities in a district where there are a number of local authorities and companies to be consulted needs careful consideration, and some time is required before all the parties can be got to agree to a common plan of organisation and development. We are not, therefore, greatly surprised to learn that the representatives of the electric supply undertakings in the South-east Lancashire area, who have only recently formed a committee to prepare a scheme for the district, have asked the Commissioners to postpone their inquiry from the end of October until March next. This seems a long delay, but if in the interval a carefully-thought-out project is prepared, and accepted by the local authorities and companies affected, it will in the end mean an economy of time and labour.

Effect of Delay.

Some of the minor local authorities—Urban and Rural Councils—are getting impatient at the delay in the formation of Joint Electricity Authorities, for they are anxious to obtain the advantages of electricity supply, and they find existing undertakers unable or unwilling to give a supply, either in bulk or otherwise, until the present period of uncertainty has disappeared. A case in point is Crompton, in Lancashire, whose Urban Council has been urging Oldham Corporation for a long time to give a supply in their district. Oldham is reluctant to do so until all arrangements have been made for the formation of an authority. In cases such as these we think the Commissioners might consider the grant of a special order to either Crompton Council or to Oldham Corporation to enable a temporary supply to be given, leaving the question of the adjustment of areas to be settled when a joint authority is being formed. It is true that what is known as a "fringe" order can be applied for under Sec. 6 of the Electric Lighting Act, 1909, to give a supply to special consumers; but this method would not apply to an entire urban area. There are several districts in the same position as Crompton, and we hope, therefore, that the Commissioners will push forward the work of settling their draft rules for applications for special orders under Sec. 26 of the 1919 Act, and thus enable the supply industry to expand in a normal, legal manner.

Electricity Supply and Rates and Taxes.

Our prediction that finance would be the rock on which the Electricity Supply Act would split is shortly likely to be fulfilled if wiser counsels than those which seem to control the Association of Municipal Corporations do not prevail. A deputation from this Association headed by Sir Robert Fox, Town Clerk of Leeds, was recently received by Mr. Arthur Neal, M.P., Parliamentary Secretary to the Ministry of Transport, and requested that the £25,000,000 placed at the disposal of the Electricity Commissioners in the new Electricity (Supply) Bill should be used to assist the new Joint Electricity Authorities in dealing with the preliminary capital expenditure necessary for carrying on their duties. In other words, that the taxes should do their part in starting the flow of the new "rivers of power" as well as the rates. The argument in favour of this is the superficially well-founded one that municipal authorities have great difficulty in raising money at the present time. But behind it is the more real, but less well founded, one that some municipal authorities might be called upon to expend from their rates a greater or less sum in helping to develop not only their own districts but also some one else's. This is, of course, anathema to the proper shellback municipal financier.

The Municipal Guarantee.

This little storm has been precipitated by the inclusion in the "Scheme for the Formation of the West of England Electricity Authority" of a clause enabling the Authority to issue precepts on the rates of the local authorities in the area. It was pointed out that this clause had been inserted by the undertakers themselves, that the Commissioners had not yet approved of it and that the Authority could impose no such obligation on any municipality. Nevertheless the Association of Municipal Corporations have been badly frightened. We are exceedingly glad the point has been raised, for it indicates the nature and direction of the opposition that may be expected to the formation of these Authorities. In an area that includes a number of progressive municipalities, as we have no doubt most of them are, no difficulties will be made about raising money that is going to be used for the development of the area as a whole, and the money itself will be forthcoming when the public see that the development is going to be carried out in an economical and business-like way. As Mr. Arthur Neal pointed out, after the first year or two the rates will really only be needed as guarantees, and unless the charges are so high as to prevent the Authority doing much less business than can reasonably be expected there will be no actual call on local purses. With good management, the will to co-operate and progressive ideas we feel sure that most of these difficulties which now loom so large in some quarters will easily be overcome. We are sorry to see that Bath is taking up a very extraordinary attitude, which is neither much credit to their good sense nor to their progressiveness.

Inductive Interference.

We understand that the report of the Committee of the National Electric Light Association on the question of inductive interference to which we recently referred in these columns has caused a certain amount of alarm in commercial and administrative circles. The fact, however, has got to be faced that where transmission lines or traction circuits are in operation telephonic communication is necessary, and that this communication is most conveniently and often necessarily effected over circuits which run close to the power lines. In considering this question, therefore, the principal object should be the discovery of methods which will enable telephone and power lines to be run together without the present trouble from inductive interference being experienced.

Counteracting Methods.

A large amount of information on this subject is given in a volume some 4½ in. thick recently issued by the Railway Commission of the State of California, where, of course, the question is of great importance owing to the presence of a large number of very high tension power lines, though it is disappointing to find that the cognate subject of interference by electric railways and tramways has not yet been considered. As Mr. J. A. Lighthipe, chief electrical engineer of the South California Edison Company, points out in a recent issue of the "Electrical World," inductive interference can be largely reduced by scientific transposition and by the use of prime movers with an appropriate wave form. Both these methods are, of course, only applicable to new work, although the correction of the wave forms at present employed is to some extent possible. He also suggests the possibility of suppressing harmonics by attaching a small generator with the necessary characteristics to the main generator shaft to produce a current corresponding to the harmonics in the main generator wave. This current would be superimposed on the primary wave at 180 degs. phase angle and would thereby counteract the original harmonics. Similar generators might under certain circumstances be connected directly to the telephone lines in opposition to the interfering wave induced in the circuit. The subject is one which is likely to become of great importance in this country, and some investigation into it is urgently necessary.

An Opportunity Missed.

A week or two ago we called attention to the paucity in number and poorness of quality of the electrical exhibits at the "Great Victory Exhibition" at the Crystal Palace. It would seem, however, that the electrical firms knew what they were doing when they either refused to exhibit or neglected to give of their best to adorn the recently opened buildings at Sydenham. For a number of those firms who have exhibited are so disappointed at the results that they have felt obliged to protest against the lack of efficient management by the exhibition authorities. This is sufficiently indicated by the absence of proper advertising arrangements and of the slightest effort to attract foreigners and other buyers who would undoubtedly be interested in the goods exhibited. For example, it is stated that no boards of direction are available in the exhibition, and some of the stall holders have found that the main part of their business has been answering the inquiries of wanderers who have lost their way. We appreciate the point of view of the signatories of the letter who took part in this demonstration of British industries in the hope that they would get a fair return for their money. There is, however, a larger question. Here was a great opportunity for exhibiting the progress and present condition of British trade. When we called attention to this exhibition before we blamed manufacturers for failing to seize this opportunity. It seems our strictures should be widened in scope and increased in severity. In conception, no less than in execution, the whole affair is an example of pitiable bungling.

"Increased Cost of Living" and Industry.

The effect of the "increased cost of living" on the fortunes of an industrial undertaking is well illustrated by some figures given by Dr. Charles Carpenter in a recent issue of the "Gas World." He compares the financial position of the South Metropolitan Gas Company for the year ending June 1914 with that for the year ending June 1920. The dividend on the ordinary stock was 6·24d. per 1,000 cubic ft. of gas sold in the first of these periods and 3·49d. in the second, while salaries increased from 1·64d. to 3·23d., coal from 16·02d. to 38·14d., and wages from 10·87d. to 36·22d. per 1,000 cubic ft. of gas sold. As Dr. Carpenter truly says, there is no profiteering here, and the situation is one which must be viewed with the greatest alarm not only by the shareholders but also by the employees who are co-partners in the undertaking. No company can continue to live under such conditions, and it must be realised that the only way to improvement lies through economy and hard work. We should like to see similar figures from some electricity undertakings. We have no doubt the same lessons could be drawn.

The Overtime Ban.

We think that the conference of the representatives of the Engineering Trades Unions can hardly realise the effect on the well-being of the community generally (to say nothing of themselves) of the decision they came to on Saturday on the question of overtime. They have, in fact, determined to restrict overtime throughout the industry and rigidly to enforce this restriction "on all classes of work irrespective of whether it be of a productive nature or breakdowns, or repairs to plant, maintenance or repairs generally, except in cases involving loss of life or limb." This decision is, of course, a sequel to the recent award of the Industrial Court and is a variation of the ca' canny movement which has the advantage that it can be carried on with a minimum of personal inconvenience to its protagonists. But the result can only be a further limitation in our already restricted output, a further increase in prices and yet more delay in placing industry generally in a stable condition. What the Trade Unions have to gain from such a policy it is difficult to see. But with too many of these organisations the desire to obtain a fleeting advantage is greater than the stabilisation of their future position in the industrial world.

Housing Schemes and the E.T.U.

The delay in turning the paper housing schemes into something more concrete in the way of bricks and mortar is having a bad effect on the fortunes of the E.T.U. In many districts there is a high percentage of unemployment, and this state of things is rather likely to increase than to diminish. Apart from the slowness with which the new work is coming forward, there is another reason for this state of affairs, and it is a reason for which the members of the E.T.U. are themselves partly to blame, and from which they—and, indeed, Trades Unions in general—might draw some useful lessons as to future policy. High wages mean high prices. High prices encourage the consumer only to purchase when he is absolutely obliged. Restricted purchase means less work. Less work means unemployment. Unemployment means that high wages are not much good. It is not a vicious circle, but it is a cycle of events that is just as harmful to the general body of labour, and Labour itself has the easy remedy.

Education in London.

The Education Act of 1918 imposes new responsibilities both on the parents and on the employers of young persons. In accordance with its provisions such young persons of both sexes, whether employed or not, must, after an appointed day, receive instruction in special continuation schools up to the age of 18. It rests to some extent with the Education Authority to determine along what lines the curriculum in these schools shall proceed, but it is obvious that to be of any real use its details should largely be governed by the occupation the child is following during the rest of his time, and that, for instance, a boy who is working in an engineering shop in the day time should not be allowed to take a course in the afternoon which is mainly concerned with the study of Greek verbs or architectural decoration.

Population and Occupation.

In a place of the size of London to accomplish this desideratum means that numerous difficulties must first be overcome. As the Education Committee of the London County Council point out in a very interesting draft scheme which they have recently prepared, the " locality " for whose education they are responsible, includes the largest aggregation of population known to industry, a population, moreover, of all grades of wealth and engaged in all sorts of occupations, from international finance to market gardening. In spite of the restrictions imposed by the London Building Acts and by the ever-increasing rates London is still one of the largest, if not the largest engineering centre in the country, while the manufacture of scientific instruments, of motor cars, of aeroplanes and of the various class of goods comprised under the heading of the metal trades is largely carried out, especially by numbers of small employers of labour. Fortunately the task of the London County Council as Education Authority is made easier by the segregation of these trades into areas, and by the excellent work which they themselves have been doing during the last ten or fifteen years in the co-ordination of the various educational facilities and in the development of these facilities both in number and usefulness. Indeed, it is not too much to say that they have, in a great measure, anticipated many of the reforms legalised by the Act of 1918.

The magnitude of the task is evident from the statement that the Educational Budget of the County amounts in 1920-21 to £9,351,294 for elementary education, and to £2,360,085 for higher education. Nevertheless these sums will have to be largely increased if London and London's children are to possess the educational system that will enable them to keep well in the van of industrial progress.

The Growth of Technical Education.

Education in London as elsewhere was first carried out, often very inefficiently, by private endeavour, and was confined to instruction in primary subjects. After a time, however, Mechanics' Institutes, providing instruction in one or more special subjects of a technical character, were established, while the opening of the Birkbeck College in 1823, and of the various polytechnics in later years, provided for the study under one roof of a large variety of subjects of this nature. And at the present time, though progress has been unequal, there are comparatively few industries which are not catered for in the technical education system of the Council. Nevertheless, none realise better than the Education Committee that there is still a great deal to be done.

The Decentralisation of Instruction.

The rapid growth of these institutions, however, carried with it the disadvantage of overlapping, with the inevitable result that some subjects were adequately dealt with in a number of institutions, while others were adequately dealt with in none. The Council, therefore, finally determined that an Institution whose circumstances were such that it could with advantage specialise in branches of instruction affecting one trade or group of trades should seek development in that direction rather than indulge in competition in other directions for which adequate provision was made by another Institution. This, it will be agreed, was the right policy, and has been justified by the results. This group system has been applied, among other subjects, to the teaching of both general and electrical engineering.

The Developments of Evening Work.

Since under the new Act it is obvious that a large part of the instruction must be given in the evening, that part of the report which deals with the development of evening work is deserving of close study. Institutes for giving this type of instruction were first organised in 1890, but suffering a more than usually large crop of infantile ailments made little real progress until a scheme of re-organisation inaugurated in 1905 was put into force. Their failure was principally due to incomplete control of the students, to the wrong class of teachers being employed, and especially to the students being insufficiently grounded in such subjects as English and arithmetic. Nevertheless, the lessons learnt from these failures will certainly be of the greatest use in preparing the way for the compulsory day continuation schools instituted in the Education Act of 1918. We are glad to see that the Education Committee of the Council insist on the desirability of higher elementary education and of courses of training which shall " bring these young persons on." We might add that these courses, by maintaining a proper balance between practical and literary subjects, should aim to teach that greatest of all lessons, which is to teach the child how to teach himself. This cannot be better done than, as the Committee well point out, by making the practical side of the curriculum more practical and the literary side more stimulating and inspiring. While we agree that one of the aims should be towards the satisfactory utilisation of leisure hours by literary work, by games and by social activities of various kinds.

Co-operation of Employers Necessary.

Work of this kind cannot be carried out without the cooperation both of parents and employers. It is, therefore, gratifying to note that " the attitude of employers, trades unions and workers has largely swung round from a former condition of apathy to one of anxious endeavour to secure the utmost educational facilities in respect of their trades, and that while so short a time ago as 1913 difficulties were found in compiling a list of some dozen examples of firms associated with the Council in educational work, to-day there are hundreds of firms so associated." This is a great advance

ACCOMMODATION AND FINANCE.

It would seem that the only real obstacles to the proper development of this well thought-out scheme are accommodation and finance. Modern ideas and increased demands are both responsible for largely increasing requirements under the first of these heads, while no explanation for an increase under the latter head is needed. Nevertheless more and better education of the right sort is a prime necessity of present-day existence, and an excellent antidote of industrial unrest. We hope, therefore, that means will be found for bringing a scheme, upon which the Educational Committee are very much to be congratulated, to a successful fruition. We would add that the report itself is not only of great historical value, but forms a good foundation upon which an educational structure really worthy of London may be erected.

Concerning Technical Publications.

The patriarch JOB never made a truer remark than when he said that "of the making of books there is no end"; and, if newspapers and technical and trade journals had been invented in his day, we do not doubt that he would also have expressed what was in his mind about them with that forcibleness for which he has since become famous. As it is, from every quarter of the globe come, not only journals, but proceedings, transactions, reports, pamphlets, catalogues, magazines and leaflets to litter our table and to strew our office. Though possibly we are unduly favoured in this respect, for an editor's time in some people's opinion should be mainly occupied in reading what other people have written, yet it is evident that a great deal too much of what is conveniently called "matter" is being printed, to the delight of its authors and the despair of those who endeavour to keep close touch with the progress in the particular department of science or industry with which their life's work is connected.

QUALITY *v.* QUANTITY.

One of the greatest disadvantages of this state of things is that quality is submerged in quantity. A large number of the articles and Papers which are now printed are more often than not a badly hashed collection of somebody else's work, from which the essential essence has long since been distilled, leaving an unsatisfying meal of bones and gristle for anyone who is foolish enough to attempt the task of abstracting nourishment from it. And they have a still graver drawback. Like leaves in an overflowing gutter, they retard or stop the stream of what is really worth having. The problem before the editor, then, is how to select the most deserving material, and for the reader how to keep himself informed of the contents of all the articles published on any subject in which he is interested.

THE LENGTH OF CONTRIBUTIONS.

The second portion of this subject has recently received some attention from Mr. C. H. WORDINGHAM in the columns of "Engineering" and from Mr. G. DETTMAR in the "Elektrotechnische Zeitschrift." The latter truly points out that the cost of production of technical journals is likely to remain at a high figure for some time to come, and that to counteract this the length of author's contributions might be cut down and a preferential tariff inaugurated for those who can write the most concise. There is something about this idea that we like. It might kill the lengthy introduction and cause the elimination of historical matter, reference to which in a footnote or two would generally be sufficient. The fact is that long articles are not wanted in journalism nowadays. To be fair, it should be added that long-windedness on the part of authors has in the past been encouraged rather than discouraged by some editors on the principle that the quality of the contribution increases with its length, when the reverse is more likely to be the case.

Mr. DETTMAR'S second suggestion, that the same Paper should not be printed in more than one journal, is one with which no editor can be expected to agree, except on the understanding that he has first option on all articles; while the further suggestion that a contribution should be split up into sections, of which each journal should publish one, can hardly be made seriously. It is altogether too reminiscent of vultures round a corpse to be pleasant. Besides, the feelings and pocket of the reader must not be left out of consideration.

NUMEROUS ABSTRACTS.

Mr. WORDINGHAM also considers the question more from the point of view of the reader than of the editor, and from the point of view of a reader whose conscientiousness in the pursuit of knowledge must surely only be equalled by the paucity of his numbers. His suggestion is that each Institution should, besides publishing the Paper in full, also publish a separate official abstract, in a form which can easily be filed, and that technical journals should do likewise with the articles that they publish. These suggestions, in our opinion, would rather augment the ills they are designed to alleviate. Is there any office which would within a short time be able to contain all these publications? To adopt this suggestion would certainly not decrease the stringency of the Paper shortage, nor would it help to lessen the cost of production, both matters with which it is highly essential to deal at the present time. Societies might, it is true, see in it a way of saving on their more bulky proceedings, but there would be no money and a maximum of inconvenience in it for technical journals. It is a subject which, like many others, where finance must be the deciding factor.

RESTRICTION *v.* MULTIPLICATION.

In our view, the tendency should be rather towards the restriction than the multiplication of the number of publications, whether in the form of proceedings or abstracts or whatever their title may be. Societies especially might consider the desirability of restricting their production of printed matter, and rely a great deal more on the technical journals to give the necessary publicity to their meetings. At present each society, however small, thinks it necessary to publish proceedings, which represent too often, for all the good they do, a waste of effort and the absorption of material that could be much more efficiently used elsewhere. At the same time, the demands of these societies on the literary output of their members detract from the interest and influence of technical journals with a world-wide circulation. The same protest in a more forcible form may be registered against the demands made by house organs and other similar publications upon members of the staff for articles whose subject matter would ensure its authors a hearing in the columns of journals with a wider appeal. The object of all electrical engineers should be to disseminate knowledge for the general good, and this will not be achieved by publication in some small journal with an artificially limited circulation. For while it is certainly true that every industry can support one journal, it is equally true that for an industry to attempt the task of supporting more than a certain number is of no advantage to anyone.

The Ealing and Shepherd's Bush Railway.

A Useful Addition to London's Traffic Facilities.

The harassed and weary Londoner whose dormitory is in the neighbourhood of Ealing received a much-needed addition to the means whereby he can get to and from his work by the opening of the Ealing and Shepherd's Bush Railway on Tuesday of this week The history of the extension is interesting. The Great Western Railway obtained authority for the new line in 1905, while the Central London Railway also obtained powers to connect their line with the Great Western new line at Wood-lane, and to extend their trains to Ealing in 1911.

The works were commenced at the beginning of 1913, and although a good deal of progress was made with the construction of the railway prior to August, 1914, the incidence of the war delayed the completion of the work, particularly so far as the electrification of the line was concerned, as it was not possible to secure the necessary equipment. Since the Armistice, however, the Great Western and Central London Companies have respectively done everything possible to complete the railway and provide the necessary rolling stock for the extension of the train service to Ealing Broadway, with the result that we have just mentioned. The new line forms a connection with the West London Line near Uxbridge-road, and is available for use by G.W. passenger and goods trains. Freight traffic has already been conveyed over it by G.W. steam trains, and great precautions have been taken to see that the settlement of the embankments, &c., is complete.

Starting from Ealing Broadway the new line parallels the G.W. main line for about half a mile, after which it turns northwards towards the G.W. London and Birmingham line, adjacent to which it pursues its course to Old Oak Common, running underneath the G.W. railway lines at that point, and proceeding along the west side of Wormwood Scrubbs. Physical connection is made with the Central London Railway at Wood-lane.

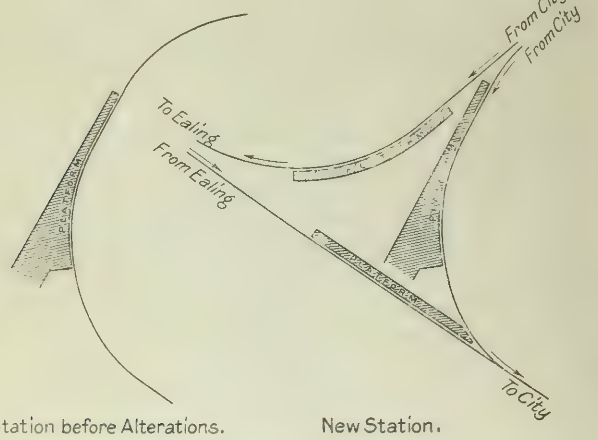

FIG. 1.—DIAGRAM OF WOOD-LANE STATION BEFORE AND AFTER ALTERATIONS.

To deal with the new traffic additional platforms have been constructed at Ealing Broadway Station, a new station has been erected at East Acton, and additional platforms have been provided at Wood-lane Central London Station, a modification in the arrangement of the platforms at the last station being necessary, as shown in Fig. 1.

Besides forming a new outlet for the excessive traffic to Ealing now carried by the District Railway, the new line, which is 4 miles 22 chains long, will develop the districts through which it passes. In fact, new houses have already been erected at East Acton, and the housing schemes in progress will be facilitated. The many works at Park Royal and Willesden will be benefited, and residents at Ealing and in Great Western main line districts are afforded another and a more direct route with the West End and City of London, with connections on the Central London Railway to all parts.

POWER SUPPLY.

The electrification of the new line has been carried out on the same principle as is already operating on the Central London Railway—*i.e.*, with centre positive conductor rail and running rail return. The necessary energy is supplied from the Great Western Railway Company's power house at Park Royal, at 6,600 volts three-phase, and this is transformed and converted to 600 volts direct current at Old Oak Common sub-station, whence the supply to the line is given. In addition to a supply for traction purposes a single-phase supply at 460 volts is provided for the electric signalling system.

SIGNALLING.

The working of the trains is safeguarded by the provision of automatic signalling, the line being divided into sections, eight on the down road and nine on the up road, the longest section being about 1,100 yds., thus enabling a service with the minimum of interval being run when necessary. There are three signal boxes. One at Wood-lane Junction, which controls a fly-over junction connecting the West London and West London Extension lines to Addison-road and Clapham Junction with the E. & S.B. Railway. This signal box works the facing points of the junction mechanically, and electrically controls the necessary signals for the protection of the junction. The North Acton signal box controls the junction between the Ealing and Shepherd's Bush line and the Great Western direct line to Birmingham; while the Ealing Broadway signal box controls the working in and out of the station of that name, though for economical working its inter-locking apparatus is operated from the District Company's signal box. This box is of the electro-pneumatic type, there being six sets of points. All signals are of the three-position type worked in the upper quadrant, and are controlled by alternating-current track circuits, giving the following indications: Horizontal, red light, danger; 45 deg., yellow light, proceed with caution; vertical, green light, proceed at normal speed.

These signals are put to "danger" on the passing of a train, and do not again alter in position until the train has cleared the track circuit of the section ahead, when the signal arm falls automatically to the 45 deg. position. Upon the train clearing the second section ahead the signal assumes the vertical position. At the junctions the signals are controlled by the signalmen in addition to the track circuits.

In each signal box there is an illuminated diagram by means of which the signalman is able to follow the movements of trains over the sections of line applying to the signal box. At each signal a train stop is provided working in conjunction with the signal arm, which on being passed in the "danger" position automatically applies the brake on the train. For foggy weather repeating light signals are provided throughout the line at a distance of 200 yds. from the signals. These are operated when necessary by means of switches.

The work in connection with the signalling system has been carried out by the McKenzie Holland & Westinghouse Power Signalling Company, under the direction of the signal engineer of the Great Western Railway.

ROLLING STOCK.

The trains used on this line consist of six cars—two motor cars and four trailers. The trailers are standard C.L.R. stock, while the motor cars were specially designed for this extension.

The control equipment supplied by the B.T.-H. Company is of the relay automatic type. The normal position of operation with this system is to place the controller at once to the full on position when starting a train. The contactors are then picked up in their correct sequence by the current limit relay, which operates as soon as the motor current has dropped to a predetermined value.

The relay consists of one main and two shunt coil. The latter carries current equal to that of one motor only. The actuating coils of the contactors are energised through one or other of the two shunt coils in a manner such that, if one is energised through one shunt coil, the next one to close will be energised in series with the other shunt coil. The two relay shunt coils act on two plungers controlled by gravity. Each plunger, when in its normal position, closes a disc switch in series with the other shunt coil; but when raised (due to its coil being energised) opens this switch. Thus, when one of the plungers is raised the shunt coil acting on the other cannot be energised because of the break in the circuit produced by the abovementioned switch, but although it is the control current that raises the plunger so as to produce this break it is the current passing through the main coil which maintains the break, and the plunger is not released until this current has dropped to the pre-determined value. Then the plunger falls and closes the switch which completes the circuit for the next contactor coil to be energised.

PRINCIPLE OF THE METHOD.

The principle underlying the method of control adopted in connection with the current limit relay is that after a contactor has been picked up, as described above, its coil is immediately trans-

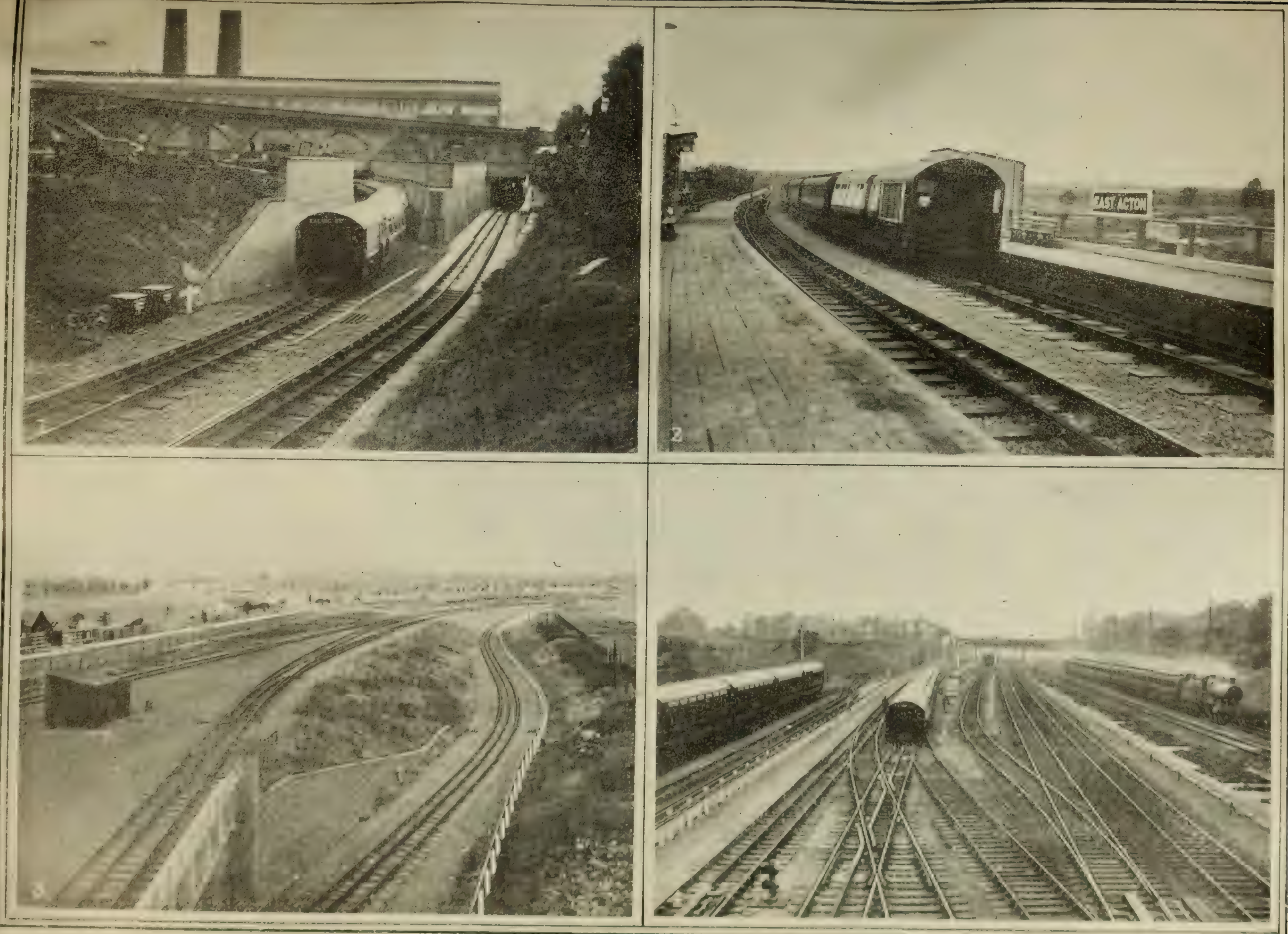

FIG. 2. SOME VIEWS ON THE EALING AND SHEPHERD'S BUSH RAILWAY.

1.—THE APPROACH TO WOOD LANE LOOKING EAST.
2.—EAST ACTON STATION.
3.—FLYOVER JUNCTION. NOTE "SPRING" POINTS OPPOSITE HUT.
4.—LOOKING EAST. GENERAL VIEW OF TRACKS FROM EALING BROADWAY STATION.

ferred by means of interlocks to another wire. There are thus essentially two operating wires, the picking up wire and the retaining wire (although other wires are introduced for forward and reverse, circuit-breaker setting, &c., &c.).

As there are no main 'bus lines down the train a potential relay is fitted on each motor car, which drops all contactors on that car when the motors lose current. This is necessary, because when no current passes through the main coil of the current limit relay it ceases to exercise its control over the rate of picking up of contactors. The controller has four forward points and two reverse (series only), of which Nos. 2 and 4 are running points, where all resistance is cut out.

A useful provision in the control is that if in the course of the automatic notching up, the controller handle is brought back to the first or third notch as the case may be, the automatic closing of contactors is stopped, but these already closed are kept up.

SAFETY DEVICES.

The working on the safety button of the controller handle differs from the C.L.R. standard in that the safety button can be released, except when the handle is at off position. If, however, the handle itself be let go, it flies back to off position when current is instantly cut off, and the brakes applied throughout the train.

Another safety device is the control circuit governor. By interrupting one of the control circuits it prevents the train being driven forward unless the train pipe of the Westinghouse brake is charged with air and the trip cock is cut in.

Each motor car is fitted with two G.E. 212 motors of 240 H.P. geared for a free running speed of 35-40 miles per hour. The brake equipment is Westinghouse with improved triple valves on the motor cars and quick-acting triple valves on the trailers. The brake blocks are of unchilled cast iron. The air compressor is of the B.T.-H.C.P. 28a type.

ROLLING STOCK.

It will be seen from the illustrations that motor cars are provided with a covered vestibule at the trailing end, and that middle doors have been fitted. The control of the latter is similar to that previously described in connection with new stock for the Queen's Park extension on the L.E.R. The interior steel panels of the motor cars are painted a light brown to tone in with the colour of the moulding, &c., which are of teak or steel, painted to match. The lamp fittings and ends of cross-seats are finished in oxydised bronze; other fittings are of aluminium alloy. The ceiling of the arched roof is enamelled flat white. With regard to ventilation, in addition to the ordinary drop lights, an air duct with perforations runs the whole length of the motor car, and is open to the air at the ends.

The motor cars are constructed mainly of steel, with some teak interior finish. The sole bars consist of 12 in. by 4 in. by 6 in. bulb angles, upon which the body framing is built up. The motor trucks are built of plate and angle iron. The trailer trucks are built up of pressed steel sections, and are fitted with the ordinary laminated side-bearing springs. The motor cars were constructed by the Cammell Laird Company, from designs prepared in the Ealing Common drawing office of the Underground Companies. The leading dimensions and weights are as follows: Length overall, 47 ft. 9 in.; width over body, 8 ft. 9 in.; total height from rail, 9 ft. 3½ in.; centres of bogies, 29 ft. 6 in.; diameter of motor wheels, 36 in.; wheel base of motor bogie, 6 ft. 8 in.; diameter of trailing wheels, 29 in.; wheel base of trailer bogie, 5 ft. Weight of car completely equipped: Motor end, 22½ tons; trailer end, 9½ tons; total, 32 tons. Total weight of six-car train (unloaded), 128 tons.

On the Energy in the Magnetic Circuit of a Magneto.[*]

By N. W. McLACHLAN, D.Sc.(Eng.), M.I.E.E.

(*Concluded from page* 130)

Taking now the second case in which the gap is constant and the equivalent and actual lengths of the horns and the central portion of the armature are variable, we have for the equation of the magnetic circuit

$$\frac{H_m}{B_m} l_m \cdot \mu = D_2 + M_1 L_a, \quad \text{where } D_2 = \mu L_g + L_p.$$

$$\therefore \quad L_a = \left[\frac{H_m}{B_m} l_m \mu - D_2\right] 1/M_1. \quad \ldots \quad (19)$$

Substituting this value of L_a in (13), we obtain energy

$$W = \frac{B^2_m}{8\pi}\left[Q\left(1 + \frac{1}{M_1}\right)\left(\frac{H_m}{B_m} \cdot l_m \cdot \mu - D_2\right) - (E - F)\right]$$

$$= \frac{B^2_m}{8\pi}\left[\frac{H_m}{B_m} K_1 + K_2\right]. \quad \ldots \quad (20)$$

where K_1 and K_2 are constants.

$$\therefore \quad W = a(by^2 + xy). \quad \ldots \quad (21)$$

where a and b are constants.[†]

From the preceding analysis, *i.e.*, (16) to (18*a*), it is clear that in this instance also there is a certain value of $y = B_m$ for which the available energy is a maximum. In this case the actual and the equivalent gap is fixed, so that the above condition is obtained by varying the lengths of the iron components mentioned above. The value of the armature diameter obtained in this way might be beyond the limits of practical construction. Neither of the preceding cases actually arise in practice, since armature reaction has been neglected.

The maximum armature reaction occurs when the primary is short circuited at high speeds and the current is a maximum in the position shown by Fig. 1. In effect, armature reaction is equivalent to increasing the reluctance of the circuit external to the magnet. From Appendix 2 we see that at high speeds the armature ampere turns depend approximately on the flux. Thus we can write demagnetising armature ampere turns $= \frac{JB_m}{4\pi}$, where J is a constant.

The preceding analysis dealing with the reluctance of the magnetic circuit has been based on the position illustrated in Fig. 3. It is in the position of Fig. 1, however, that the armature reaction should be taken into account. This difficulty can be surmounted, in order to preserve uniformity in the analytical treatment, by choosing a value of the constant J to be applied in the position of Fig. 3, so that the actual reluctance of the armature in Fig. 1 position, plus that equivalent to armature reaction in this position, is equal to that of Fig. 3 (including reaction).

Thus

$$H_m l_m - J_1 B_m = \frac{B_m}{\mu}(\mu L_g + L_p + L_a);$$

$$\therefore \quad \frac{H_m}{B_m} l_m \cdot \mu = (\mu L_g + L_p + L_a + J_2).$$

where $J_2 = \mu J_1$ and $J_1 = aJ$, a being constant.[‡]

The energy equations for these conditions are found by substitution in (12) and (13). They are as follows:—

Case 1.

$$W = \frac{B^2_m}{8\pi}\left[F_1' + \frac{H_m}{B_m} \cdot l_m\right] \quad \ldots \quad (22)$$

where $F_1' = D - \left(G + \frac{D_1'}{\mu}\right)$; and $D_1' = L_p + L_a + J_2$.

$$\therefore \quad W = a(by^2 + xy. \quad \ldots \quad (23)$$

In this case the air gap is variable.

Case 2.

$$W = \frac{B^2_m}{8\pi}\left[K_2' + K_1' \frac{H_m}{B_m}\right]. \quad \ldots \quad (24)$$

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[*] This Paper was received by the Editor on February 23, 1920.

[†] b can only be considered constant for a limited range of y. This applies throughout the analysis.

[‡] From hypothesis (d) we get $d = 1$. In practice, however, it might be necessary to disregard (d).

where $K_2' = (E - F) + Q(1 + 1/M_1)D_2'$, $K_1' = K_1$,

and $D_2' = \mu L_1 + L_p + J_2$.

$$\therefore \quad W = a(by^2 + xy). \qquad (25)$$

In this case the length of the armature horn and centre portion are variable.

Hence the energy equation, with or without armature reaction is of the form given by (25). In whatever way the magnet flux is varied by alterations in air gap or armature, there is a certain value of $y = B_m$ for any given length and type of magnet, for which the energy is a maximum. It does not follow, however, that the dimensions of the armature would fall within the limits of practical construction. Since it has been assumed that there is neither iron nor copper loss, the above conclusions are approximately correct only when the variation of primary current with speed is small, *i.e.*, at fairly high speed.

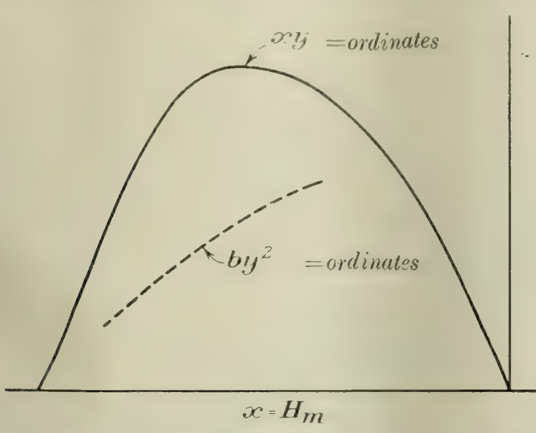

Fig. 5.—Diagram showing $W_1 = xy$ and $W_2 = by^2$, being terms in Equation (25).

In practice the value of b in equation (25) will generally be negative. This is due chiefly to armature reaction. In the absence of armature reaction it might be zero or positive. Considering the three cases, (1) positive, (2) zero, (3) negative, we find that for maximum energy in case (1) the flux density in the magnet is greater than that when the product $H_m B_m$ is a maximum; in case (2) the flux density is equal to that when $H_m B_m$ is a maximum; in case (3) the flux density is less than that when $H_m B_m$ is a maximum. Hence we conclude that in any of the three cases the hysteresis quadrant ought to approach a rectangle in shape, and particularly in the case where b is negative, the coercive force should be large. The effect of the algebraic sign of b * on the energy curve is shown in Figs. 5 and 6.

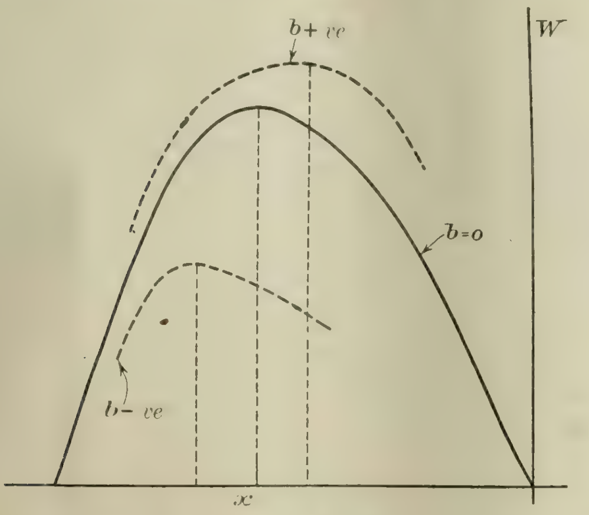

Fig. 6.—Diagram showing Curves $W = a(by^2 + xy)$ for b Positive, Negative and Zero.

Although the analysis is only valid when the assumptions are not violated, it is possible to construct energy curves for actual machines for the armature positions of Figs. 1 and 2. Allowance would be made for variations in the different factors with varying armature diameter and flux. By this procedure any point on the energy curve would be obtained using data which differed from that of other points. The analysis is sufficient to show, however, that in the actual magneto there is a certain condition under which the maximum available energy in the primary winding can be obtained.

Appendix 1.

The Energy of Magnetised Iron.

The usual method of treating the energy recoverable from an iron-cored magnetic circuit is to use the expression, energy $= \frac{BH}{8\pi}$ or $\frac{B^2}{8\pi\mu}$, where B is the flux density and H the magnetising force actually operative on the iron, *i.e.*, $H =$ External magnetising force − Demagnetising force due to free magnetism. The late Lord Rayleigh† and Sir J. Larmor‡ have discussed the question of the energy associated with magnetised iron. They have shown from theoretical considerations that the above expression does not represent the total energy. Sir J. Larmor gives the expression, energy

$$W = \text{Electrodynamic component} + \text{Magnetic component}$$

$$= \frac{BH}{8\pi} + \frac{BI}{2} \text{ per unit volume, where}$$

$$I = \text{Intensity of magnetisation} = (B - H)/4\pi.$$

Substituting in the above expression for I, we obtain

$$W = \frac{B^2}{8\pi} = \mu\left[\frac{BH}{8\pi}\right].$$

We can also write this expression in the form,

$$W = \frac{B^2}{8\pi\mu}[1 + (\mu - 1)].$$

Thus the second term is $(\mu - 1)$ times the value of the first term. The first term represents the energy which is recovered on cessation of the current, and the second represents that which remains in the iron. Owing to the absence of experimental data, however, the question of how much energy is actually available is quite uncertain. If the energy in the magneto was obtained solely by cessation of the current, and this latter was unaccompanied by oscillations, we might in the light of the above analysis be justified in taking the term $BH/8\pi$. Since oscillations occur, these must influence the behaviour of the iron, and we are left in doubt as to whether the whole or a part of the energy represented by $\frac{BI}{2} = (\mu - 1)\frac{B^2}{8\pi\mu}$ is recovered. If a definite fraction of this energy is returned, we can write W for iron, per unit volume $= Q\frac{B^2}{8\pi}$, where Q is some constant determined by experiment. Variations in Q would cause variations in the energy available and in the relationship between energy, flux density and armature length. There would not, however, be any alteration in the general trend of the above results.

The preceding argument holds chiefly when the configuration of the magnetic circuit is such that there is an appreciable amount of free magnetism causing demagnetising forces, *i.e.*, the leakage is large. In the magneto this should not be serious, since the circuit is almost completely closed, so that the magnitude of Q is less than that for an open circuit.

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* It should be observed that in this analysis the value of b is only constant for limited values of H_m and B_m, i.e., x and y. Thus in Figs. 5 and 6 the by^2 curve is restricted. If allowance were made for variations in b, the energy curves would pass through the points $x = 0$, $y = 0$; $x = 0$, $y = 0$.

† "On the Energy of Magnetised Iron," "Phil. Mag.," Vol. 22, p. 175, 1886.

‡ "On the Electrodynamic and Thermal Relations of Energy of Magnetisation," "Proc." Roy. Soc., A, Vol. 71, pp. 229-239, Feb. 1903.

APPENDIX 2.

THE ENERGY OBTAINABLE FROM A MAGNETIC FIELD.

Suppose that a resistanceless coil of self-inductance L is rotated in a uniform magnetic field of intensity B from the

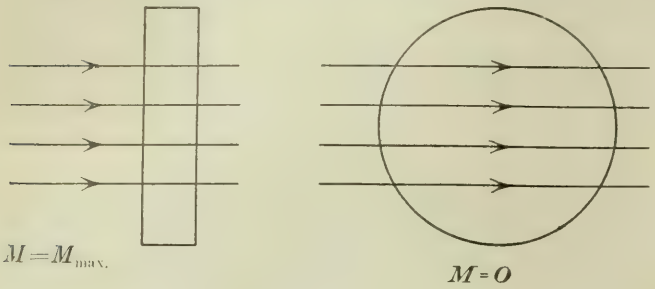

FIG. 7.

position $M=M_{\max.}$ to $M=0$ (see Fig. 7). We have the following equation due to Maxwell :—

$$-L\frac{di}{dt}=n\frac{dN}{dt} \tag{1}$$

Where N=total flux through coil=BA, and n=number of turns.

From (1) we have

$$-L\,di=n\,dN \tag{2}$$

and the current is independent of the speed ;

or $$-Li=nN+a \text{ Constant.}$$

When $i=0$, $N=N_{\max.}$. Hence Constant$=-nN_{\max.}$.

$$\therefore \quad Li=n(N_{\max.}-N) \tag{3}$$

Since the rotation stops when $M=0$, N is also 0; and

$$\therefore \quad Li=nN_{\max.} \tag{4}$$

$$\text{Now energy}=\tfrac{1}{2}Li^2=\tfrac{1}{2}\frac{(Li)^2}{L}=(nN_{\max.})^2/2L.$$

But L=Const.$\times n^2$, where Const.$=KA/l$, and $K=a$ const.,[*] A=area, l=length.

$$\text{Hence Energy}=(N_{\max.})^2/2\text{ Const.}=(B_{\max.})^2Al/2K.$$

$$\propto (\text{Flux Cut})^2. \tag{5}$$

From (4) $$\text{Const.}\times n^2 i=nN_{\max.};$$

$$\therefore \quad ni=\frac{N_{\max}}{\text{Const.}}$$

Thus if the self-inductance is altered so that the constant is the same, the ampere turns do not vary, although the actual number of turns on the coil is increased. This could be effected by reducing the size of the wire and preserving the same over all dimensions. Since the electromagnetic energy $=\tfrac{1}{2}\text{const.}(ni)^2$, it follows that this also is unaffected by varying the number of turns. These conclusions only hold when the coil is resistanceless and the flux cut is constant, *i.e.*, $N_{\max.}$ is constant. In the magneto things are somewhat different owing to iron and copper loss. It is evident that the nearest approach to the ideal[†] would be attained by using very thin high resistivity—low hysteresis armature laminations, and a primary of a few turns of thick wire. There are two reasons why the latter suggestion is impracticable : (*a*) the large currents at break would cause serious flashing at the contacts, which could not be eliminated by a condenser of reasonable capacity ; (*b*) the primary self-inductance under the oscillatory discharge would be so small that the secondary peak voltage would suffer great reduction. It is evident from the above that the primary current will be reduced by increasing the number of turns, since this increases the self-inductance and the resistance. Owing to increased resistance, the current and energy are decreased at low speeds. At high speeds the inductive reactance is very much larger than the resistance, including that due to iron loss, so that the current approximates to the ideal given by the formula above. Thus if the cross-section of the core and the space allotted to the primary winding is constant, the electromagnetic energy and the ampere turns in a magneto at high speeds is approximately independent of the number of turns.

We are here faced with a difficulty concerning the meaning of the self-inductance of a magneto armature. This, however, has been treated elsewhere and reference should be made to a former Paper on the subject.[*]

APPENDIX 3.

LIST OF SYMBOLS AND CONSTANTS.[†]

$M_{\max.}$=Mutual inductance between armature and magnet in position of Fig. 1.
H_m=Magnetising force on magnet hysteresis quadrant of Fig. 4.
=Demagnetising force due to circuit external to magnet.
B_m=Flux density in magnet.
μ=Permeability of iron components of magnetic circuit external to magnet.
W=Energy available from magneto.
A_m, A_p, &c.=Cross-sectional area of magnet, pole shoe, &c.
l_m, l_p, &c.=Actual length of magnet, pole shoe, &c.
L_p, &c.=Equivalent length of magnet, pole shoe, &c.
Q=Constant in energy equation $W=QB^2/8\pi$.
$D=Q[2(L_p+L_h+L_k)+L_g]$.
$D_1=(L_p+L_h)$.
$D_1'=L_p+L_h+J_2$.
$D_2=\mu L_g+L_p$.
$D_2'=\mu L_g+L_p+J_2$.
$E=2[Q(L_p+L_h)+L_g]$.
$F=(QL_p+L_g)$.
$F_1=Q\left[L_p+2(L_h+L_k)+L_h\left(\frac{1}{M_1}-1\right)\right]-(L_p-L_h)\,\mu$.
$F_1'=F_1-J_2/\mu=F_1-J_1$.
$G=Q(L_p+M_1L_a)$.
J=Factor for demagnetisation due to armature reaction.
$J_1=\begin{cases}\text{Factor for demagnetisation applicable to position of Fig. 3.}\\ \alpha J.\end{cases}$
$J_2=\mu J_1$.
$K_1=\mu Q l_m(1+1/M_1)$.
$K_1'=K_1$.
$K_2=Q[L_p+2L_h-(1+1/M_1)(\mu L_g+L_p)]+L_g$.
$K_2'=K_2-QJ_2(1+1/M_1)$.
$M=l_aL_g$.
$M_1=L_h/L_a$.

"Alternating Current Work," by A. Shore, is a small book on elementary alternating currents apparently intended for the use of wireless operators. It gives a short account of the production of an alternating current, and then discusses the effect of introducing resistance, inductance and capacity into the circuit. Transformers and electrical measuring instruments are briefly dealt with, and there is a good chapter on high frequency resistance. There are a number of misleading diagrams, and some confusion of ideas in some of the statements made, which it would be better if the author revised before placing the book in the hands of students. Fig. 30 shows a very ambiguous diagram of a rotary converter, and the explanation of the tappings required for three-phase currents is very vague. In dealing with power, the use of the terms idle component or wattless component of the current is to be deprecated, because we cannot physically consider any part of the current idle or wattless at any time. In the chapter on inductance, where the growth of current in a solenoid is considered (p. 57) the statement is made that the current flowing in one turn is in the opposite direction to the current in an adjacent turn : Fig. 37 is ambiguous as it is not stated where the current circuit is broken, and the coefficient of self-induction is defined as the ratio of the total number of magnetic lines of force in the circuit to the current producing them. C.G.S. units are sometimes used without any explanation as to their relationship to the practical units. It would have been better in an elementary book to have left these out. There are a number of obvious misprints which require correction.

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[*] K depends on ratio of length to diameter if coil is single layer on a cylindrical former.

[†] Apart from stray losses in metal fittings. It is possible that there is short circuiting on the smooth surface of the armature after grinding, which augments the eddy current loss.

[*] Advisory Committee for Aeronautics Engine Sub-Committee Report No. 45.

[†] It should be borne in mind that the term "Constant" only applies for restricted values of H_m and B_m.

Progress in the Employment of Self-Propelled Vehicles for Industrial Purposes.

In a revised edition of his Paper on "Self-Propelled Electric Vehicles and their Applications,* Mr. L. Brookman gives an interesting account of some new designs of battery locomotive. We have the permission of the Chloride Electrical Storage Company, who in most cases supplied the batteries for this equipment, to reproduce some of the details.

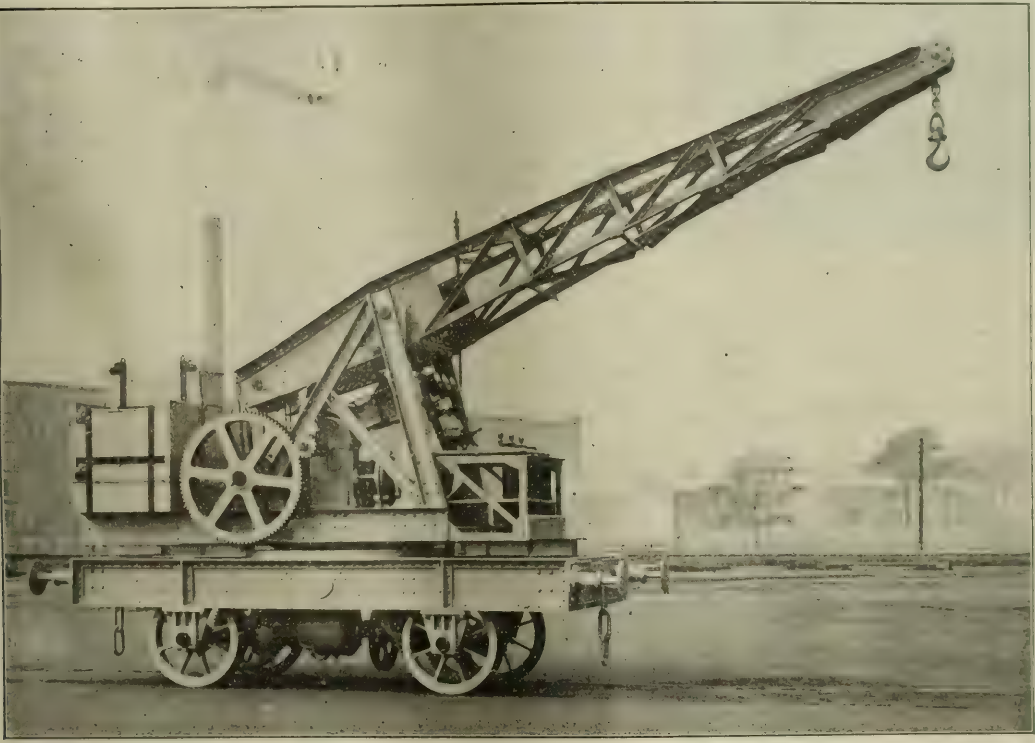

Fig. 1.—Portable Bascule Crane.

We may first mention a type of battery locomotive supplied to a Glasgow shipbuilding yard by the Metropolitan-Vickers Electrical Company. This locomotive is used for shunting purposes, hauling loads up to 100 tons at about 3 miles per hour on the average. The approximate gross weight is 14 tons. The electrical equipment consists of two standard type Westinghouse motors, slow-speed winding, series wound for 250 volts direct current, each motor being fitted with a 15-tooth pinion, which gears into a 70-tooth wheel. Electrical energy for actuating the locomotive is obtained from 160 iron-clad exide type cells, size I.M.V. 4, supplied by the Chloride Electrical Storage Company, with a capacity at various discharge rates as follows: 129 ampere hours in five hours, 114 ampere hours in three hours, 102 ampere-hours in two hours, 84 ampere hours in one hour. The battery compartments are formed by sloping extensions to the cab on the front and rear ends, and are fitted with two hinged doors in top as well as one in each side, the mild steel sheeting thereof being arranged as louvres to give efficient ventilation. The locomotive can be operated by one man, whose services are available for other duties when the work is not continuous.

Battery locomotives for double duties—hauling and hoisting combined—are a most attractive proposition for dealing effectively at a minimum cost with certain classes of shunting work. Messrs. Craven Brothers (Manchester), Ltd., specialise in equipments of this description. A bascule type of jib crane is mounted on a strong under-frame carried on two axles and four pairs of railway pattern wheels, 4 ft. 8½ in. gauge, the wheel base being such as to enable the crane to travel freely round curves of small radius. The undercarriage, at the centre, is fitted with a large-diameter circular roller path, on which the superstructure revolves by means of four conical rollers (Fig. 1). The tail of the superstructure is arranged to receive the storage battery, while at its front the operator's cab is located with all controls convenient for manipulation and a clear view of the load. A short length of chain and lifting hook are provided at the front end of the jib, the back end carrying the sheaves for the elevating motion, around which the ropes from the worm and spur gear driven barrel are reaved. A "clip" type of automatic magnetic brake and patent cut-out switches effectively prevent over-running. For revolving the superstructure a reversing motor is employed, driving, through worm gear, a vertical shaft the bottom end of which is fitted with a pinion engaging a rack on the under carriage, and fixed concentric with the roller path, a brake applied by a lever controlling this slewing motion. All the motors are series wound and totally enclosed; controllers of the tramway type are used.

Battery locomotives for running on narrow gauge tracks are made by the Brush Electrical Engineering Company, and combine a great range of usefulness with remarkable economies both in energy consumption and in wages. Fig. 2 shows the normal appearance of a factory locomotive and Fig. 3 an indoor type of battery locomotive. Hinged doors are provided on each side of front and rear battery compartments to facilitate attention to the cells. The battery equipment consists of 48 ironclad Exide cells, specially designed for traction purposes and fitted into four containing trays. For ordinary service a storage capacity of 150 ampere hours at the five-hour rate of discharge is sufficient to haul 3 to 4 tons at about 5 miles per hour—or at a somewhat reduced speed on gradients—making a total of 15 miles between charges, spread over an eight hour day. If a midday boost of one hour's duration is given, the service may be increased to, say, 10 miles before and 10 miles after the boost, the battery being fully recharged at nights. The energy consumption of locomotive and trailing load as above will thus be found to average approximately 1 unit per mile. The locomotive is mounted on four flanged running wheels of cast steel, 14 in. diameter on the tread.

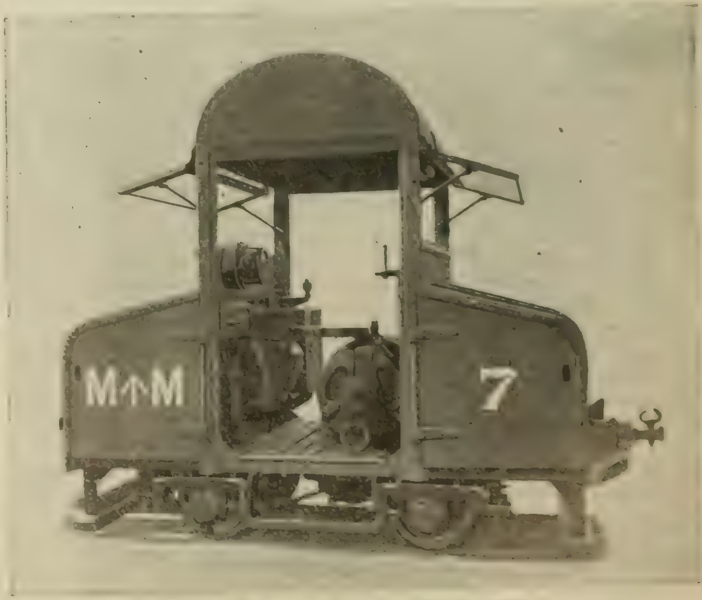

Fig. 2.—Electric Factory Locomotive.

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* The Electrician, Vol. LXXVIII., p. 703.

and about 3 in. over tread and flange. Simple spring draw and buffing gear is provided for coupling, and angle steel fenders with wood packing are fixed across each end for levering the locomotive back to the track in case of derailment. A standard "Brush" interpolar direct-current motor 80/100 volts transmits power through a countershaft, silent chain, sprockets and chain drives to each axle, the band brake acting on a cast-iron drum secured to the countershaft. The controller is arranged to give three speeds in either direction, while a circuit-breaker is fitted to guard against overloading the motor. The approximate weight is 3 tons.

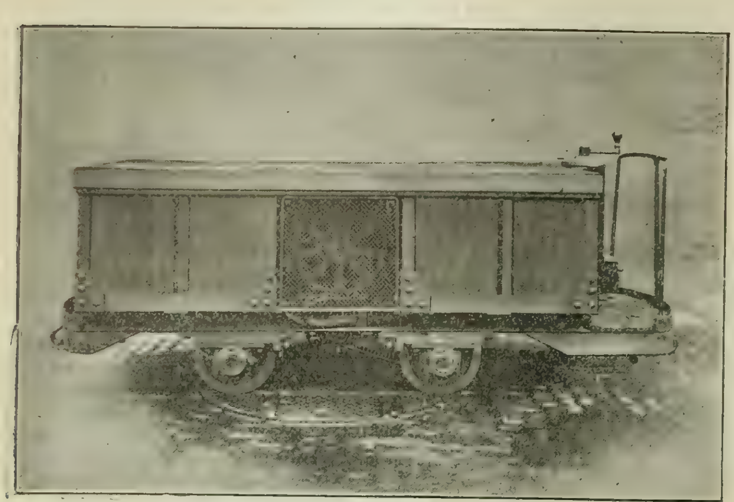

Fig. 3.—Indoor Battery Locomotive.

Further, there is the important development of the battery locomotive with auxiliary trolley-pole attachment for situations where the overhead equipment is practicable only for a limited distance compared with the total length of line over which electrical haulage has to be provided. Alternatively, such duplicate service locomotives find ready application in mines, tunnels and localities with low head room generally, or where any tendency to arcing at the trolley wheel might constitute an element of danger. This arrangement is remarkably flexible, and gives many advantages. The current taken from the trolley wire can be made a fixed amount at all times—say, for example, 80 amperes. If the locomotive requires less than this, then the balance goes as a charge into the battery while the locomotive is running. Should the load be heavier and require more current, then the battery discharges automatically to make up the difference in the demand. Whenever the locomotive is standing at rest, connected to the trolley wire, the entire 80 amperes are taken up by the battery, thereby reducing the length of time required to complete recharging at the end of the day's work.

These combination locomotives under given service conditions have proved extraordinarily useful for distances otherwise beyond the scope of battery haulage, while operating at low cost and with minimum demands on the power station. Anti-friction bearings for the wheels of wagons which make up a trailing load are most desirable, compared with the plain variety. Roller bearings are capable of effecting a reduction up to 50 per cent. on the tractive effort or train resistance, and in that way materially help to raise the ton-mileage to be realised with battery locomotives on one full charge of the cells.

The Electrical Equipment of the "Vaterland."*

The construction of the "Vaterland," with its steam turbines and four screws, has been described by Dr. E. Förster, and from his description the following particulars relating to the electrical equipment are taken, together with information obtained from other sources. The ship has an electrical installation with a capacity of 1,490 kw., made up of five steam turbine units of 288 kw., running at 2,000 r.p.m., and an emergency petrol-driven set of 50 kw. It has thus an equipment corresponding to 27 watts per registered ton, as against 22 watts for the "Imperator." The total weight of this machinery is 62 tons, which corresponds to 43 kilogrammes per kilowatt, about one third of that of a similar installation on another liner which has machines driven by pistons at 225 r.p.m. The main portion of the machinery is housed amidships behind the engine room; the emergency petrol set is on the upper deck at the stern, and can be started either by hand or by compressed air, which is supplied from a reservoir fed by a 1-h.p. petrol-driven air pump. On the switchboard, there are six circuits for lighting, four for heating, and 22 for power, the voltage being 110. Motor-generators are employed for certain purposes. One is used to supply energy to the three wireless transmitters; the generator in this case is a high frequency machine with a periodicity of 10,000. A second is used for the captain's purposes for conveying orders and signals. There is also another, as stand-by for the same purpose. They consist of a 12·5 kw. direct current motor, and an alternator of 3·6 kw., at 112 volts, together with a direct-current dynamo of 7·6 kw. at 26 volts, for lighting the captain's cabin and for charging the 16-volt battery. The signals are conveyed on the alternate-current system. One of these motor generators is in the main power house; the other is on the upper deck to be used in emergencies. Four others are used in connection with the compasses, for which polyphase current at 120 volts with a periodicity of 333 is required. Here, again, stand-by sets are provided in case of need. Finally, there are two 16-volt batteries used for telephone work.

There are altogether 14,000 lights on board, of which 800 are always kept alight under all circumstances. Electric heating is used in addition to steam heating in the first class cabins; an automatic adjustment of the current keeps the temperature constant. This is done by a series of contacts which are used in connection with a relay-switch, the latter cutting out the resistance in series with the heater to a greater or less extent. The contact-apparatus is of the shape of a U, and consists of strips of two metals, the unlike expansion of which causes it to bend and make contact. The relay-switch is of the mercury type, and closes when the corresponding relay carries no current. The range over which it works is considerable. There are in all about 300 heaters, carrying current from 10 to 20 amperes, with a total capacity of 400 kw. Electric heaters are also used for many other purposes, including the sterilising of water for medical use in the kitchen in a variety of ways, &c.

For power transmission there are more than 225 motors, 103 of which are used for centrifugal fans. In addition to this there are several hundred fans on the decks and in the saloons. Lifts and cranes are also worked electrically. There are 10 motors with a total capacity of 147 kw. for lowering the ship's boats. Thirty motors, in all 44 kw., are used in connection with operations in the kitchen, and others are used for hygienic purposes, such as vibration massage, gymnastic exercises, &c. On turbine ships, it is necessary to be able to lift the upper half of the turbine case, and to rotate the blades for inspection; for this eight motors with a total output of 147 kw. are provided. Motors are provided for repair work, for tools for cleaning the boilers, and for printing. Even the main steam valves are operated by an electric motor. The pneumatic post has electric power for the compressed air, which is also used in connection with soldering.

For telephonic and telegraphic purposes there is a very complete installation. There are three completely independent wireless transmitters, one of which is worked in connection with a high-frequency generator, this being the first instance of the use of such a generator on board ship. For sending telegrams with waves of 600 and 1,800 metres, and for the high-frequency generator, an antenna on the roof of the upper deck is used, 190 metres long. For shorter wave lengths and for the emergency transmitter, two other antennæ are provided, consisting each of a single wire connected to the smoke funnels.

The "Vaterland" has also a Forbes apparatus for determining the speed of the vessel. In the middle of the ship there is a tube, 30 centimetres in diameter, which can be lowered in to the water. There is an opening into this tube on the port side at the bottom, and at the back side at the top. As the ship moves forward water is forced through the tube by means of these holes, passing on its way through a small turbine, the vertical axis of which passes into the vessel and is connected by gearing to a dynamo. The voltage of the dynamo is proportional to the speed of the vessel, the scale being calibrated in knots. The axis of the turbine also actuates a make-and-break device, which conveys an intermittent impulse to a train of wheels so arranged that the total distance travelled by the ship is recorded. There is also an electrical device for testing for any saline impurity in the feed water. This is done by measuring the current which passes under a pressure of 24 volts between two platinum electrodes; it is easy to calibrate the scale so as to show the presence of salt in the water, and the extent to which it is present. A projector is also carried to detect icebergs, and there is an ozone installation, which is worked by alternate current at about 8,000 volts.

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* Abstract from the "Elektrotechnische Zeitschrift, No. 40, 1919.

Recent Developments of the Electric Furnace in Great Britain.*

By D. F. CAMPBELL, M.A., A.R.S.M.

In no branch of metallurgy have greater advances been made during the war than in the development of iron and its alloys, which has given us materials of extraordinary strength and physical properties.

In 1914 the quantity of energy used on electric furnaces in Britain, excluding those used for aluminium, was probably less than 6,000 H.P., but on the day of the Armistice the total capacity was in excess of 150,000 H.P., of which 135,000 H.P. was producing steel and 18,000 H.P. was working on the reduction of chromium and tungsten ores. On the day of the Armistice electric energy was being consumed at the rate of nearly 300,000,000 kw.-hours per annum for this purpose alone. The electric steel production had then reached a total of over 200,000 tons per annum. Similar increase has also been made in the electrolysis of brine for the manufacture of caustic soda and chlorine to meet war requirements, and the older processes are now superseded by the electric method of manufacture. The manufacture of large quantities of phosphorus by electric-furnace methods was necessary during the war, and the excellent fused silica ware for laboratories and chemical works, made with such remarkable success on the Tyne, is perhaps the most interesting example of the use of the electric furnace for fine work. The making of electrodes, an essential subsidiary industry for electric furnace work, which was unknown in Great Britain in 1914, is now established in Newcastle and elsewhere, and also the manufacture of artificial graphite in the form of electrodes for furnace work and electrolysis and powder for accumulation and similar purposes.

Electric melting enabled us to use advantageously the vast quantities of steel turnings made in the shell factories. The re-melting of nickel-chrome steel is a wasteful and most difficult process in all other furnaces, but the reducing conditions and absolute control of the electric furnace make it possible either to retain or remove at will most of the chromium, and thus large quantities of a valuable metal were saved. The economic manufacture of stainless steel has been rendered possible only by the electric furnace, which is required both for the preparation of the refined ferro-chrome and the steel melting. The application of electricity and metallurgy has given us the low-hysteresis iron that is now universally used in the transformers, for this is made by the addition of high-grade ferro-silicon to the steel. The use of the arc furnace in one of its many forms is now almost universal, and the fascinating principle of induction heating is no longer used. Electric furnaces owe their value to their intense reducing conditions, as they utilise the only practical source of heat which does not require oxygen for its generation. The tendency in electric-furnace design is rather to increase the power of transformers on furnaces of moderate capacity than to build large furnaces.

The development of electrical energy on the north-east coast is undoubtedly the most progressive and comprehensive system in Great Britain, and it is hoped that the development of other districts will result in schemes for linking up existing supplies, exchange of surplus capacity with a general reduction of stand-by plant, and the erection of a few large stations at suitable points, so that the small and inefficient stations may be abandoned or relegated to the position of emergency stand-by plant. There are great advantages in establishing certain electro-metallurgical processes in England, in spite of the lack of water-power, for this country is so highly favoured with the other essentials for successful industry that the supposed advantages of cheap hydro-electric energy are counterbalanced in the case of many processes in which skill and cheap raw materials are an important factor; consequently, power economically generated from steam and efficiently distributed may form the basis of many electro-chemical industries.

The production of aluminium, ferro-silicon and carbide are industries for which water-power is usually essential; but processes such as steel-making, that only use about 40 per cent. load factor, are more suitable for steam stations. In Newcastle, shops equipped with electric furnaces for war alloys have been reconstructed, and are producing alloy steels. The manufacture of artificial graphite has been established, and electrodes of a size and quality equal to the best in the world are being produced, and the manufacture of alloys and amorphous electrodes is developed along the lines of present requirements. The next immediate development will probably be the general application of electric smelting to the treatment of complex zinc ores and the gradual improvement of existing processes in the development of power and utilisation of the fuel we now waste.

Correspondence.

THREE MAGNETICALLY-COUPLED CIRCUITS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In your issue of July 16th Mr. Bellini treats the problem of three coupled circuits by the method of repeated differentiation: this method does not appear to be so illuminating as the following solution by operational determinant.

If the determinant of equations (1), (2) and (3) in the article referred to is formed and equated to zero, we have the equation for natural periods of the system, and the form of the determinant brings into prominence several important points.

Writing ip for $\frac{d}{dt}$:—

$$\begin{vmatrix} \frac{1}{C_1} - L_1p^2 & -M_{12}p^2 & 0 \\ -M_{12}p^2 & \frac{1}{C_2} - L_2p^2 & -M_{23}p^2 \\ 0 & -M_{23}p^2 & \frac{1}{C_3} - L_3p^2 \end{vmatrix} = 0$$

If all three circuits are tuned to frequency p the diagonal terms (1·1), (2·2), (3·3) are all zero, the determinant is zero, and p is a root of the equation. This solution is not a resonance of the middle circuit, however, and the tuning of the middle circuit is not essential to the existence of this resonance in the terminal circuits, for the determinant is still zero if the term in the centre is not zero. If either of the end circuits is mistuned an examination of the determinant shows at once that p is no longer a free period of the system.

The remaining free periods are very readily found by multiplying out the determinant and solving for p. These resonances are common to all the circuits, for they do not depend upon annulling one or more individual terms in the determinant, but involve all the significant terms.

If the condenser in the middle circuit be short-circuited the root $\frac{1}{\sqrt{L_1C_1}}$ remains for the reason that it is independent of the term involving C_2, and, as has been shown, this frequency does not appear resonant in the middle circuit. The other root is easily found as before.

In a similar way the effect of alterations in tuning or coupling are readily studied in a way that is both simple and instructive as to what is actually taking place in the circuits.—I am, &c.,

N. Woolwich, July 31. L. C. Pocock.

THE SUNDERLAND TURBO-GENERATOR.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Reference occurs in your issue of July 9th to a report the writer recently made to his Committee to the effect that trouble had been experienced with a 6,000 kw. turbo-generator first put on load last September, and Messrs. The General Electric Company, Ltd., the sub-contractors for the electrical portion of the equipment, point out that the publication of this undetailed statement is prejudicial to their interests. I therefore have pleasure in saying that the electrical portion of the equipment has been in every way satisfactory, and has been in no way concerned with the trouble which has been experienced, and with which the main contractors are dealing.—I am, &c.,

Sunderland, July 30th. Alfred S. Blackman.

At 6.30 on Friday evening last, when the Marconi station at Chelmsford, working on a wave length of 3,500 metres, was in communication with the Scandinavian countries, the London correspondent of the "Nationaltidende" (Copenhagen), "Morgenbladet" (Christiania), "Aftonbladet" (Stockholm), and the "Morgenpost" (Gothenburg), transmitted news messages to those journals, and afterwards Mr. Lauritz Melchior, the celebrated Danish Royal Opera tenor, gave a number of selections, including the anthems of Denmark, Norway, Sweden and Great Britain. By arrangement with the various telephone departments, the telephone exchanges of the big Scandinavian towns were connected up with the wireless stations. The test, which was fairly successful, was interfered with by atmospheric disturbances.

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* Abstract of a Paper read before the Society of Chemical Industry.

Heating and Cooking Notes.

New Lighting Rates and Lampholder Appliances.

Diffidence is being expressed in some quarters as to whether it is wise to advocate the use of irons, milk heaters and the smaller household appliances supplied from a lampholder—*i.e.*, off the lighting circuit—owing to the present prices charged for electrical energy consumed through the lighting circuit meter. Take a 2-pint copper kettle with self-contained 700-watt element as an example. Such a kettle, under ordinary conditions, will boil 2 pints of water in 10 minutes starting from cold, and with electricity at 8d. per unit the cost is practically one penny.

At first this seems an exorbitant figure, but when it is realised that the price of gas has also advanced in equal proportion to electricity, because both are dependent on rising charges for labour and coal, the cost of so boiling water is not prohibitive; while in the case of irons convenience is a most important factor, and the saving in walking to and from the stove is considerable. There is possibly a danger in recommending the use of radiant hot plates of 750 watts or over on the lighting circuit, because this method is not nearly so efficient as the self-contained utensil. To boil 2 pints of water in an aluminium kettle on a radiant hot plate loaded to 1,000 watts would take 13 minutes, and at 8d. per unit would cost practically 1¼d. It is, therefore, necessary to consider the price of electrical energy before recommending consumers to use radiant hot plates, small grills, &c., off the lighting circuit. Before such a recommendation is made, the cost of installing a heating circuit should be estimated, and then the consumer can be shown how long it would be before the saving so effected in the cost of current would pay for the additional outlay involved in installing a special circuit. It is mainly on circuits working at from 200 to 250 volts that this question crops up, because the use of a 1,000-watt piece of apparatus on a 100-volt lighting circuit is usually impossible, owing to the wiring not being sufficiently large. It is therefore somewhat surprising to find such 100-volt apparatus offered for sale complete with flex and a cocus adaptor. The large stores are possibly the greatest offenders in this respect, but one would have thought that the manufacturers would in their own interests have warned retailers against the practice, which only leads to future complaints, either due to "blown" fuses or costly lighting bills, and in the end retards progress for all.

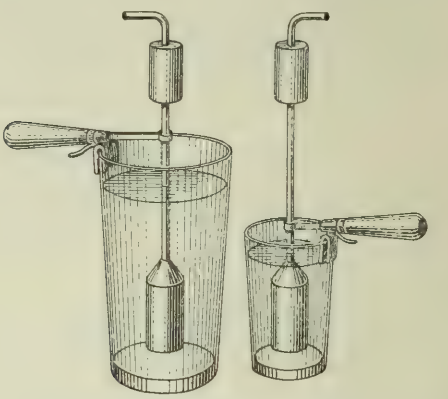


Fig. 1.—Adjustable Immersion Heater, which can be attached to side of a vessel by means of a clip.

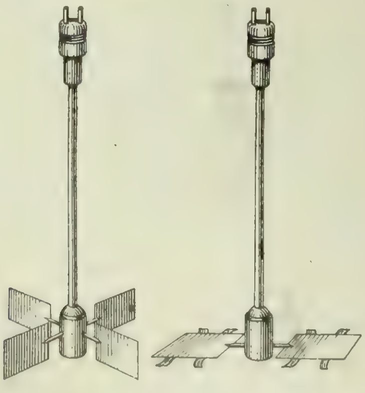


Fig. 2.—Continental Immersion Heater with Heat Distributing Paddles.

It is also somewhat surprising to notice the prices that some stores get for such electrical appliances—if press advertisements are a guide. It really indicates that there is a good market for such apparatus, and that because contractors and some supply authorities do not draw attention to them the public goes to the big store to purchase.

This practice is liable to lead to apparatus being used on circuits which are quite inadequately wired, to say nothing of voltage difficulties.

Heating and Cooking on the Continent.

At the offices of the E.D.A. recently we saw some very interesting papers relating to the progress of electric heating on the Continent. In Norway a series of tests are being made for the purpose of obtaining reliable data on the heat insulating properties of various building materials. Some 24 single-room houses or huts have been built in a row, all being identical in shape and size, but constructed with walls of different materials, and in each case provided with double windows and doors. In every hut, in the same corresponding positions, is installed a 2 kw. radiant electric fire, a thermostatically controlled electric regulator, and a watt-hour meter, the normal temperature for which the thermostatic regulator is set being 15°C. Careful records of the atmospheric conditions are kept throughout the test, and the readings of the watt-hour meters give a relative but very precise measure of the inefficiency of the material of which each house is built from the termal insulation standpoint.

In Switzerland considerable progress is being made with the installation of electric water heaters operating at a uniform load throughout the 24 hours, and storing water in a heat insulated tank.

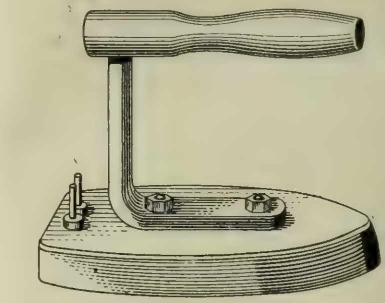


Fig. 3.—Continental Type of Electric Iron.

Electric motors are being employed in farm work, the motor being mounted on a wheeled trolley with trailing cables, and used for driving fruit crushers, vegetable choppers, &c.

Electric immersion heaters for household use seem to have received more attention than they have in this country. Care has been taken to provide means of safeguarding against the risk of upsetting the vessel containing the fluid to be heated. For example, the heater shown in Fig. 1 is provided with a metal clip, which is attached to the side of the vessel. This clip also grips the neck of the heater and allows the position to be so adjusted that the heater and clip can be used for utensils of various heights. In other cases the heating element is housed in a frame provided with paddles, like fan blades, which aid the quick distribution of heat.

The electric irons most popular in Switzerland mainly differ from English ones in regard to the arrangement of the handle. Reference to Fig. 3 will show that the wooden portion of the handle grip is considerably larger, and only one support is used to connect it to the iron base. This method does not look so attractive, but it certainly provides a firm hold without much risk of a burn. It is, unfortunately, a fault with many English irons that the metal handle supports get too hot.

The type of fire most in demand seems to be those which take the form of a radiant spiral element mounted on a porcelain cone or bobbin, and fixed in the centre of a parabolic reflector. Instead of being only used as a portable fire, as is the case over here, the fires are used as units and assembled in blocks or groups of two or more, and fitted into the corners of rooms.

Electro-medical heating appliances in the form of pads, bandages, muffs, footwarmers, rugs, &c., are apparently much more popular in France and Switzerland than they are here

Health Exhibition at Birmingham.

The thirty-first Congress of the Royal Sanitary Institute was held at Birmingham University from July 19 to 24, and under its auspices a Health Exhibition of appliances for housing and general sanitation and all matters relating to health and physical welfare occupied Bingley Hall until yesterday.

This exhibition marked a big advance on anything previously attempted, and, as might be expected, electrical equipment constituted an important feature.

For a very comprehensive stand, the object of which was to demonstrate the hygienic value of electrical appliances, the City of Birmingham Electric Supply Department was responsible, and to it is awarded the Silver Medal of the Institute. A view of this stand is given herewith. The equipment was of a wide range, and had relation primarily to things that were required in the home, and in the hospital and dormitory. The contributions to this stand were by eight firms. Berry's Electric Ltd., Birmingham, showed their Magicoal fire. Callender's Cable & Construction Company showed rubber wires and cables, as well as the Kaleeco wiring system, and Kalanite insulating material. A characteristic collection of products was made by the British Thomson-Houston Company, Ltd., and features in the exhibition by the Crendenda Conduits, Ltd. included an electric still, giving a supply of distilled water at the rate of four pints per hour. This still, as well as sterilisers, is suitable for use in dispensaries and laboratories, &c. The General Electric Company's allocation was devoted largely to automatic sterilisers, towel heaters, and a pedestal heater (the latter taking 600 watts), which is largely used in kinema pay boxes. The new Connor Magneto was also included. The Metropolitan-Vickers Electrical Manufacturing Company, Ltd., were represented, in their products, by, among other things, the Cosmos drawn wire lamps, the "Metric" heating and cooking apparatus, and the new Helium lamp. The latter is for half-watt lamp lighting, is dust proof, and gives a diffused light. It can be arranged for any half-watt lamps up to 2,000 candle power. Interesting contributions were also made by the Premier Electric Heaters, Ltd., and David Shanks & Company, Ltd., the latter with opal and alabaster bowls, fittings and standards.

View of the Birmingham Electric Supply Department's Stand.

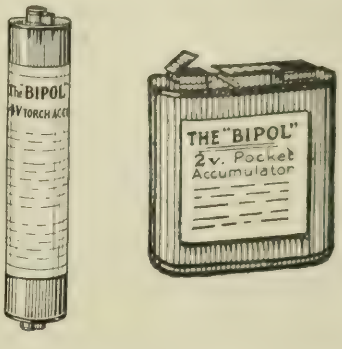
The Hoover Suction Sweeper Company, Ltd., was awarded a silver medal for an electric suction sweeper. The air suction lifts the carpet from the floor, and the effect is to bring the fabric into contact with a brush having two spiral rows of soft hair bristles. By current the brush is revolved more than 1,000 times a minute.

A Bronze Medal was given to Charles E. Beck & Company, London, for their "Thor" electric washing machine, which demonstrates the ease with which each household may be equipped with its own laundry. The machine, as is well-known, embraces modern laundry principles. A similar distinction (bronze medal) was conferred on the Gem Labour-Saving Device Company, of Manchester, for an electric vacuum cleaner.

A wide selection of electric irons, fans and fires is made by the Western Electric Company, and as might be expected popular attention was directed to vacuum cleaners and sewing machines, all operated by electric current.

A Canadian electric vacuum cleaner, which is fitted with a six-blade steel fan, was exhibited on the stand of Napier-Kimber, Ltd., and Beatty Bros., Ltd. give demonstrations with their Time-Saver electric washing machine, which has the capacity speedily and effectively to wash and wring the clothes. A continuous demonstration was made at the stand of the Magic Appliances, Ltd., with a suction cleaner which works on any electric current, and with a blower for use in factories. Apparatus for telephone and electric cable laying was shown by F. J. Mathews & Son, London.

Bipol Storage Batteries.



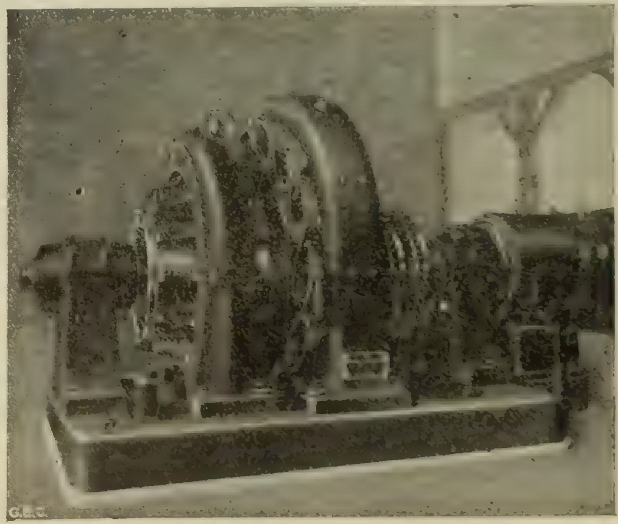
There are some interesting features in the design and manufacture of the Bipol storage battery which is marketed by Messrs. Greenwood & Batley and is claimed by them to be particularly suitable for such uses as supplying electric lighting for motor cycles, scooters, ordinary bicycles, police lanterns and torches of all kinds and shapes. We understand that great attention has been paid to reducing the weight, so that a considerable percentage is saved in this way when compared with the older type of storage battery. The grids are made of a particular kind of wood which is treated by a special process to render them porous. In this way excessive sulphation of the plate units, which are very robust, is prevented and their special construction also makes them less liable to buckling, short circuiting and rapid disintegration.

We understand from the manufacturers that Bipol batteries can be discharged to zero and can then be allowed to remain in this condition for any reasonable time without any harmful after effects. The patent grids used are particularly suitable for employment with spun glass wool packing, and so spilling is prevented.

Having designed a good piece of apparatus the next difficulty is to sell it, and Messrs. Greenwood & Batley have successfully taken this problem in hand by opening in many towns, in Great Britain and Ireland, special Bipol sales and service stations. This organisation will enable an efficient service of up-to-date electric lighting apparatus for various requirements at a very cheap rate to be maintained.

Rotary Converter in Tube Works.

In order to provide additional power at the Landore works of the British Mannesmann Tube Company for the electric driving of rolling mills, &c., a 1,000-kw. rotary converter was supplied by the Swansea branch of the General Electric Company. A condition of the contract was the maintenance of unity power factor and this was the main consideration in adopting a rotary converter. A three-phase supply at 6,600 volts, 50 cycles, is taken by the Mannesmann Company from Swansea Corporation. The works operate at 220 volts, which naturally involves the use of heavy currents. Consequently special precautions had to be taken by the designers to ensure the safety, reliability and efficiency of the machinery. A reference to the illustration shows that a double commutator machine was provided, and that the brushgear was designed on substantial lines. The continuous current brushgear is carried by a separate central rocker mounted on the baseplate. This rotary operates upon the well-known G.E.C. self-synchronising principle, the necessary control being provided by a specially designed boiler plate cubicle. The chief feature of the switchgear is the main switch, which is of 3,000 amperes capacity. Owing to the difficulty that



G.E.C. 1,000-kw. Rotary Converter.

would be experienced in working a switch of such size by direct operation, a geared bevel wheel has been provided. A suitable sequence device prevents the switch from being closed without being first put into the position for self-synchronising. All switching and starting apparatus and accessories are contained inside the cubicle. The instruments used are of the flush pattern.

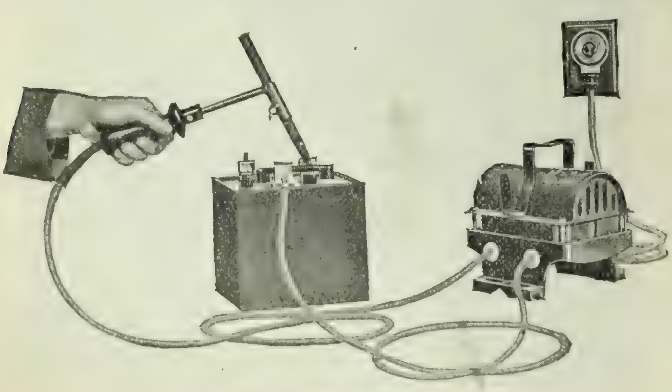
The G.E.C. self-synchronising method of starting is briefly as follows :—The rotary is run up to approximately full speed by means of a starting motor. The current is then switched on to the rotary through reactances and the machine pulls into synchronism automatically with correct polarity. Next the reactances are short circuited and the starting motor switched off. The advantages obtained by this method of rotary starting are : (1) The starting motor is used only to start the rotary and bring it up to synchronism ; it is not used for limiting the current flowing to the rotary for self-synchronising. (2) The self-synchronising is carried out through separate reactances, which can be easily and simply adjusted to give the best conditions to suit each particular case. This adjustment is quite independent of the starting motor. (3) The operation can be performed by comparatively unskilled operators.

This rotary converter has been running for 18 months and it has successfully withstood the heavy duty imposed upon it by a highly intermittent steelworks load comprising bar mills, pilger mills, piercing mills and auxiliary gear.

The Pyrotip Electric Burner.

The Pyrotip electric burner has been designed to meet the demand for an economical and convenient means of lead burning, such as is necessary in the repair and construction of lead storage batteries and in other operations involving the welding of lead plates or strips. Essentially it consists of an auto-transformer by which the ordinary supply voltage is reduced to a suitably low pressure and the current increased in the same proportion. From the secondary or low voltage side of the transformer two heavy rubber insulated cables carry the current to the work. One cable terminates in a spring clip which is attached to the metal close to the point where the burning is to be done. The other cable is attached to a holder with an insulated handle, containing a carbon electrode about 8 in. long. The carbon electrode, when the circuit is closed by applying it to the lead, produces an intense heat. One electrode will burn from 250 to 300 joints. The double conductor from the primary side of the transformer is fitted with a 2-pin plug top or adaptor for connection to a well socket or lamp holder.

Pyrotip electric burners can, of course, only be used on alternating-current circuits, the standard types being made for use on supply pressures of 100-110 volts and 200-240 volts, and for periodicities of 25-49 cycles and 50-140 cycles. When the transformer is connected to the lighting circuit, it reduces the voltage and gives a heavy current. After connection is made to the work by means of the spring clip, the circuit is completed by bringing the carbon point into contact with the lead at the place to be melted. When the point of the carbon touches the lead it becomes intensely heated and instantaneously melts the lead over a restricted area. The carbon point is worked to unite or flow the lead where desired. No adjustments are required before starting or during operation. No arc is drawn when the outfit is being properly handled, the point of the carbon being kept barely in contact with the lead surface. A slight current adjustment may be made by increasing or decreasing slightly the depth of the carbon point in the lead.



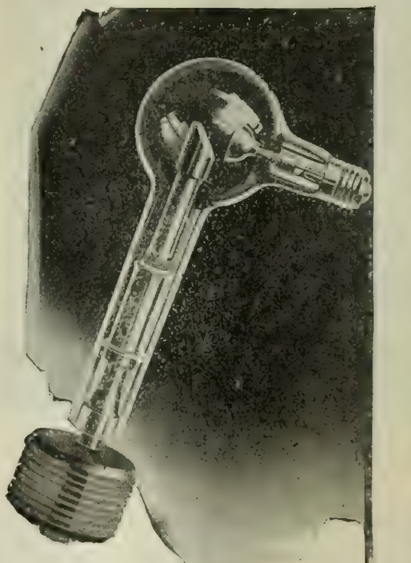
Pyrotip Electric Burner in Use.

Owing to the simplicity of control in the electric burner, due to its local application of heat, an operator with any previous experience in lead burning can easily and quickly acquires the art of electric lead burning, and an inexperienced operator can do satisfactory work in a short time.

The Pyrotip burner can be employed to remove or burn on cell to cell connectors, cut off or build up posts, disconnect plates from posts, build up or cut off risers on plates and burn risers into strips (or posts). Under most conditions the expense of operating an electric burner is less than that of other methods, and many users are saving as much as 50 per cent. in cost of operation. These economies are due to the small power required (about the same as the household electric iron) and to the intermittent operation, power being required only when work is actually being done. All charges cease when the transformer is disconnected from the line, and when the burner is not in use and the transformer is connected to the line the power consumed is negligible. Electric service is available in most garages and workshops at power rates, and the only additional expense is for carbons. Each carbon is of sufficient length to burn from 250 to 350 joints. The joint receives an electrical test at the same time as it is being burned. The intense heat ensures a perfect mechanical joint, so that electrically made joints are better both mechanically and electrically than others. It is possible to work with the carbon point in confined places where a flame is difficult to handle. The work is always under control, and the only current variations required are automatically made by increasing or decreasing the depth of the carbon point in the surface of the lead. The outfit is portable, so that work may be done on batteries without removing them from the car. Pyrotip electric burners are supplied by The British Thomson-Houston Company, from whom information as to prices, &c., may be obtained.

X-Rays in Dentistry.

Modern dentistry owes a great deal to radiology, and especially to the Coolidge X-Ray tube which, in its special dental radiator type, has considerably increased the accuracy and speed of dental radiographs. This type of Coolidge tube has been developed for use only with specially designed apparatus and is not suitable for general radiographic work. Of especial interest is the fact that by far the greater part of the heat imparted to the target is conducted to the copper radiator, and it is, therefore, possible to make the bulb of the dental tube quite small—3¾ in. in diameter. In addition, the tube is self-rectifying within the limits of its allowable energy output, and can be used directly across the terminals of an induction coil or transformer. The cathode arm extends 2 in. from the bulb at right angles to the anode arm, which measures 9 in. from the bulb to the end of the radiator. By this construction the rays are emitted from the tube in a line with the axis of the anode, thus facilitating the manipulation of the tube. The cathode circuit being earthed, there is only one high-tension wire and this is always connected to the part of the tube farthest from the subject to be radiographed. It is thus possible to employ a minimum distance between film and focal spot, enabling satisfactory radiographs being obtained with comparatively short exposures. The dental tube is designed for an energy imput not exceeding that corresponding to a current of 10 m.a. at a "useful" voltage equivalent to a 3-in. parallel spark-gap between points. As it is intended to operate at a fixed voltage and current, the procedure is limited to closing the switch for the time necessary to produce on the photographic film the desired effect, the time factor being the only variable in the making of radiographs with the tube. As the cathode terminal is connected direct to earth, it is possible to bring the tube near to the patient without danger of shock. The anode end, during operation, is at the maximum potential and is that part of the tube which is always farthest away from the patient. The short distance between the focal spot and film makes it possible to take satisfactory radiographs of the teeth and jaws with a small expenditure of energy. With a distance of 8 in. between the film and focal spot the photographic effect may be secured with one-fourth the energy which would be necessary if the distance were 16 in. Where other forms of X-ray protection are not available, the special lead glass protective shield (made in two halves which clamp together over the tube) should be used. Information regarding the dental radiator and other types of Coolidge X-Ray tubes may be obtained from the British Thomson-Houston Company, owners of the British patent rights.



B.T.-H. X-Ray Tube.

In view of the numerous applications received by the Electricity Commissioners for Maps of the Electricity Districts already provisionally determined by them, arrangements have been made whereby copies can be supplied to those interested at a charge of 2s. per copy, inclusive of postage. Applications for copies should be made in writing to the Secretary, Electricity Commission, Gwydyr House, Whitehall, S.W.1. and should be accompanied by the necessary remittance.

Parliamentary Intelligence.

The Increased Postal and Telegraph Rates.

The Post Office and Telegraph Bill, which provides for the new rates for letters and telegrams, was read a second time in the House of Commons on the 28th ult.

Mr. Illingworth, Postmaster-General, stated that the total expenditure had risen from £25,600,000 in 1913-14 to over £61,000,000, and of that sum £48,000,000 was paid in wages. In 1916-17 there was a profit of £6,190,000; in 1917-18, £6,647,000; and in 1918-19, £7,447,000, but through circumstances over which he had no control that had been swept away. The increased charges on post-cards and printed packets would not come into force until October or after. Power was taken to charge immediately for telegrams 1s. for 12 words, and 1d. per word after. It was also proposed to charge 6d. extra for telegrams sent on Sunday, Christmas Day and Good Friday. While the total increase in the telegrams sent on weekdays was only 5 per cent. over 1914, telegrams sent on Sunday had increased 45 per cent. Newspapers had always been carried at a loss, and that loss was getting serious. It was proposed to increase the charge from ½d. for 6 oz. to 1d., and an extra ½d. for every additional 6 oz. up to 2 lb. Power was given to people who had entered into a contract for delivery of newspapers by post to cancel the contract, provided they gave notice within 14 days after the increased rates had come into operation. It was also proposed to increase the remuneration of the railway companies for the carriage of parcels by 60 per cent. The new charges were estimated to produce £4,000,000.

Dr. Murray objected to the extra charge on newspapers; it was a tax on education and intelligence. Other members also opposed the increased postal rates on newspapers.

Mr. Pike Pease, Assistant Postmaster-General, said there was no increase in the rate for telegraphed news, because the new rates only came into operation on Jan. 1 last, and the Committee decided that it would not be wise again to increase them.

London Electric Railways Bill.

The Select Committee of the House of Lords, which has been considering the Bill of the London Electric Railway Companies to authorise an increase of fares and charges, has found the preamble of the bill proved, subject to the excision of the words "after twelve noon" as applying to the time at which return fares would be available. This will enable workmen to return at any time during the day.

Lord Ashfield said it was originally proposed to abolish workmen's altogether, but it was now proposed in principle that those fares should, instead of being arbitrary as before, bear a fair proportion and a definite relation to the ordinary fare, whatever might be agreed by the Ministry of Transport. Generally the workmen's concession was a single fare for return journey. The working of the railways showed a deficit of a quarter of a million during the past quarter in excess of the figures given in the statement to the House of Commons.

Mr. C. D. Johnson, Comptroller of the London County Council, stated that the proposed average increase of 40 per cent. would give the shareholders greater dividends than they should reasonably expect. In his opinion they would be making a very good thing.

Legal Intelligence.

Battery Refill Dispute.

In the City of London Court last week, before Mr. Assistant Registrar Tattershall, Messrs. Calmont, King & Company, Ltd., electrical engineers, sued Mr. Geo. Smith for the sum of £4. 10s., balance of account for battery refills supplied. The Assistant Registrar said he had read a long statement sent by defendant, in which he claimed to have returned to plaintiffs a quantity of goods for which he said he had not received credit. If his statement was true then his offer to pay half the amount claimed would be rather acceptable.

Plaintiffs' witness said they had given defendant credit for all goods returned within the date. The goods were sold with a specific guarantee, and the probability was that the goods were not returned until some time after the expiry of the guarantee, which was for one month.

Defendant said he had returned the goods within the month, between November and January; he had ordered 720 refills, and had returned 218 out of that quantity for which he had received no credit. The goods were sold at 10s. per dozen.

Ultimately the Assistant Registrar adjourned the case for a proper detailed account to be made out, showing what goods had been supplied and those returned.

The outline of a very big power scheme for the EASTERN UNITED STATES is given in a recent issue of "The Engineer" of Canada. The idea is to construct a 250,000-volt transmission line from Boston, via New York, to Washington, and to feed it from three points, two at the coal-fields, and one at Cedar Rapids, where use could be made of the water power of the St. Lawrence. The feeders would be from 150 to 250 miles long and the main transmission line about 500 miles.

Commercial Topics.

Electric Traction in South Africa.

The decision of the Government of the Union of South Africa to proceed with the electrification of the line from Cape Town to Simonstown and the section of the Natal main line between Durban and Pietermaritzburg will probably mean that important contracts for generating plant and rolling stock will be given out shortly, and British firms should be prepared to submit tenders. It is reported that two steam-driven generating stations, one at Cape Town and the other at Durban, will be required. On the Cape Town-Simonstown line there is a fairly heavy passenger traffic, and on the section of the Natal line selected there are numerous curves and heavy gradients with a heavy freight traffic, so that the present should give some interesting experience as to the economy of electric traction.

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Electric Conduits for Cuba.

According to a despatch received by the Department of Overseas Trade from the Commercial Secretary to H.M. Legation at Havana (Mr. G. T. Milne, O.B.E.), it is stated that a Cuba company is desirous of receiving from British manufacturers quotations for black enamelled rigid conduits in 10 ft. lengths, diameters from ½ in., rising by ¼ in., to 1½ in., and then by ½ in. to 4 in. The quotations, which should be based on delivery c.i.f. Havana, are desired for four car-load lots of ½ in. conduits and two car-load lots of each of the other sizes. The firm is stated to be the most important concern of its kind in the island, and is predisposed towards goods of British manufacture. British manufacturers should communicate direct with the applicant firm, whose name and address may be obtained from the Department.

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Amalgamation of Engineering Firms.

Another interesting Association of engineering interests has been arranged. The directors of the Agricultural & General Engineers, Ltd., propose to acquire the whole of the fully-paid ordinary shares of Messrs. Henry Bessemer & Company, Ltd., steel manufacturers, of Sheffield. The administration of Messrs. Bessemer & Company will continue as heretofore, but the Board will be strengthened by the addition of Mr. L. W. Smith, of the Board of the A.G.E., who is also managing director of Clarke's Crank and Forge Company, of Lincoln; while Mr. A. G. Longden will accept a seat on the Board of the A.G.E. as a representative of the Bessemer Company. The Agricultural and General Engineers, Ltd., which has an authorised capital of £8,000,000, controls a number of well-known engineering firms, who manufacture agricultural machinery, gas and oil engines, boilers, electric vehicles, &c.

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The Dominions Touring Exhibition.

In a pamphlet issued by the Department of Overseas Trade particulars are given of this exhibition which is being organised for the purpose of fostering and developing trade with the Dominions, and of providing manufacturers and merchants with means to bring their goods to the notice of buyers in all parts of the Empire. The exhibition will carry specially selected samples of British manufactured goods to South Africa, Australia, New Zealand and Canada, and the principal cities will be visited. The Governments of the Dominions are offering facilities, by providing exhibition halls and arranging reduced freights, &c.

It is pointed out that the Dominions want British goods, notably electrical machinery and apparatus, scientific instruments, motor cars, industrial, mining and agricultural machinery, glassware and other goods. The tour will start early in 1921 and will travel for about two years. Particulars of charges and other details may be obtained from the Department, 35, Old Queen-street, S.W. 1.

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New Zealand Projects.

In presenting the Budget to the House of Representatives last week the Prime Minister (Mr. Massey) gave particulars of various schemes for the development of the industries and trade of the State. He stated that £1,000,000 would be appropriated for the extension of the railways, the construction of light railways, &c.; and for the development of hydro-electric schemes and other public works there would be an additional sum of £3,500,000. Every encouragement would be given to scientific research by extending the powers of the Scientific Board, and improved and accelerated transport facilities would be provided between New Zealand and Great Britain.

TAURANGA Borough Council has been authorised by the ratepayers to borrow £30,000 for electricity supply works, and the Borough of PUKEKOHE proposes to borrow £1,500 for fire brigade equipment and an alarm system, and £26,000 for electrical extensions. There will, therefore, be a brisk demand for electrical machinery, transmission lines, motors, lamps and other electrical apparatus for some time, and British manufacturers should be prepared to meet American and other foreign competition, which is keen at present.

There are also many other municipal electric supply schemes under consideration, and it would be well if British exporters paid closer attention to developments in New Zealand. At present there is a general impression in the Dominion that British manufacturers are so pressed with domestic and continental orders that they cannot undertake delivery within a reasonable time, and an organised attempt should be made to place the true position before local merchants and dealers. It is stated that much business has gone to other countries, in spite of adverse exchanges, on this account. The sentiment in favour of British goods remains, but it needs to be fostered and developed.

Electricity Supply.

Tunbridge Wells Council have applied for a loan of £1,500 for two superheaters.

Shrewsbury Corporation have applied for sanction to a loan of £4,000 for mains and services.

Barnsley Corporation has been authorised to borrow £36,250 for additional plant at the electricity works.

Sanction has been received by Cheltenham Corporation to borrow £29,000 for electric supply extensions.

Birkenhead Corporation have received consent to loans of £20,000 for mains and services, and £12,500 for meters.

Poplar Borough Council has received sanction from the L.C.C. to a loan of £23,593 for electricity supply purposes.

Battersea (London) Borough Council is substituting 100-watt electric lamps for 364 gas lights at a cost of £3,755.

We regret to notice that the Barrow Council have rejected, by a majority of one, a proposal that the salary of the Borough Electrical Engineer should be £950 per year, as from April last.

Lowestoft Electric Works Committee has obtained authority to borrow £3,706 for plant, and it is proposed to apply for sanction to a loan of £4,000 for laying cables to the new housing site.

There was an official inspection on the 29th ult. by members of the Wolverhampton Corporation of the recent additions to the electricity works at Commercial-road. The capacity of the plant is now 23,800 kw., or three times the pre-war figure. We hope to give a description of the new plant in an early issue.

Manchester City Council are recommended by the Electricity Committee to enter into an agreement with Mr. S. L. Pearce, chief engineer and general manager, whereby, for a period of seven years, he receives in addition to a salary of £2,500 a year the sum of £1,000 per year for special services rendered in the construction of the Barton station, or any other new power station that may be required during the period.

Warrington Electricity and Finance Committees have discussed with representatives of local manufacturers the proposed extension of the electricity works. A large and immediate extension is necessary to meet the growing demands, and the various firms are to consider their ability to assist in financing the scheme. One firm is prepared to assist to the extent of £50,000 provided the Corporation scheme goes forward.

The borough electrical engineer of Bolton Corporation (Mr. W. J. Wood) has reported on a suggestion by the Electricity Commission that the Back-o'-th'-Bank generating station should be laid out for plant capacity of 46,000 kw. The necessary extensions to the buildings and to the generating, boiler house and condensing plant would cost about £497,000 for extensions, and it has been decided to apply for sanction to borrow this sum in addition to £374,379 for the extensions to plant and buildings now in hand.

In presenting the minutes of the Electricity Committee at the meeting of Chester Corporation last week, Mr. E. Noel Humphreys pointed out that Chester's favourable position so far as the increased prices for electricity was entirely due to the successful development and working of the hydro-electric works on the old Weir. Other towns were now anxiously looking forward to the utilisation of whatever water-power was available, so as to put themselves on the same footing as Chester. The Corporation has decided to apply for a number of "fringe" orders, in order to supply works and factories outside the present area of electricity supply.

The delay in defining electricity districts is holding up the extension of electric supply to several urban and rural areas. A case in point is that of Crompton, whose Urban Council has frequently asked Oldham Corporation to extend their supply cables to the district. The Mayor of Oldham (Ald. C. Hardman), who is chairman of the Electricity Committee, has intimated that "they are unable to do anything at present, as arrangements and being made for the formation of districts for the supply of electricity." Ald. Hardman favours the formation of a district comprising Oldham, Chadderton, Lees and Royton, which would be a convenient and compact area.

A revised scale of charges for electricity supply, averaging about 22½ per cent. increase, has been prepared by the Electricity Committee of Glasgow Corporation. Notwithstanding the increased cost of fuel and wages (160 per cent. over pre-war figures) the scale of charges for electricity has remained at its present level for two years, and since 1914 the charges (including the present increase) have been advanced only by 70 per cent. For the past year the total revenue amounted to £977,486, an increase of £112,446 over that of the previous year, and working expenditure was £713,456, leaving £264,035. Interest on loans, sinking fund and depreciation amount to £318,650, leaving a deficit on the year of £54,614. The higher expenditure principally arises from increased cost of coal, wages and material, but taxes and interest also increased by £61,129.

An important meeting of representatives of electric supply undertakings in the South-east Lancashire Area was held at the Manchester Town Hall last week to consider the formation of a Joint Electricity Authority. Ald. Dagnall presided, and about 100 representatives were present. After discussion it was decided to form a committee of 42 members, consisting of municipal and company representatives, together with their engineers, town clerks and other officials, in order to prepare a scheme for the area. Of the committee, 12 will be engineers, seven of them being the electrical engineers of Manchester, Salford, Bolton, Bury, and the Stalybridge, &c., Board, with the engineers of the Lancashire Electric Power and the South Lancashire Tramways Companies. It was also decided to ask the Electricity Commissioners to extend the time for holding the proposed inquiry from October next to March, 1921, so as to give adequate time to prepare the scheme.

Walsall Corporation has decided to adopt electric lighting for the municipal houses which are being erected at Blakenall and Leamore. There was some opposition to the scheme owing to the fact that the estimated capital expenditure was nearly £17,000 and the annual income only £1,400. The proposal to supply current to tenants at 2d. per lamp used, especially as there would be no restriction upon the amount of electricity used was criticised by some members.

Naturally, Mr. Venables, chairman of the Gas Committee, was opposed to electric lighting. He stated that over £3,000 had been spent already in laying gas mains to the new housing sites, and it was understood gas would be used for lighting and cooking.

It was explained by Mr. Hayward, chairman of the Electric Supply Committee, that if it was found tenants wasted current they would impose an increased charge. Ultimately, the Council approved the full scheme. Gas will be used for cooking purposes.

We are glad to learn that the workers at the Newport (Mon.) Electricity Works, who went out on strike on short notice on the 27th ult. in sympathy with the permanent way workers, have returned to work. It was a foolish and unjustifiable stoppage of work that did a great deal of injury to local trade and industry by cutting off the supply of electricity, and lost, rather than gained, sympathy for those for whom they struck. The dispute originated with the labourers employed in permanent-way work and on the tramways. They demanded 1s. 9d. as from May 1, and 2s. 1d. as from July 1, equivalent to the building trade rates. The Council offered 1s. 8d. as a compromise, which the men declined to accept. These men belong to the National Union of General Workers, as do the power station staff at the Electricity Works, and the former were successful in persuading the power station men to come out in order to bring the "big stick" to bear on their behalf. The Corporation made no attempt to run the works with volunteer labour, but it is to the credit of the technical staff, who are all members of the E.P.E.A., that whilst they were not prepared to "blackleg" for general supply purposes, they entirely objected to hospitals being deprived of supply, and they maintained the supply continuously to those institutions by taking it in turns to stoke one boiler for the purpose.

The Severn Electricity Area.

Bath City Council has adopted a report of the Electricity Committee, which contains some criticism of the draft scheme for the formation of a Joint Electricity Authority for the Severn area, and the chairman of the committee (Ald. Sir H. Hatt) and the Town Clerk have been authorised to submit the following representations to the Electricity Commissioners :—

(*a*) That the scheme does not include any proposals relating to the efficiency and economy of the supply of electricity in the district or the convenience of administration ; (*b*) that no reasons have been furnished in support of the scheme or of the proposed boundaries of the area ; (*c*) that no indication has been given of the position which the Bath undertaking will occupy in relation to the scheme ; (*d*) that the terms upon which the Bath generating station and main transmission lines would be taken over by the joint authority cannot at present be defined ; (*e*) that no opinion can be formed as to the position which consumers in Bath will occupy under the scheme in regard to the price and conditions of supply of current ; (*f*) that in these circumstances the Corporation ask that the adoption of any scheme and the making of any order shall be postponed until proper information upon all these points has been prepared.

Sir Harry Hatt, speaking of the conferences that had been held, said that he was more impressed with the topsy-turvy nature of the proceedings than anything else. It was decided to set up a machine without knowing what work it had to do. He understood the Commissioners had agreed to the purchase of the Beachley station, though it was a considerable distance from the Forest of Dean coalfield. Gloucester and Cheltenham had approved the scheme, though they were in some doubt. They were assured that if the authority were formed before any big expenditure were embarked upon there would be very careful investigation. But if an expenditure of £365,000 for laying cables, plus the purchase price of Beachely station and the cost of step-up and step-down transformers, was regarded as not a big outlay. Bath ought to be much more careful still before pledging itself to form part of the authority.

Notwithstanding the somewhat captious criticism of Bath, nearly all the local authorities and undertakings interested accepted the draft scheme on the 6th ult., and some of them have confirmed the decision of their representatives. Bristol Electricity Committee, reporting on the matter last week, stated that the Minister of Transport, on the recommendation of the Electricity Commissioners was prepared, subject to the sanction of the Treasury, to proceed with the construction of transmission lines between Beachley, the Forest of Dean, Gloucester, and the Stroud Valley at an estimated cost of £365,000. The money is to be met out of money provided for by Sec. 18 of the Electricity Supply Act, 1919, on the understanding that active steps are being taken by the respective authorities to submit a scheme which will involve the establishment of a Joint Electricity Authority. The Minister pointed out that as no certainty could exist at present as to the future establishment of the Joint Authority, he was of opinion that before the construction of the transmission lines could be proceeded with by him the Local Authorities concerned should be made acquainted with the fact that he had provisionally consented to construct them on the faith of the resolutions passed by the Local Authorities to set up a Joint Electricity Authority at as early a date as possible.

Electric Traction.

YORK City Council has decided to adopt universal twopenny fares in the tramways.

ILFORD Urban Council has been authorised to borrow £8,500 for the purchase of electric vehicles for refuse collection.

In consequence of the Lot's-road power station being flooded by Monday's rain, the service of the **LONDON TUBE RAILWAYS** had to be reduced between 8 a.m. and noon on Tuesday.

MORECAMBE Council are in a quandary in regard to their antiquated horse-drawn tramcars. The Traction Committee considers electric traction is out of the question on the ground of cost, and recommend the use of motor 'buses. The Council will probably adopt this suggestion, but the Committee is to report on the merits of electric and petrol 'buses.

The General Vehicle Company recently supplied to **SCARBOROUGH** Corporation a 3½-ton chassis fitted with a 750-gallon watering tank. The vehicle has an ironclad battery 44 I.M.V.8 and runs about 35 miles per charge at a speed of 10 miles an hour. In a recent paper by Mr J. Bee, of Blackpool, it was stated vehicles of this character, which were employed for street watering, were effecting a saving of £20 per week.

In the annual report of the **GLASGOW** Cleansing Superintendent (Mr. W. Greig) it is stated that petrol vehicles have not proved entirely suitable, the cost being considerably higher than that of either horse or electric traction. Electric vehicles, on the other hand, have given very satisfactory results, having been found efficient, reliable, economical and easily driven. It is proposed to place a further order for several electric vehicles.

MIDDLESBROUGH Corporation has again rejected the suggestion that a conference should be held with Stockton and Thornaby with the object of establishing a joint control of tramways in the respective areas. The lines are to be taken over shortly from the Imperial Tramways Company. A sub-committee of the Tramways Committee has been instructed to select a site for a depot, and the tramway manager and the borough engineer have been instructed to prepare plans of future tramway routes required by the development of the town.

GLASGOW Corporation has referred back a proposal of the Tramways Committee to place a contract for special track work with the United States Steel Products Company, and for 10,000 tons rails and fishplates. Mr. Walker alleged that the firm did not conform to trade union conditions, and asked if the special guarantee required by the Standing Orders from foreign firms had been obtained. The Convener (Mr. Kelly), having admitted that no special guarantee had been received, the town clerk (Sir John Lindsay) said the contract was not in conformity with the Standing Orders, and the Corporation unanimously agreed to send the matter back to the Committee.

An interesting test has been carried out at Wolverhampton on the economy of refuse collection by electric vehicles. An "Orwell" electric vehicle was employed for a period of 21 days, and 178 tons of refuse were collected, or an average of 3 tons per load. The cleansing superintendent stated that it required three horse-drawn vehicles and six men to do the same amount of work, and the following comparative costs are given: Horse-drawn vehicle, £473 17s. 1d. per annum, or cost of three horse-drawn vehicles, £1,421 11s. 3d.; electric vehicle, £1,123 per annum, showing a saving per annum of £297 13s. 7d. The capital charges for the electric vehicle (which required a driver and three loaders) are based on an outlay of £1,538 per vehicle, and a seven years' loan.

The traffic receipts of the **CROYDON** Corporation Tramways for the year ended March 31, were £159,728 and other receipts £1,438, a total of £161,166. The working expenses were £158,780, war allowances £916, and alterations to blacksmiths' shop £303, leaving a credit balance of £1,167. Adding bank interest, &c. (£1,871), the balance is £3,038. Interest on capital, contribution to sinking fund and income tax requires £20,291, leaving a deficit of £17,253, compared with a surplus of £12,554. Traffic receipts increased by £26,777, or 20·12 per cent.; miles run by 782,309, or 39·32 per cent. passengers carried by 4,752,226, or 20·15 per cent.; and working expenses by £59,402, or 59·77 per cent. The percentage of working expenses to traffic receipts is 99·41 per cent., increase of 20·69 per cent. The wages of motormen and conductors increased by £28,631 owing to the 8-hour day agreement and war bonus advances, and all other items show an advance, except the war allowances. Compared with 1913-14 the working expenses per car-hour have increased from 4s. 0·7d. to 8s. 11·92d.

The revenue of the **BRIGHTON** tramways department for the year ended March 31 was £116,838 (compared with £86,987 in previous year), and gross profit £18,680 (£21,341). Interest required £7,231 (£7,232), sinking fund £5,811 (£5,789) and income tax £4,016 (£3,797), leaving net balance £1,981 (£5,092). Total revenue per car-mile was 23·29d. (21·95d.), and working expenses, including power, were 19·52d. (16d.). Passengers carried were 20,441,351 (18,498,267) and car-miles run 1,203,961 (951,072). The engineer and manager, Mr. Wm. Marsh, says in his report, in reference to the result of the increase of fares on March 31, 1919, the average fare for the 10 years prior to that date was 1·1d. per passenger; but during last year it was 1·35d. On the number of passengers carried this amounted to £20,240, leaving £9,101 from the extra passengers. The increase in fares has been about 50 per cent., while expenses have gone up fully 150 per cent. A tramway undertaking has its charges laid down by the 1870 Act, and Mr. Marsh advises that advantage should be taken of the Tramways (Temporary Increase of Charges) Act to obtain some relief from this anomalous position.

Imperial and Foreign Notes.

In consequence of the receipt of proposals for the development of hydro-electric power in **JAMAICA**, the Colonial Government desires to vest all watercourses of the island in the Crown, and a Bill to give effect to this policy is under consideration by a Committee of the Legislature.

The Federal Council of the **FEDERATED MALAY STATES** has engaged an electrical engineer to prepare a scheme for the uniform supply of electricity for power lighting to the Straits Settlements and Federated Malay States. Attention will also be given to the utilisation of water power.

At the meeting of the **EAST INDIAN RAILWAY COMPANY** on the 28th ult., the chairman (Sir David Barbour) gave particulars of various projected developments. These include the construction of a bridge over the Hooghly at Bally and the electrification of the suburban lines at Calcutta.

The question of constructing an underground electric railway at **SYDNEY**, N.S.W., which was drawn up in 1915 and postponed owing to the war, has been revived by the Minister for Works and Railways. The traffic on the metropolitan tramways and railways is very congested, and means will have to be found to relieve the situation. The estimated cost of the new underground line is put at £2,750,000.

We learn from "The Times" Trade Supplement that the Sydney (N.S.W.) Municipal Council has purchased a coal mine, and proposes to generate electricity at the mouth of the pit, and convey it by transmission line to the city. At the outset only an expenditure of about £100,000 will be involved, but if the experiment be successful the full scheme will be proceeded with, and this will cost from £3,000,000 to £4,000,000.

Tenders are required for the erection of about 2,500 miles of rural and toll **TELEPHONE LINES** in **ALBERTA** (**CANADA**). Earlier in the year a contract was let for some 5,000 miles of long distance circuits. It is expected that tenders will be invited this summer for still further construction of rural telephone lines. Approximately 700 miles of long distance telephone lines will be built by the Saskatchewan Government this year, involving the use of 28,000 poles and about 1,200 miles of wire.

A syndicate of U.S.A. financiers have acquired the tramways of **MARACAIBO** (Venezuela), and it is proposed to extend and modernise the system.

Personal and Appointments.

Edinburgh Corporation has increased the salary of the tramway manager, Mr. R. S. Pilcher, from £1,000 to £1,200.

BARNSTAPLE Council has increased the salary of the electrical engineer (Mr. J. W. Hadfield) from £375 to £425 per annum.

Mr. E. Rawson, head of the engineering department at Portsmouth Municipal Technical College, has been appointed Principal of West Bromwich Municipal Technical Institute.

Major W. E. Simnett, M.B.E., Assoc.Inst.C.E. (late R.E.), has retired from the direction and editorship of "The Technical Review" on his appointment to direct the Intelligence Branch of the Ministry of Transport.

Mr. H. Nimmo, M.I.E.E., M.Amer.I.E.E., A.M.I.Mech.E., who since being disembodied from the London Electrical Engineers, R.E. (T.), has been employed on the Government of Burma hydro-electric survey work, has now been appointed (temporarily) Officer-in-Charge of the Hydro-electric Survey.

For the position of borough electrical engineer at Wrexham, 120 applications were received, and the following candidates have been selected for interview: Messrs. D. H. Davies (Heywood), G. H. Barnby Holmes (York), E. D. Coe (Blackburn), T. Taylor (Burnley), C. J. Turner (Hoylake) and H. Hodges (Nuneaton).

The following promotions and appointments have been made by the Manchester University authorities: Dr. H. Robinson, senior lecturer in physics and assistant director of the physical laboratories; Mr. R. W. James, M.A., B.Sc., senior lecturer in physics; Mr. E. C. S. Dickson, B.A., Ph.D., lecturer in physics.

The following appointments have been made in the Faculty of Technology: Mr. R. O. Boswell, B.Sc. (Eng.), lecturer in mechanical engineering; Mr. A. Glynne, M.A., and Mr. H. J. Shelley, B.Sc., assistant lecturers in electrical engineering.

The Franklin Institute recently handed to Sir A. Geddes the Franklin medal awarded to Sir Charles Parsons "in recognition of his epoch-making success in the development and construction of the steam turbine, which has revolutionised the art of steam engineering, particularly in regard to the propulsion of mercantile and naval vessels, and the driving of electrical generators."

Obituary.

The death is announced of Mr. **EDWARD DEWHURST**, electrical engineer, of Preston and Fulwood. He was 57 years of age, and had been in business for thirty years.

The death took place suddenly on the 24th ult. of Mr. **GEO. F. DAVIDSON**, of Messrs. Wallis & Watson, Ltd., electrical engineers, of Leeds. Mr. Davidson had suffered from a severe illness, but had recovered sufficiently to attend to business, and his death was unexpected. A native of Middlesbrough, Mr. Davidson went to Leeds about 10 years ago as manager, and later managing director, of the firm with which he was associated.

Miscellaneous.

Several wireless telephone messages, including one from Queen Alexandra and one from Senatore Marconi, were transmitted on Friday last from Chelmsford to the chief Scandinavian stations.

The first meeting of creditors of Alfred Rowland Meggett, electrical engineer, 45, Thrumpton-lane, East Retford, will take place on Aug. 9 at the Official Receiver's Office, Lincoln, and the public examination on Sept. 16 at the Sessions House, Lincoln.

By a recent decree of the Argentine Government, the Marconi Wireless Company has been authorised to install a Wireless High-power Station, to be used exclusively for communication between the Argentine and Great Britain.

The diploma of Associate of the City and Guilds of London Institute's Technical College, Finsbury, has also been awarded to eleven matriculated third-year students in civil and mechanical engineering, five students in physics and electrical engineering, and twelve students in applied chemistry.

The Council of the City and Guilds of London Institute have awarded diplomas of "Associate" to 100 matriculated third-year students in engineering of the City and Guilds (Engineering) College, who completed a full course of instruction at the close of the recent session. The Siemens Medal was awarded to Mr. E. G. Holley, the Bramwell Medal to Mr. W. F. Simonson, and the Henrici Medal to Mr. F. T. Edmunds.

The Rayleigh Memorial Committee have decided to erect a mural tablet in Westminster Abbey as a Memorial to the Late Lord Rayleigh. The tablet will be placed near the memorials to Sir H. Davy and Dr. Thomas Young. After all expenses are met there will be a balance, which it is proposed to use in establishing a library fund at the Cavendish Laboratory, Cambridge, with which Lord Rayleigh was closely associated.

Industrial Councils and Recent Awards.

The District Industrial Councils of the Electricity Supply Industry appear to be getting into working order. Council No. 5 (West Midlands Area), which covers the Counties of Shropshire, Staffordshire, Warwickshire and Worcestershire, has issued its schedule of duties and inclusive rates to be paid to the employees of the several electricity supply undertakings in the district as from June 14 last. The undertakings in the distruct have been classified into three zones for the purpose of determining the rates of pay to employees as follows: Zone "A": Birmingham, Coventry and the Shropshire, Worcestershire and Staffordshire Electric Power Company (Smethwick); Zone "B": Midland Electric Corporation for Power Distribution, Ltd., Redditch, Rugby, Stoke-on-Trent, Shropshire, Worcestershire and Staffordshire Electric Power Company (Dudley), Stafford, Walsall, Wolverhampton, Worcester and West Bromwich; Zone "C": Barford Electric Supply Company, Church Stretton Electric Supply Company, Ludlow Electric Light Company, Leek, Leamington & Warwick Electrical Company, Midland Electrical Light & Power Company, Market Drayton Electric Light & Power Company, Malvern, Newcastle-under-Lyme, Nuneaton, Stratford-on-Avon Electricity Company, Sutton Coldfield, Shrewsbury and the Shropshire, Worcestershire & Staffordshire Electric Power Company (Kidderminster).

There are 58 grades of employees in the schedule, but foremen are excluded, as these will receive rates of pay to be mutually agreed between the undertakers and employees. The rates given are total minimum rates, including all bonuses and the 12½ per cent. award, and apply to all employees of 21 years and upwards. On an average the rates for Zone A are about ½d. or 1d. per hour more than in Zone B, while the latter exceeds Zone C by the same amount. The schedule has been approved by the Joint Industrial Council.

The claim of the National Union of Railwaymen for another increase of 4d. an hour in wages for men employed in the railway companies' electrical power and sub-stations, has been rejected by the Industrial Court. As regards stations which supply railway workshops with lighting and power, the court decided that the conditions of service should be the same as those obtaining in the workshops of which the power stations virtually form a part.

The Industrial Council has also rejected the L.C.C. Tramway Employees' claim for an increase of a penny an hour for slingers and 8s. a week for shed men. The employees also asked that the conditions of employment contained in the memorandum of the conference (held on Dec. 24, 1918) between the Shipbuilding Employers' Federations and the unions affiliated to the Engineering Trades Federation should be applied, but the Court states that throughout the country there is a distinction drawn between a depot where cars are made and repaired, which is regarded as an engineering establishment, and running car sheds, which are regarded as part of the traffic department and not as an engineering establishment. The case of London did not appear to be one which could be differentiated from the rest of the country.

In regard to the claim of the Vehicle Workers', Enginemen's, and General Labourers' unions with respect to the position of tram washers and other tramway employees, the Court decided that the central repair depot should be deemed to be an engineering establishment to which the national or general awards and agreements affecting the engineering and allied trades apply; that running car sheds should be deemed part of the traffic department of the Council's undertaking, to which the national or general awards and agreements affecting the national transport workers apply, and that skilled men, wherever employed, should continue to follow the present practice whereby national or general awards affecting the engineering and allied trades are applied to them.

Tenders Invited and Accepted.

Portsmouth Corporation invite tenders for a 4,000 kw. turbo-alternator and two water-tube boilers. Specifications from the Acting Engineer and Manager, and tenders to the Town Clerk by Aug. 25.

Tenders are invited by Sept. 7 for the supply of telephones (schedule 1,634) and cable (1,635) to the Australian Commonwealth Postmaster-General's Department. Tender forms, &c., from the High Commissioner, Australia House, Strand, London, W.C.

Portsmouth Tramways Committee require tenders by Aug. 17 for 12 months' supply of insulating materials, lamps, motor windings, overhead line materials, castings, oils, &c. Specification from the Engineer, Vivash-road, Fratton, Portsmouth.

Grimsby Corporation invite tenders (by August 12) for the supply and erection of two water tube boilers, with economisers, fans, chimney, &c., a 3,000 kw. high pressure turbo-alternator and condenser plant. Specifications fromthe borough electrical engineer, Lieut.-Col. W. A. Vignoles.

Tenders are wanted by August 31 for porous cells and jars (1,627), bronze wire (1,629) and covered and braided wire (1,633) for the Australian Commonwealth Postmaster-General's Department. Tender forms from the High Commissioner, Australia House, Strand, London, W.C.

The N.S.W. Department of Public Works, Sydney, require tenders by 2 p.m., August 30, for switchgear, lighting arresters and power factor improvement apparatus for Avon Dam (Sydney Water Supply. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.

Manchester Electricity Committee invite tenders for supply and erection of one 75-ton and one 15-ton electric crane at the Barton power station. Specifications from the Secretary, Mr. F. E. Hughes, and further particulars may be obtained from the chief engineer and manager, Mr. S. L. Pearce. Tenders to chairman of Committee by August 13.

Bradford Corporation invite tenders for the supply and erection of Boiler House Equipment, including Buildings, Water-tube Boilers, Economisers, Induced Draught Plant, Feed Pumps, Coal Handling Plant, and Piping Systems. Specifications, &c., from the city electrical engineer, Mr. Thomas Roles, and tenders to the town clerk, Mr. N. L. Fleming, by Sept. 9.

Blackpool Corporation invite tenders for the supply and erection of two water-tube boilers, superheaters, economisers and mechanical stokers, &c.; two induced draught plants with steel chimneys, fans, &c., and coal hoppers and coal and ash elevators and conveyors. Specifications from the borough electrical engineer (Mr. Charles Furness), and tenders to the chairman of the Electricity Committee by Aug. 27

Leyton Urban Council has accepted the tender of E. Allen & Co., for the supply of tram rails.

Barnsley Corporation has accepted the tender of Messrs. Aiton & Company for the supply of cast-iron pipes at £1,052.

Yarmouth Corporation has placed a contract with the Brush Electrical Engineering Company for a 1,400 kw. turbo-generator at £20,710 and for a 500 kw. frequency changer at £4,902 10s., and with the General Electric Company for a 500 kw. rotary converter at £3,838.

The London County Council has accepted the following tenders: Brown Bayley's Steel Works, 4,000 driving wheels, £5 1s. 3d. each, and 3,500 trailing wheels, £4 3s. 6d. each. There were nine other tenders, the figures of the Bochumer Verein Steel Works being £6 10s. and £4 10s. respectively.

Bradford Corporation has accepted the following tenders:—Stewarts and Lloyds, auxiliary piping for boilers; Cammell, Laird & Co., 50 chrome steel axles; J. Brown & Co., 200 steel tyres for tramcar wheels; National Rail and Tramway Appliances Company, 6 tons c.i. brake shoes; and Waygood-Otis, Ltd., two electric lifts.

Business Items, &c.

Messrs. Vickers, Ltd., have opened a depot for Wales and the South-west of England at 43, Park-street, Bristol, at which address inquiries for their products will be received.

H. R. Barker and G. J. Neale, electric lighting contractors, &c., 13, Lowndes-street, and 42, Kinnerton-street, London, S.W., have dissolved partnership. Debts by Mr. Barker, who continues the business as Barker & Neale.

Messrs. Simplex Conduits, Ltd., notify that, owing to the growth of their business in the Midland district, they have opened a sales office at 41, Church-street, Birmingham. The new office is in the charge of Messrs. Underwood and Westwood, who have been representing the company in this area for many years.

Messrs. Erskine, Heap & Co., 5, Chapel Walks, Cross-street, Manchester, announce the introduction of new sizes of gas-filled (half-watt type) lamps as follows:—For 100-130 volt circuits, 40-watt lamps, the overall dimensions being 4¾ in. by 2⅜ in.; for 200-260 volts 60 watts, the dimensions being 5¾ in. by 2¾ in.

Messrs. Price, Waterhouse & Company announce that Messrs. Monkhouse Goddard & Company, chartered accountants, of Newcastle-upon-Tyne (including Messrs. Armstrong, Harrison, Swan & Company, of London), have recently been amalgamated with them, and the offices of the two firms at London and Newcastle have become merged. Mr. W. F. King, O.B.E., A.C.A., and Mr. T. P. Parmeter, F.C.A., who have been associated with Messrs. Price, Waterhouse & Company for a number of years, will join the firm at Newcastle.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919 SPECIFICATIONS.

143,358 EFANDEM CO., OWEN & CUTLER. Electric lighting sets, more especially for use with motor cycles. (9/4/19.)
143,372 WHEATLEY. Electrical transmission disengaging lock-switch. (30/4/19.)
143,378 RICKETS. Controlling and regulating systems for dynamos, applicable also as motor-starting systems. (5/5/19.)
143,387 DEWTY. Portable electric lamp, specially adapted for use by police officers on duty. (20/5/19.)
143,390 CROLL. Telemotor apparatus. (22/5/19.)
143,397 JONES. Adjustable supports or brackets for carrying electric lamps.(29/5/19.)
143,404 JOHANSSON. Support for electric-incandescent lamps. (6/6/19.)
143,413 RICKETS. Regulating systems for dynamo-electric machines. (16/6/19.)
143,448 GRIGSBY. Extensible electric lamps for motor and other vehicles, boats, and the like. (25/8/19.)
143,456 THOMPSON. (Bethenod.) Electro-magnetic wave navigational systems. (9/9/19.)137,032 AKT.-GES. BROWN, BOVERI ET CIE. Apparatus for diminishing the injurious earthing currents in earthed high-pressure nets having a capacity that is non-symmetrically distributed over the phases of the net. (23/12/18.)
143,593 GREVILLE & READ.—Electrode and fastener for electro-medical appliances. (11/2/19.)
143,599 CRABTREE. Electrical plug and socket switches. (20/2/19.)
143,600 CREEDY. Multi-speed dynamo-electric machines. (20/2/19.)
143,614 MARKS. (Splitdorf Electrical Co.) Ignition magnetos. (24/2/19.)
143,619 WADE. (Central Mining & Investment Corpn.) Electrodes for electrolytic recovery of metals from solutions. (24/2/19.)
143,620 WADE. (Central Mining & Investment Corpn.) Electrolytic recovery of metals from their solution. (24/2/19.)
143,624 WADE. (Universal Winding Co.) Winding machines for electrical coils and the like. (25/2/19.)
143,625 WESTERN ELECTRICAL CO. (Western Electric Co.) Electric selective signalling. (26/2/19.)
143,630 B.T.-H. CO. (G.E. Co.) Electric discharge devices. (26/2/19.)
143,636 B.T.-H. CO. (G.E. Co.) Protective devices for electric circuits. (27/2/19.)
143,676 HALL. Electric lamps. (28/3/19.)
143,685 MARKS. (Electric Arc Cutting & Welding Co.) Electrode holders for use in electric cutting and welding. (8/4/19.)
143,695 OLDHAM & OLDHAM. Galvanic batteries. (24/4/19; cognate application, 11,206/19.)
143,704 WATSON, GREENHILL & POLLARD. Electric liquid heaters. (13/5/19.)
143,720 NORTON. Electrical generators or dynamos. (31/5/19.)
143,737 B.T.-H. CO. (G.E. Co.) Control for electric furnaces and the like. (19/6/19.)
143,750 SMITH. Self-regulating dynamos. (11/7/19; additions to 131,978).

APPLICATIONS FOR PATENTS.

NOTE.—*Names within parentheses are those of communicators of inventions.*

February 25.

.5611 IGRANIC ELECTRIC CO. (Cutler Hammer Mfg. Co.). Electrical control apparatus for lighting systems, &c.
5619 EFANDEM CO. & WILLIAMS. Electric lamps.
5643 HILLS. Electric switches.
5650 MASON. Incandescent lamps for projection, &c.
5715 PUPIN. Multi-step amplifiers of electrical oscillations. (4/2/18, U.S.)
5728 PUPIN. Transmitters of high frequency sound waves.
5671 WESTINGHOUSE LAMP CO. Thermo cells for electrical measuring apparatus.
5697 ROUND. Wireless direction finders. (27/2/19, U.S.)
5736 HRDGES. Apparatus for charging and discharging batteries.
5738 STERLING TELEPHONE AND ELECTRIC CO. & DAVEY. Automatic telephone exchange systems.
5743 TAYLOR. Electric toasters.
5748 RANSOMES, SIMS & JEFFRIES & MOSSAY. Brake mechanism for electric vehicles.
5749 RANSOMES, SIMS & JEFFRIES & MOSSAY. Electric controllers for electric vehicles.

February 26.

5763 RICHARDSON. High tension battery.
5774 WILKINSON. Aerial systems for wireless telegraphy.
5777 BUSBRIDGE. Suspension of electric light fittings.
5782 FERGUSON & JOHNSIONE. Automatic electric lighting systems.
5785 AUTOMATIC TELEPHONE MFG. CO. (Automatic Electric Co.). Call indicators for telephone systems.
5786 AUTOMATIC TELEPHONE MFG. CO. Railway signalling systems.
5796 SIEMENS, COLLYER & PETITHORY. Selecting devices for automatic telephone systems.
5802 FRITZE. Connection for permitting simultaneous use of several electrical burners for welding, &c. (30/10/18, Germany.)
5807 SAUNDERS ELECTRICAL CO. Accumulators.
5813 HOGHTON. Receivers for wireless telegraphy and telephony.
5816 SIEMENS & HALSKE A. G. Production of light electrically. (26/7/18, Germany.)
5845 STONE & CO. (Walter). Fuse and junction interminal boxes.
5859 ARMSTRONG, WHITWORTH & CO. & LACON, LEE & ROBERTSON. Electro-magnetic generators and motors.
5868 & 5869 STERLING TELEPHONE AND ELECTRIC CO. & DAVEY. Automatic telephones and exchange systems.

February 27.

5890 MACNAMARA. Transmission of power from windmill to dynamo, &c.
5895 ROCHFORD. Electric illuminating devices for theatrical stages, &c.
5899 WESTINGHOUSE LAMP CO. Electrion tube apparatus.
5904 ABBOTT. Fuse boxes, switchgear, &c.
5925 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (2/5/19, U.S.)
5942 GARRETT & SONS. Safety controlling gear for electric vehicles
5945 B. T.-H. CO. & HUTT. Electric control of electric machines.
5949 HOLDER BROS. & THOMPSON & LIPMAN. Alternating current instruments for indicating synchronism, &c.
5988 RIES. Machines for generating electrical energy.
5989 RIES. Electrical apparatus.
6010 BARTON. Magneto electric machines.

February 28.

6055 OGDEN. Electrically driven blocks, hoists, &c.
6059 HOGAN. Cable gripping device.
6060 HOGAN. Self-regulating constant current variable speed dynamo.
6063 GARDNER. Electrical signalling apparatus for railways.
6079 DITCHAM. Wireless telephony.
6082 DAMEY. Switches.
6084 ANDRE. Brush-holders for electrical machines.
6085 ANDRE. Voltage regulators.
6086 ANDRE. Electrical regulators.
6087 ANDRE. Electro-magnets.
6090 SIEMENS & SCHUCKERTWERKE. Rotary electric hand drills. (26/6/14, Germany.)
6091 SIEMENS & SCHUCKERTWERKE. Heat measuring appliance for electrical purposes. (12/9/16, Germany.)
6101 LEGGATT & NIECE. Apparatus for subjecting molecular matter, &c., to electrostatic stress of R. T. discharge.
6106 WESTERN ELECTRIC CO. Printing telegraph systems.

Companies' Reports, &c.

B. T.-H. MEETING.

At the annual meeting of the BRITISH THOMSON-HOUSTON COMPANY, LTD., last week the chairman (Mr. H. C. Levis) gave a lengthy explanation of the reorganisation of the company's capital and of the growth of the business at home and abroad. He said their share capital had been comparatively small, consisting of £400,000 in 4 per cent. cumulative preference and £400,000 in ordinary shares. Their floating debt, mainly due to the General Electric Company, of New York, and afterwards to the International General Electric Company, had been large. No dividends had been paid on the preference shares for a number of years, as the directors considered it best to conserve their resources for the expansion of the business. Holders of preference shares had the right to require that their holdings should be converted into ordinary shares, and recently the necessary percentage made a formal request to make the conversion, which had been carried into effect. The £10 shares were divided into 10 £1 shares, and the ordinary shares were increased to £2,000,000. Resolutions had also been passed creating 2,000,000 £1 7 per cent. cumulative preference shares, so the authorised capital was now £2,000,000 in ordinary and £2,000,000 in preference shares. The payment of the accumulated dividends would absorb £250,000 of ordinary shares. The remaining ordinary shares and all the preference shares would be issued as the requirements of the company demanded.

WORKS EXTENSIONS.

During the year they expended on additions to factories at Rugby, Coventry and Willesden £184,660, and they wrote off £59,660, leaving the net book value at £950,000. In September last they purchased factory buildings and lands at Blackheath, near Birmingham, but they only got possession in June. The floor space at present available was about 250,000 sq. ft., but the land was over 70 acres. Manufacturing operations would commence as soon as possible and plans were in hand for further extensions at those works. Considerable additions to the Rugby works would greatly accelerate and increase their output of turbines, large motors and generators, also incandescent lamps. Negotiations had been completed for a considerable area of land in another part of the country, where it was proposed, among other things, to erect a lamp factory, as the facilities at Rugby for the manufacture of lamps could not advantageously be extended much beyond present limits.

DISTRIBUTION OF PROFITS.

The year's profits, after deducting all expenses and charges, other than interest on debentures and loans, and after making provision for estimated war taxation for 1919, were £412,399. With the amount brought forward (£150,862), the available total was £563,262. Deducting interest on debentures and loans (£134,230), plant depreciation (£59,660) and £154,723 set aside for a further possible loss in exchange, the balance was £208,430, which was subject to adjustment of the reserves made for munitions levy and excess profits duty for 1917, 1918 and 1919. As the accumulated dividends had been paid up they did not recommend any further distribution at present. It was hoped that the company could next year resume the payment of dividends on a satisfactory basis.

ORDERS AND FOREIGN INTERESTS.

The large electric steel rolling mill equipments had now been in commerical operation for several months; their performance had been in every way up to expectations and had given entire satisfaction. The volume of orders placed with them since the Armistice had been very great. The orders received for the first six months of this year were larger than those for the corresponding period of last year, though 1919 was a record year, and the volume of orders on hand at present was the largest in their history. One of the greatest hindrances to their output had been the shortage of castings accosioned by the moulders' strike. All branches of engineering were still embarrassed by that shortage, and it seemed almost impossible to make up for the time lost. They had made a contract with the International General Electric Company, of New York, which took the place of the one previously existing with the General Electric Company. It would substantially increase the possibilities of the company's business, and was a very valuable asset, having in mind the fact that it conferred on them the patent rights of all the inventions of the General Electric Company of New York, as well as the benefit of its research laboratories. In order to be able to keep in close contact with business on the Continent of Europe, they had taken a financial interest in the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston and the Société d'Electricité et de Mécanique (Procédés Thomson-Houston and Carels), of Belgium, and several of their directors were on the boards of those two companies.

After referring to the company's cordial relations with its employees and the deleterious effects of the Excess Profits Duty, the chairman moved the adoption of the report and accounts. This was seconded by Lord Carmichal and agreed to.

The directors of the ELECTRICAL DISTRIBUTION OF YORKSHIRE, LTD., have declared an interim dividend on the ordinary shares for the half-year ended June 30 last at the rate of 6 per cent. per annum.

The directors of the WESTMINSTER ELECTRIC SUPPLY CORPORATION, LTD., recommend payment of an interim dividend at the rate of 8 per cent. per annum (less tax), for the half-year ended June 30.

The directors of the CHARING CROSS, WEST END & CITY ELECTRICITY SUPPLY COMPANY, LTD., have declared an interim dividend on the ordinary shares of the West End undertakings for the half-year ended June 30 at the rate of 2s. 6d. per share. Warrants will be posted on the 14th inst.

The proposal of the GREAT NORTHERN TELEGRAPH COMPANY, LTD., to distribute a dividend and bonus of 22 per cent. for 1919 (inclusive of 5 per cent. already paid) was passed at the general meeting held at Copenhagen on the 31st ult. The final dividend and bonus for 1919 (34s. per £10 share) is now payable at Messrs. C. J. Hambro & Son's, against coupon No. 21.

The report of the directors of the YORKSHIRE ELECTRIC POWER COMPANY for the half-year ended June 30 states that satisfactory progress has been made. The cost of coal, labour and materials has been higher during the half-year, but owing to production on a larger scale the profit earned on the larger capital employed has been more than proportionately increased. After payment of bank and other interest, the net profit was £30,146, compared with £19,229 in the corresponding half-year of 1919. The dividend for the half-year on the 6 per cent. cumulative preference shares was paid on the 1st inst. In view of the strengthened financial position, the board have decided to pay an interim dividend on the ordinary shares at the rate of 3 per cent. for the half-year. New contracts have been made to supply large additional amounts of power which will bring a further increase of revenue. Additional plant and mains have been ordered to meet these further demands.

The revenue of the BRAZILIAN TRACTION, LIGHT & POWER COMPANY, LTD., for 1919 (in Canadian currency) was $8,877,005, and after deducting general and legal expenses and administration charges, interest and charges on secured gold notes and other loans, and providing for general amortisation, the net revenue was $7,873,967. The dividends on the 6 per cent. preference shares absorbed $600,000, leaving a surplus of $7,273,967. The total gross earnings of the subsidiary companies in Brazil were 113,073,982 milreis, an increase over the previous year of 11,179,819 milreis, and the net earnings from operation were 58,423,485 milreis, an increase of 6,291,950 milreis.

The construction work on capital account carried out during the year comprised additions and extensions to the tramway, light, power, gas and telephone plant and installations, the amount expended being $4,910,028, of which $2,364,385 was spent on the telephone system. The tramways carried 332,525,451 passengers (against 283,682,656), and the gross earnings were 50,057,213 milreis (41,174,220). There are 117,613 electric lighting consumers (106,875), and 4,897 power consumers (4,544), the earnings being 33,385,263 milreis (31,465,034). The number of telephones was 57,216 (47,642), and the gross earnings 12,175,263 milreis (9,551,946). The concessions and assets of the Companhia Telephonica do Estado de São Paulo, Companhia Rêde Telephonica Bragantina, Interurban Telephone Company of Brazil, and Companhia de Telephones Interestadoaes have been transferred to the Rio de Janeiro and São Paulo Telephone Company.

New Companies.

BRIGHTON LIGHTING AND ELECTRICAL ENGINEERING COMPANY, LTD. (169,143).—Private company. Reg. July 20, capital £5,000 in £1 shares, to carry on the business of electrical, mechanical and general engineers, manufacturers of and dealers in electric and other apparatus and machinery, &c. Reg. office: 46, Old Steine, Brighton.

NORTH BRITISH PREMIER ELECTRIC WELDING COMPANY, LTD. (169,231.)—Private company; reg. July 23, capital £40,000 in £1 shares, to take over the business of the North British Electric Welding Company, Ltd., to carry on the business of welders of metals or other substances by electrical, oxy-acetylene or other process, electric, civil and mechanical engineers, ship builders and repairers, &c. Solicitor, E. A. B. Maurice, 46, Parliament-street, S.W.

WM. TROY & COMPANY, LTD. (169,339.)—Private company; reg. July 29, capital £25,000 in £1 shares, to acquire the business carried on by Mary A. W. Bentley-Taylor as "Troy & Company," to carry on the business of builders, decorators, electrical engineers, wiring contractors, manufacturers of and dealers in electrical appliances, &c. First directors are F. G. Price (chairman) and A. W. Ralph (managing director). Reg. office, 194, Finchley-road, N.W. 3.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—"The Air Ministry Competition"; "The Case for an Air Reserve"; and "The Design of Supercharged Motors."

"The Cabinet Maker":—"Eight-Legged Tables"; "Gesso: Its Application to Cabinet Work"; and "The Significance and Value of the Silhouette."

"The Chemical Age":—"Union or Disunion"; "Electric Telphers for Chemical Works," by H. Blythe; and Annual Report of Chief Inspector of a British Alkali Works (II.).

"The Fruit-Grower":—"Railway Rates Inquiry"; "Temporary De-Control of Apples"; and "Paying for State Control."

"The Gas World":—Full Text of the Gas Regulation Act; Monthly By-Product Coking Section; and Gas Engine Indicator Diagrams.

"Hardware Trade Journal":—"Labour Saving in the Foundry (XIII.), by Joseph Horner; The Fire Arms Bill; and "Steam Motor Wagons."

"Ways and Means":—"An Irishman's Outlook," by Maurice Boyle; "Railway Delays and Excuses," by S. T. James; and "Overlapping Propaganda," by the Editor.

Forty Years Ago.

(THE ELECTRICIAN, AUGUST 7, 1880.)

A DEFUNCT ELECTRICAL JOURNAL.—We regret to hear that our contemporary "The Electro-Metallurgist and Electrical Light Journal" has ceased to exist; the number for June being the last issue. The paper was started in January of the present year, and has contained information of considerable interest and value in the direction of electro-deposition, and in relation to the precious metals.

THE ELECTRIC LIGHT IN PARIS FOR THE FETE OF JULY 14.—On this occasion nearly all the inventors of apparatus and the companies for electric lighting were represented. About 40 Jablochkoff candles were arranged in groups at the Bois de Boulogne; four lamps of M. Lontin were placed on the July column at the Place de la Bastille, and six more on the boulevard Montparnasse; the Serrin lamp was conspicuous on the Place de la Republique, and at the "Mairie du Temple," whilst the modification of this lamp by M. Suisse was to be seen burning in the open air at the rue Sedaine; six Jamin lamps illuminated the "Magazins réunis," and others were observed in Belleville; Messrs. Siemens Brothe had 14 of their differential lamps at the "Palais Royal," and four on the "Place de la Bourse"; the "Loggia" of the Opera was illuminated by six Duboscq regulators; the Compagnie Meritens and the Société Werderman had been active at various points; whilst the Société Générale d'Electricité was very conspicuous at "Notre Dame," the Luxembourg, the Trocadero, the Pantheon and elsewhere.

THE TELEPHONES.—A motion was made on Thursday morning, July 29, before Vice-Chancellor Malins, to restrain the United Telephone Company from issuing advertisements stating that they were taking proceedings against Mr. Louis J. Crossley, of Halifax, for infringement of their patent for carbon transmitters, pending legal proceedings which Mr. Crossley invited the Company to take against him for infringement of the patent. The Company are assignees of the Edison patent, and the day after the registration of assignment commenced proceedings against various parties. Mr. Crossley contended that his carbon transmitter, the "compound microphone," was no infringement of the Edison patent assigned to the Company. After a short discussion the defendant company undertook not to issue the advertisements complained of, without prejudice to any question of the propriety of the proceedings which had been taken. Mr. Aston, Q.C., Mr. Philbrick, Q.C., and Mr. Macrory, instructed by Messrs. Philbrick & Corpe, 18, Austin Friars, appeared for the plaintiff; and Mr. Classe, Q.C., and Mr. Cozens Hardy, instructed by Messrs. Waterhouse & Winterbottom, of Lincoln's Inn, appeared for the defendants.

COOL, BUT NOT CONSIDERATE.—A fortnightly contemporary still continues to fill its columns with matter extracted from THE ELECTRICIAN, but it forgets to acknowledge the source of its information.

Prices of Metals, Chemicals, &c.

TUESDAY, Aug. 3.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£109 0 0	£2 0 0	—
Electro Wirebars...	..	£116 0 0	£2 0 0	—
H.C. wire basis......	per lb.	1s. 4$\frac{5}{16}$d.	$\frac{3}{16}$d.	—
Sheet	,,	1s. 5¾d.	⅛d.	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. 9$\frac{5}{16}$d.	$\frac{3}{16}$d.	—
Brass 60/40—				
Rod, basis ......, ..	,,	0s. 10⅞d.	—	—
Sheet, basis	,,	1s. 3¾d.	—	—
Wire, basis	,,	1s. 3¾d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£39 10 0	—	—
Foreign or Colonial	,,	37 5 0	—	—
Tin—Ingot	,,	268 10 0	-	£2 0 0
Wire, basis	per lb.	0 3 5½	—	½d.

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 10s.

,, (Roll Brimstone).—Per ton £18 10s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 9d.

Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 10d.; plantation 1st. latex, 1s. 9¼d. per lb.

Shellac.—T.N. Orange, 675s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

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Notes.

Cheap Cable Rates.

IT is natural that one of the chief topics to be considered by the Imperial Press Conference at Ottawa should be the collection and dissemination of news, a matter which is closely related to submarine and land line telegraph facilities, and in all of which subjects we are profoundly interested both as engineers and as journalists. We yield to no one in our desire to see the establishment of cheap and efficient means of transmitting news items between the various parts of the Empire equally for commercial, social and other purposes; but we question if the movement for a cheaper and better telegraph service will be advanced by foolish remarks, such as those made by some of the delegates, who seem to be ignorant of the most elementary facts concerning the cost of laying and maintaining submarine cables. For instance, Mr. ROBERT DONALD moved a resolution recommending the Governments of Great Britain and of the self-governing Dominions and India to increase cable communications and reduce the rates of news messages, and so ensure the fullest interchange of news and opinion within the Empire. So far so good. But when he goes on to recommend that these Governments should make increased grants to the cable companies and the Pacific Cable Board to enable them to reduce tolls, and also that these Governments should lay down new cables or enter into arrangements with cable companies to do so under conditions which safeguard the public interest we part company. For we feel quite certain that if the Governments concerned decide to operate submarine cables they will be much less successful at the task than the existing companies. Incidentally, it is curious, seeing the opposition there is to the existing State Telephone System, that the suggestion to inaugurate a State Telegraph System should be made at all. In supporting the resolution Mr. DONALD told his hearers that, in regard to cable facilities, the position now was worse than in 1909, notwithstanding the considerable advance in wireless telegraphy; and he suggested that a cable company should be started to compete with the Eastern Telegraph Company between Great Britain, Asia, Africa and India. "The universal penny postage obtaining in pre-war days is not more reasonable than a universal cable rate of a penny per word for British possessions," he added.

Inaccuracy and Strong Language.

BUT Mr. DONALD is inaccurate. The Eastern Telegraph Company's facilities for communicating with Egypt, India and the East are far greater than they were in 1909. Several new cables have been laid, and others are projected, but, as we recently pointed out, owing to the increase of war and official messages, coupled with the restrictions upon the use of some of the Great Northern and Indo-European Companies' lines, the traffic over the Eastern cables has increased in a greater ratio. It seems a bold claim to call for "penny a word cables" at a time when the POSTMASTER-GENERAL has decided to introduce a charge of a penny a word for inland telegrams, and to realise Mr. DONALD's ideal at present would entail such a heavy subsidy that no Government could entertain the the suggestion. Mr. DONALD's criticism of the attitude of the Government towards radio-telegraphy was equally rash. Speaking to a resolution declaring that the Empire and the world should be provided with the advantage of wireless telegraphic and telephonic communication, he said the Imperial Wireless Committee was "piffling and useless and already obsolescent." Strong language, however, does not make a good argument.

Standard Electrical Ranges.

IN issuing a standard specification for two sizes of electrically-heated cooking ranges, the British Engineering Standards Association has made an interesting step forward. At the stage which electric cooking has now reached it is desirable that there should be a series of rules for its construction, compliance with which would represent good practice, the rules being more in the nature of a "bogey" than an ideal. The specification includes standard sizes for two cooking ranges, each of which is in two parts, a cooking table comprising a grill, hot plates or heaters, and a warming cupboard; and an oven complete with shelves, racks and heating equipment. In the preparation of this specification the British Electrical and Allied Manufacturers' Association, the Incorporated Municipal Electrical Association, and the National Electrical Contractors' Trading Association, among others, have co-operated, the detailed work being carried out by a sub-committee, first under the chairmanship of Mr. C. H. WORDINGHAM, and subsequently under the chairmanship of Mr. S. T. ALLEN. It is further to be noted that this specification is not like the laws of the Medes and Persians, but will come up for revision next year, by which time it is hoped that accumulated experience will be available for the sub-committee. We hope that every opportunity will be taken to provide constructive criticism, for in the right design of this apparatus lies much of its future usefulness.

The Optophone.

Any means whereby the eternal darkness of the blind, a darkness which cuts them off from intercourse with their fellows and from much of the enjoyment of natural things may be lightened is to be encouraged in every possible way. We are, therefore, glad to see that Messrs. Barr and Stroud have been able to place on the market the apparatus invented by Dr. Fouriner d'Albe, and known as the Optophone, whose object readers of The Electrician will remember is to convert light into sound, and so make the ear of the blind perform those functions which in the normal person are performed by the eye. The properties of selenium are, of course, the vehicle by which this is effected, making it possible for the blind man to read ordinary print by listening to the sounder in a telephone receiver. The "trick" of the apparatus is easily learned, and there seems no reason why a person of ordinary hearing, and the blind are as well-known super-normal in this respect, should not become expert in the use of the apparatus in a short time. The speed of reading that can be attained is about 25 words per minute, which, though, of course, relatively slow, compares favourably with that obtainable when Braille or other raised type is used.

Manchester and Mr. Pearce.

Readers of The Electrician will learn with interest the details of the agreement that has just been entered into between the Manchester City Council and their chief electrical engineer, Mr. S. L. Pearce, C.B.E. It is one of those instances, only too few in municipal electrical engineering, where a municipal authority brings honour upon itself, not by rewarding one of its chief officials according to his desserts, but by realising that though those desserts cannot be measured by cash payments an adequate salary is one of the least of the ways in which they can show appreciation of his work. In future Mr. Pearce is to receive a salary of £2,500 per annum with an additional £1,000 per annum for special services which would otherwise be rendered by a consulting engineer. As Ald. Dagnall pointed out, in adopting this unusually generous attitude towards their chief electrical engineer the Corporation would be saving some £30,000 on consultants' fees. Naturally there was some opposition to the arrangement, but this died down when it was announced that in the event of an adverse vote Mr. Pearce would resign. It will be an advantage when more chief electrical engineers are able to take up this unequivocal attitude when their salaries are under consideration, for the chief thing about Manchester's action is its singularity. It must not be forgotten that the remuneration of these highly qualified officials suffers in a comparison with those of men of like experience and position engaged in commercial work, and though, perhaps, the two cases are not exactly comparable the discrepancy is greater than it should be.

The Consultant Question.

The conditions of Mr. Pearce's new agreement raise a question which has often been discussed in these columns: The desirability, no less than the ethics, of an electrical engineer holding an official post undertaking consulting work to the exclusion of those in positions of greater freedom, and sometimes, we may add, of less financial strength. As far as a municipal electrical engineer's own undertaking is concerned we think that his close connection with it as consultant either alone or, preferably, with an independent man is likely to be the most beneficial policy that can be pursued. The municipal engineer is the man most well aware of the needs of his own area, while the presence of an outside man ensures that criticism of policy and detail by independent authority which is a guarantee that the best work is obtained. This arrangement has the further advantage that the engineer who is to be responsible for the operation of the new plant has had a large say in its design and construction. In this connection it is interesting to note that Manchester has followed the same policy in the Waterworks Department. With regard to the larger point of the acceptance of outside consulting work by the municipal electrical engineer it is difficult to give a general answer. There is much to be said for allowing the consumer to obtain the best advice where he will, and the argument that the municipal electrical engineer is already holding a paid position must not be over-stressed. For it is obvious that with the demands his own undertaking and the increasing calls that "linking-up committees," industrial councils and other similar bodies make upon his time he is not a free competitor. On the other hand, his connection in a practical way with electrical progress is very greatly for the good of the undertaking that he controls, because it is also good for him.

The German Electrical Industry.

At the present time Germany is a no less important factor in the world's politics than she was in 1914. And though for some time yet her influence is likely to be rather potential than kinetic, the probable effect of her re-entry into international trade and commerce, a re-entry which will certainly come to pass before long, is worthy of close consideration, particularly by electrical engineers. In connection with this problem, one of the greatest difficulties is to determine exactly what Germany's present position is. Accounts are so conflicting, while the source from which they proceed must also receive careful analysis before any deductions are made. With these qualifications an address on the present position of the German electrical engineering industry recently delivered by Herr Heinrich, manager of the Siemens Schuckert Works, to the Workers' Association of the German Electrical Engineering industry provides some suggestive information.

Then and Now.

Comparing the position of that industry now with its position in 1913, the speaker said that its world's position had been deeply shaken, especially by American competition; and by the fact that the inland production prices were, owing to the present state of exchange, above the market prices of the world, making it impossible to compete in foreign countries. This throws an interesting light on such transactions as have recently been occurring at Newport. Herr Heinrich went on to point out that the position was at its worst in the cable industry, with the small motor and installation branches not far behind. The export trade which was over 50 per cent. of the production before the war, was now not more than 25 per cent. This figure, unsatisfactory as it is to our late enemies, is, however, a sufficient indication of the recovery that has been made in face of great difficulties; though it may only be a flash in the pan, as there would seem to be hardly an electrical engineering firm that is not in the gravest financial difficulties. As in this country so in Germany, the position is complicated by strikes, ever rising wages and difficulties connected with the supply of raw materials and the rate of exchange. With them as with us, amelioration of these conditions can only come through hard work. This, we believe, is realised much more fully in Germany than it is in this country, doubtless because conditions there are worse than they are here. We must see to it that the momentum gained in improving these conditions is not employed to the prejudice of our own industry. The remedy is in our own hands.

Encouragement of Research Work.

THAT the importance of encouraging research work is not yet sufficiently realised in this country is shown by the opposition recently offered by some of the shareholders of Messrs. BRUNNER, MOND & COMPANY to a proposal of the directors to subscribe £100,000 for scientific education and research. We should have thought that the lessons of the war and the extent to which research organisation has been developed by German and American industrial corporations would have been enough to secure unanimous support for the enlightened policy of the directors. We are glad, however, to learn that the proposal has now been adopted, and that the shareholders are granting £100,000 from the company's investment surplus reserve for the encouragement of scientific education and research at such universities or other institution as the directors may select. In a circular to the shareholders, the Chairman (Mr. ROSCOE BRUNNER) rightly pointed out that not only is it of the utmost importance to the future of the company that there should be at the service of the chemical industry an adequate number of young men abreast of the latest developments of chemical knowledge and method, but that the history of the war has shown how infinitely valuable, when any industrial problem has to be solved, the help of university laboratories can be with their band of scientific supermen. The peace-time competition in manufacture between this country and its industrial rivals will demand, no less than war, the whole-hearted co-operation of all the powers that make for development and progress. The raising of the general standards of chemical study necessarily reacts upon the chemical industries of the country, and if standards are allowed to fall in any sphere below those of its competitors the latter will in the long run be triumphant.

Difficulties of Industrial Councils.

THE work of the District Councils of the Electric Supply Industry does not appear to be proceeding very smoothly. In various parts of the country criticism has been levelled against the scales of salaries and wages awarded to the technical staff and employees, and in a few cases it has been decided not to abide by the awards. It is only natural that some difficulties should arise, but we regret to learn that Torquay Corporation has now taken the extreme step of withdrawing from membership of the Whitley Council for its district in so far as the electricity undertaking is concerned. We think this a most unwise action, and if the example be followed to any extent it will militate against the success of the movement for conciliation and arbitration in industrial disputes. The fault seems to reside, not in the general principles underlying the Whitley Council idea, but rather in the constitution of the District Councils and in the manner in which the awards are made and promulgated. It is, therefore, a pity that the Torquay Electricity Department did not make a greater effort to get a modification of the award either through the District or the National Council and thus allow an opportunity of the utility of the Councils being proved.

Drawbacks of the Grading Method.

THERE is, however, no doubt that many electric supply undertakings, especially the smaller ones in non-industrial areas, have been hit very hard by the increasing cost of coal and supplies, by recent wages awards and by other causes, all tending to affect their financial stability. The areas of the District Councils are usually divided into grades for the purpose of deciding upon the wages to be paid, and it is probable that in the definition of these grades sufficient care has not been taken to give due consideration to the special circumstances of particular districts. Mistakes are bound to occur in the development of a national organisation like Industrial Councils, but these mistakes should be rectified. The language used by Mr. TAYLOR, chairman of the Torquay Electricity Committee, at last week's meeting of the Town Council will, however, not help to that end. He said the Committee found it impossible to carry on with the Whitley Council. Awards were coming along so fast that they did not know how to deal with them. If the men's unions were not satisfied they could tell them to take their men away; the people of Torquay would have electricity all the same. The time had come when the Council must take a firm stand on the wages question. Surely, the Whitley Council cannot be bad for the electric supply industry and good for the others? The principle cannot be reprobated when applied to one undertaking and approbated in regard to other municipal services. The Torquay Electricity Committee must try again.

The Corporation Tax and Electric Supply Companies.

THE Finance Bill contains a point of considerable interest to Electric Supply Companies in the incidence of the Corporation Tax. The final form into which the Bill has been shaped leaves the electric supply companies exempt from the operation of this tax for three years, which is an improvement on the Bill as it was first presented to the House, where no such exemption was allowed. Seeing that the tax works out at 5 per cent. on all profits, this exemption is obviously of appreciable financial importance, but unless this section of the Bill is meanwhile repealed the Corporation Tax will fall on the companies in three years' time. And the mere fact that the exemption is only temporary adds another burden to the Sisyphean labours of Electric Supply Companies in regard to the raising of new capital. Gas companies, water, railway and other statutory companies are, of course, all in the same boat in this respect. But electric supply companies are especially hard hit. The uncertainties which hang over the future of the companies, the difficulty in the way of getting authorisation of adequate scale of charges for electric supply were bad enough, and now this added imposition fully warrants one picturing the raising of capital by such companies as a herculean task. The Electricity Commissioners will, we hope, share the view of the companies on this point, and exercise a kindly consideration, which shall afford the latter a happy issue of, at least, this among their many afflictions.

The Coal Crisis.

THE crisis in the mining industry to whose approach we called attention a week or two ago, has now arrived. The delegate meeting of the Miners' Federation met yesterday to decide whether there shall be a ballot on the joint issue of a reduction in the price of domestic coal by 14s. 2d. per ton and an increase in wages of 2s. a day. The result of the deliberations at this meeting were unknown at the time of going to press, but in any event it is probable that a ballot will be decided upon, and it therefore remains to be seen whether in this encounter moderate counsels will prevail or whether once again the hotheads will have their way. We have already exposed the essential feebleness of the miners' case, but were it ten times stronger than it is nothing could excuse this attempt not only to stop the industrial machinery of the country, but to suborn the very processes of democratic government. The real issue is, of course, the nationalisation of the mines; and the policy the miners are proposing for the adoption of this quack panacea is one which by impoverishing whole districts of mines and by thus ensuring that they should be subsidised by other districts would precipitate that Government control of which it is so necessary we should be rid without delay. We only hope that the authorities will continue in their present firm attitude towards these demands, for the supposition, to which recent practice has but too much colour, that they have an infinite compressibility is not a little responsible for these constantly recurring demands. This question must be settled here and now; and we are glad to see that the Triple Alliance is working in the direction of peace. Peace, however, must not mean compromise.

“Acts of God” as a Defence to Actions.

Though exemption from liability for damage caused by an “Act of God” is sometimes claimed in actions for damage due to the uncontrollable working of natural phenomena, it is not often raised as a defence by electricity supply authorities. The term “act of God” is used by lawyers to describe events which cannot be foreseen, or which, if foreseen, cannot be guarded against. It is confined to damage which is occasioned by the elementary forces of Nature, such as storms, tempests and lightning, unaccompanied by the agency of man or other similar cause. It appears that the Quebec Railway, Light, Heat & Power Company recently resisted an action for the destruction of some houses which were set on fire by the conductors of the Company’s 2,200-volt transmission line coming into contact in a storm with the branch lines that supplied the houses with electric current. As the company had not adopted the ordinary practice of earthing the secondary wires, we are glad that the Privy Council found the defence set up failed. All reasonable care must be taken by supply authorities, and as overhead transmission lines are liable to be damaged by both storms and lightning, every known precaution should have been taken to guard against the contingency. The earthing of secondary wires is recommended by the Canadian Fire Underwriters, and, as the company were advised to carry this work out, they could not plead ignorance of the practice. Where a person can guard against the action of natural forces, and does not do so, it seems to us to be an abuse of language to ascribe the result to an “act of God.”

The Human Factor in Industry.

Speaking at the recent annual dinner of the Institution of Mechanical Engineers, Sir J. J. Thomson pointed out that some of the engineer’s greatest difficulties nowadays were to be discovered in his dealings with human nature. Now, the effect of the working of that complicated machine, human nature, in its relations to engineering and industry generally, has always been sufficiently prominent to be the theme of speakers on occasions when moral apothegms suitably form the main part of the discourse; but in recent years this factor has forced its way into the inmost recesses of industrial life, and has profoundly affected the development of that life in many ways.

The Workman as a Machine.

The study of the causes and the history of this great change are full of interest. For many years after the introduction of machinery the workman was himself little more than a machine. Poorly paid and badly organised, he was at the mercy of the employer for whom he worked to a very large degree, and an iron discipline was maintained over his output and his behaviour by the threat of unemployment. This is not to say that all employers were harsh in their relations to their workers, for this is far from being the case; but it is not to be wondered at that there flourished, even among the best employers, the idea that the workman was of another nature than themselves, and that the ethical and physiological rules which governed their own lives were not applicable to those who toiled in their factories or on their land.

The Worker as a Man.

It is true that this attitude still exists; but the power which it once had has now almost entirely disappeared. The reasons for this change are well known. The growth in numbers and power of the Trade Unions, the artificial conditions brought about by the war and by its aftermath; and, it must in fairness be added, the more enlightened ideas now held by employers, are all contributory factors to improvement. Unfortunately, this change for the better has brought with it a turn of mind which goes far to counteract the potential good of the alteration, for with the development of the Trade Unions has grown up the insidious idea that the aims of capital and of the worker (to give them their usual labels) are antagonistic, and that the legitimate desires of the latter can only be accomplished by the destruction of the former. And while we must deplore the short-sighted attitude of the employers of old, as being one of the contributing causes of Labour’s present attitude, we must equally deplore the policy of the Trade Unions, not only because of its essential wrongness, but because it is quickly driving us along the road to disaster.

The Realities of the Problem.

It is obvious that, if this movement is to be checked, steps must be taken to educate both parties in the true realities of the question. Fortunately, there are those who are not lacking in apprehension of the dangers by which we are faced, and we are glad to see, not only the purely Trade Associations, but the more scientific bodies, are considering the question from many points of view, in the hope that a solution may be found before it is too late. One of the latest contributions to the discussion in this form is a Paper read at the recent summer meeting of the Institution of Mechanical Engineers by Mr. Alexander Ramsay. We reproduce this Paper on another page of this issue. Mr. Ramsay rightly points out that “the whole structure of industry is ultimately at the mercy of those who work with their hands,” and that the attitude of this large body is therefore of supreme importance. Unfortunately, they do not at present seem to appreciate that wealth is not unlimited, or, indeed, that wealth is in the broadest sense, and irrespective of its distribution, necessary to their own and the Nation’s well being; or that this wealth can only be maintained and increased by the combined efforts of everyone doing his best in his own particular sphere. Examples of this ignorance are to be found in the objections to payment by results, in the embargo on overtime, in the “ca-canny” methods employed at a time when there is the greatest need for the maximum effort. It is not yet recognised that the ultimate end of this policy must react disastrously on the workers; but we fear it will not be long before it will be only too patent.

Sympathy and Antipathy.

With this, and with a great deal of the more detailed arguments in Mr. Ramsay’s Paper, we are in complete agreement; but we are not quite so sure that he has hit upon the right solution of these difficulties. His idea is that those acquainted with the problems of management (in other words, the employer) should establish personal contact with the worker, and keep him in touch with the factors affecting the particular article upon the production of which he is engaged, through works’ journals, weekly talks, and generally by developing a community of interest. Unfortunately, this solution takes no account of the suspicion against the employer and all his works that resides in the breast of the average worker. The only result of all this "getting together" would be, we fear, the generation of the idea that the employer hoped to get something out of it, and therefore ultimate failure would result.

The Task for Trade Union Leaders.

We think, however, that this very necessary enlightenment of the worker might be brought about in another way. The help of the Trades Union Leaders (many of whom are alarmed at the present results of a propaganda which they formerly encouraged) might be enlisted, and the fundamentals of industrial stability catalogued by Mr. Ramsay laid before the men by them rather than by the employers or other representatives. Such an arrangement is not unattended by obvious difficulties, and it is not accompanied by that glamour which surrounds much of the present-day propaganda; but, nevertheless, it is along such lines that real improvement is likely to be found. And similar propaganda is no less necessary among employers, so that both sides may realise that each is but a cog in one industrial machine, each necessary to the other and each useless without the other. To talk of the destruction of Capitalism or of "whiffs of grape shot" for Labour is equally futile as a solution of the present very real problems. A spirit of conciliation and a realisation of the other difficulties with which both parties are faced will take us a good way towards the desired goal to the general advantage.

A Fragment of History.

For some years past we have reproduced each week in The Electrician paragraphs from the corresponding issue of forty years ago, and have thus attempted to indicate succinctly the progress that has been made in our knowledge of electrical phenomena. The perusal of these ancient issues to select the necessary items is at once a pleasant and a curious task. At present, as our readers will be aware, we are passing through the year 1880. If we could reproduce the issues of that year in full, instead of being limited by space demands to a few short notes, our readers would find that "the electricians" of those days were mainly concerned with the advances then being made in "weak current" applications, with the electric arc (then a comparatively newcomer for industrial purposes), with electro-metallurgy on a small industrial scale, and with the elucidation of patents, in which inventors were groping for means whereby the use of electricity could be developed on a commercial scale. The results of these efforts we, forty years afterwards, are only just beginning to see the beginning. Of the applications of electricity to power purposes, except in the most desultory way, there is no mention in 1880; equally, electric lighting was only just about to be employed for domestic purposes, so that it is not surprising that there is nothing said about those "other uses" to which we are now turning as an extensive field for new electrical activities. In fact, electricians in those days (they had hardly then become electrical engineers) were frankly a little fearful of anything new, a state of mind which is not entirely absent even now, though after reading what we have done we might be forgiven for thinking that there is no development of electricity which is outside the bounds of possibility.

The Engineer's Restless Spirit.

To be more particular, there are two adjacent paragraphs in The Electrician of August 14, 1880, which particularly take our fancy. In one of them reference is made to a prophetic article published in an issue of the "Quarterly Review" in 1854, in which the author, as sometimes even the wisest writers do, attempts to forecast the possibilities of international telegraphic intercommunication, then, of course, very much in its infancy. He complains that "the restless spirit of the English engineers," not content with "having provided for the internal communications of Great Britain and her telegraphic dependencies, seems bent upon stretching out her lines to the East and to the West, so as ultimately to clasp the entire globe." He points out that the project of connecting England with America by such means is under serious consideration; but, though he believes such a cable might be laid, he doubts the feasibility of passing an electric current through it; and to circumvent the difficulties which, as we know now, were certainly met with, but were successfully overcome by the genius of Kelvin, he suggests an alternative route via the Orkneys, the Shetlands and the Faroe Islands, thence via Iceland, Greenland and the Davis Straits in such a way as to reduce the maximum length of submarine cable employed on any one run to 900 miles. The only obstacle to this arrangement, he points out, is the partiality of the Esquimaux for old iron! "Can there be any reasonable doubt," he concludes, "that before the end of the century [telegraphy] will bring the four quarters of the globe within speaking distance of each other, and enable the electric fire to put a girdle round the world in forty minutes." This man prophesied better than he knew. Before the end of the century the world was encircled by many times the number of cables that he had conceived possible, and a new development—almost, indeed, a new science—had been born, of which the most imaginative among us are only now beginning to conceive the ultimate possibilities.

Gas Engineers in 1880.

In the same issue another engineer tries his hand at prophecy. In his presidential address of that year to the North British Association of Gas Managers, Mr. J. Robb had something to say about the future of electric light, and what he said was very like what many other gas managers have said since. After referring to certain advances in gas engineering, he continues: "We may well ask—what next? Some one will say 'The electric light'; but, gentlemen, I think we are far from seeing the realisation of the hopes of those persons who have embarked their fortunes in the production thereof." Really that does not sound like forty years old, nor does the admission that follows, that electric light has some advantages. For during those forty years electrical engineers have gone on improving their methods, and gas engineers have gone on protesting that there is nothing, or at least very little, in it. And so it may well be to the end of time.

An Obvious Moral.

Now there is a certain very obvious moral to be drawn from the two extracts which we have quoted, but a moral which is none the less useful for all that. In the space of forty years electrical engineering has developed, not by sitting down and saying that this or that cannot be done, but by just doing it without the aid of subsidies or doles, and often in the face of very active interference. To-day we also have our difficulties which have got to be overcome. There are certain operations which could be performed better electrically if we only knew how, there are certain improvements in method which could be made if we could only get down to the task, and that is doubtless what the pioneers of 1880 felt; but now we admire their work, and look back rather fearfully at the enormous distance we have traversed since then. Will that be the attitude of the electrical engineers of 1960 to us? Not unless we strive in order to achieve.

A Method of Amplifying Electrical Variations of Low Frequency.

By **W. H. ECCLES** and **F. W. JORDAN.**

It is well known that the amplifiers used for amplifying the high frequency oscillations received in wireless telegraphy are sometimes incapable of passing oscillations of much lower frequency, such as those of audible frequency, and in fact are sometimes purposely designed so as to refuse passage to current of audio frequency. The method to be described, however, enables one to utilise a high frequency amplifier for the amplification of speech currents. In general the method can be used for certain ranges of frequency with any amplifier. For example an amplifier designed for direct use with oscillations of frequency 300,000 per second may be used for amplifying fluctuations of, say, 30,000 per second, or 3,000 per second or 3 per second; while an amplifier built for magnifying oscillations of frequency 1,000 per second may by aid of this method be used to amplify fluctuations of, say, 50 per second or lower. In order to assist in explaining the method let the frequency of the oscillations for which the amplifier is designed be called the "carrier frequency" and the frequency of the oscillations or fluctuations to be amplified the "lower frequency"; then the method may be compactly described by saying that it consists of impressing upon a source of carrier oscillations the lower frequency fluctuations to be magnified, and then passing the modulated carrier oscillations through the amplifier, which magnifies them as modulated. The lower frequency oscillations are then rectified or otherwise detected in the magnified currents and voltages. Details of some convenient ways of performing these processes are given below.

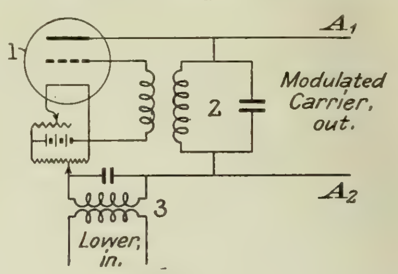

Fig. 1.

One merit of this method especially when the amplifier is designed to pass only a particular frequency is that resonance at the carrier frequency may be utilised to increase the magnification; and an advantage over triode amplifiers designed solely for audible frequencies is that valve noises and sustained singing troubles can be reduced. Obviously the amplifier may be of the transformer or resistance cascade type passing and magnifying a variety of carrier frequencies, or it may be especially designed to magnify only one frequency; or a combination might be made of a high frequency amplifier with a frequency sifting device.

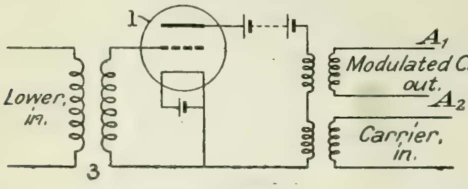

Fig. 2.

The source of oscillations is most conveniently an ordinary triode oscillator, but it may be any other type of oscillation generator. The lower frequency electrical fluctuations may be impressed on the carrier oscillations by any of the means used for the same purpose in radio telephony. It is well known that in radio telephony the vibrations of speech frequency are impressed on radio oscillations which are then utilised in producing free electric waves for transmission to a distance. In the method here proposed, however, the carrier oscillations are not used for creating electric waves, but are used only for passing the fluctuations through the amplifier.

As illustrations of the method we shall now describe some experiments we have made on the magnification of speech currents by aid of the French military amplifier using a carrier wave-length of about 3,000 metres.

Fig. 1 shows a circuit in which the three-electrode tube 1 generates radio oscillations in the closed oscillatory circuit 2, the voltage applied to the anode being tapped off the filament battery. Speech currents are imposed on the anode circuit by means of the transformer 3 and the modulated radio oscillations are led from terminals A1, A2 to the radio amplifier.

Fig. 2 shows a circuit in which carrier oscillations from an independent source are imposed on the anode circuit of a three-electrode tube while the lower frequency fluctuations are imposed on the grid circuit. The modulated carrier oscillations are taken from the anode circuit to the radio amplifier.

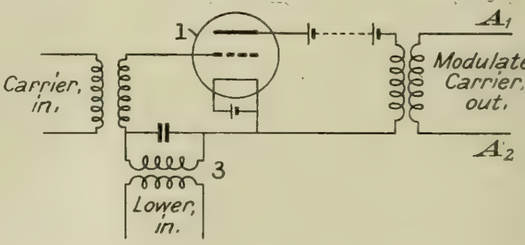

Fig. 3.

Fig. 3 shows a circuit in which both the carrier oscillations and the microphone currents are imposed upon the grid circuit of a three-electrode tube, the modulated carrier oscillations being taken from the anode circuit to the amplifier.

Fig. 4 shows a circuit in which the carrier oscillations are imposed on the anode circuit and the audio vibrations on the grid; the modulated oscillations are taken from the anode circuit to the amplifier.

For the purposes of separating or detecting the lower frequency in the amplified modulated currents and voltages any of the methods familiar in the practice of radio-telephony may be used. For example, the amplified modulated currents may be passed to a crystal detector or to a diode or triode arranged for rectifying and the rectified currents used with any indicating instrument or with a telephone receiver; or the amplified modulated currents may be passed directly to a thermal indicating instrument or to a thermal telephone.

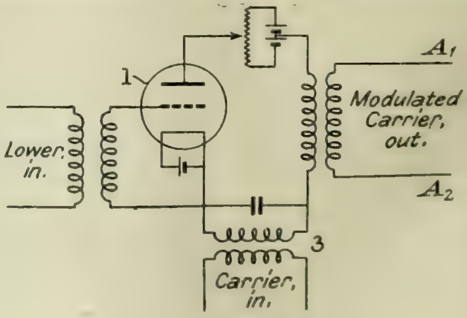

Fig. 4.

The method was very successful with speech currents, the articulation being quite unimpaired by the whole amplifying process. It promises to be successful also for magnification of currents or voltages varying relatively slowly—such currents as are met with, for instance, in the physiological laboratory. But the writers have not had the opportunity of testing the strictness of the proportionality between the voltage applied for modulating the radio oscillations and the resulting rectified current at the extreme end of the chain of operations.

The Significance of Maxwell's Theory.

By A. PRESS.

The Infinite Speed of Longitudinal Wave Propagations.- The deferred potentials of Lorentz have recently been introduced into electromagnetic theory with a view to explaining the radiation of earthed coils and antennæ. The conclusions have been so extraordinary in character that it must prove profitable to have better cognizance of the fundamental conceptions involving the usual electromagnetic theory, for, to say the least, the conclusions are certainly not Maxwellian.

Our notions of wave propagation follow from the characteristic involving the space and time differentials. Thus, in the equation—

$$\frac{d^2H}{\alpha x^2}=\alpha^2\frac{d^2H}{dt^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

it is known that the constant $1/\alpha$ corresponds to the velocity with which the magnetic force H can be resultantly propagated along the co-ordinate x. However, the expression (1) is a derived equation, and therefore must be interpreted in the light of the two simultaneous curl equations which individually constitute the basis of the Maxwellian theory.

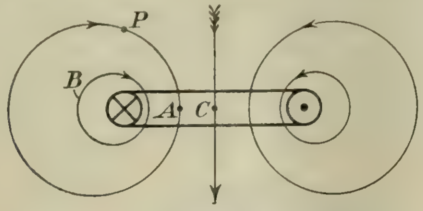

Fig. 1.

The conception of curl implies circuitality as opposed to divergence. Thus, the electric current and the magnetic flux must both be closed circuit phenomena according to the Maxwellian system. If a current (or a magnetic flux) exists at any moment of time it must exist as a closed circuit entirely or not at all. In other words H and E, along the lines of force, that is, longitudinally, are propagated at infinite speed. The velocity coefficient $1/\alpha$ in equation (1) has reference therefore to a resultant lateral wave effect, and has nothing to do with longitudinal waves.

Let us now consider, for example, a closed metallic loop carrying a suddenly generated current.

In the Maxwellian system the flux line passing through any distant point such as P must be set up at exactly the same time as it occurs at A despite the fact that P is located further from the coil than the point A. Moreover, if the shorter flux path B is set up as a whole at infinite speed then the $A-P$ flux path must be similarly considered without in any manner having to introduce time deferred potentials. The above reasoning also applies to the flux line C passing along the axis of the coil. The above suggests, in fact, a sort of rigid body interlinking. It should be noted that wave propagations in finite time are particularly excluded in the two curl equations leading to the wave propagation expression (1); for the gaussage formula $\varphi H \,.\, dl=ni$ is devoid of any time term. Yet a velocity coefficient α is obtained by combining two component equations of condition which of themselves do not contain a velocity term.

No Preponderance of Electricities.—Triode Theory.—Since magnetism (H or B) is circuital it follows that isolated magnetic charges (poles) cannot exist, for the latter give rise to flux divergence over a closed envelope if properly taken. On the other hand, electric displacement D can be divergent, but in so far as the rate of change of displacement dD/dt constitutes current, and currents are always circuital, there can be no preponderance of negative electricity over positive electricity, and vice versa. This fact seems to have been lost sight of when dealing with the so-called space charge of triodes. If a certain quantum of negative electricity is shot off from the incandescent filament an equal and opposite amount of electric charge must be left behind on the filament, so that the problem of electric force distribution between filament and plate or filament and grid must take the positive surface charge into account. Not without reason did Maxwell insist that mathematically the true displacement current was indistinguishable magnetically from the true conduction current.

In this connection it should be pointed out that in the triode we have a thermo-electric layer which constitutes the source of E.M.F. To cross the layer requires work to be done as pointed out by Sir J. J. Thomson in his "Conduction of Electricity through Gases" when discussing the Richardson theory. The pressures p referred to therein are the electronic pressures in the conductor and in the vacuous space. If the current is that of saturation then the lower limit p_1 refers substantially to a vacuous space devoid of electrons, and then $p_1=O$. The whole theory of the space charge needs to be gone into more carefully.

Electrostatic Lines of Force Laid Down at Infinite Speed.—It is agreed that when the dissimilar electronic charges are separated that a state of electrification exists. (Note.—A mechanical system is absolutely required to effect this separation, and in the illustration below the required mechanical system is understood and must not be lost sight of.) The normal state can be said to be one in which no field exists. An E.M.F. or mechanical circuit is absolutely necessary, so that when the charges coalesce a circuital path for the current must be at hand.

As the charges are slowly separated lines of force are set up. If then the charges are separated at a speed very much greater than the velocity of light the question arises what mechanical force would be exerted on a unit charge situated at P distant from the axis AB. Would it be possible that with sufficient speed of separation no force would be present at P? The answer is that if lines of force (longitudinally) are laid down at infinite speed then P will always experience a true mechanical force. It may be said that in some quarters it has been thought that the lines of force in some manner are always generated laterally at the speed of light.

The Stationary Wave Components of Electromagnetic Wave Propagation.—If the impressed force H throughout space is always, componentally, in time phase with the impressed current J, and the electric force E is in time phase with the magnetic current dB/dt, the problem suggests itself immediately as to how progressive electromagnetic waves can be generated. It is a well-known fact that given two stationary wave components differing from each other in time phase as well as space phase that a progressive wave will result. This is particularly exemplified by the solution of the vertical grounded antenna already referred to by the writer. In fact, it can be said that the electric and magnetic field distributions set up by the conduction portion of a series circuit are out of time phase and space phase from the dielectric or condenser portion of the remaining part of the circuit. It is for this reason that where the condenser portion is in series effectively with the conduction portion as in an antenna that the writer has referred to voltaic and galvanic effects.

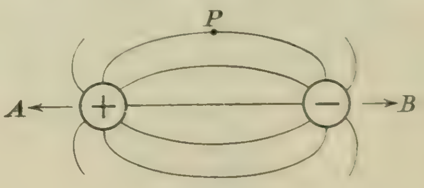

Fig. 2.

The Dielectric Current Loses Identity Because of Circuitality.—The latter terms seem to have been misunderstood in some quarters. Thus, in deriving the two componental curl equations leading to the d'Alembertian (1) in the general case at the point (x, y, z), the field is assumed to be filled with an imperfect—that is, partially conducting dielectric. In this case the dielectric current component dD/dt is in parallel with the conduction current J at the point, whereas in the circuit above mentioned the two are in series and when integrated merge into the same aggregate value. The two cases are totally dissimilar, and the Lorentzian (or, rather, general Maxwellian) forms should be interpreted in the light of the above. In so far as dD/dt is a current at all it must always be circuital, though D itself when referring to the dielectric displacement can be divergent. It is hoped to deal further with electromagnetic wave propagation in a subsequent article. Sufficient has been said to warrant a close scrutiny of the Maxwellian and Lorentzian forms, and especially the significance to be attached to the deferred and undeferred vector potentials.

The Automatic Protection of Large Electrical Power Distribution Schemes.

F. B. Whitaker's System.

(COMMUNICATED.)

The problem in laying out the protection scheme described in this article was to protect each conductor from the generator to the extreme ends of the central distribution network. This can be done by first surrounding the conductor with a conducting shield lightly insulated from the conductor, and then connecting the conductor to the shield by means of a tripping circuit that is capable of isolating the conductor if a leakage current passes through it.

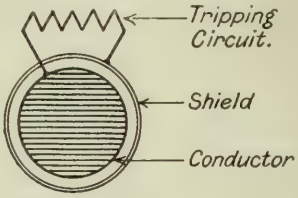

Fig. 1.

Fig. 1 represents diagrammatically any conductor on a system. The conductor proper is insulated relatively lightly and then surrounded by a conducting shield, a tripping circuit being connected between the conductor and its shield. In this scheme of protection this composite conductor (conductor proper, insulation and shield) is treated just as if it were the conductor on systems as at present constructed—*i.e.*, insulated to earth and between phases in the usual way.

Wherever the conductor passes through an automatic oil switch, the shield is discontinuous, as shown in Fig. 6. One tripping circuit is connected between the conductor and its shield on every section.

It will be seen that the only current passing through the tripping circuit under normal conditions is the small capacity current to the shield; therefore, if the tripping circuit be made of reasonable impedance, there would only be a very small difference of potential between the conductor and shield; in fact, it may be taken that the shield and conductor are normally at the same potential.

Operation of the Tripping Circuit.

Now, any leak which occurs will take place from the shield. This will cause current to pass through the tripping circuit, and this can be utilised in various ways completely to disconnect the faulty conductor from the system. It will be noticed that if a leak occurs from any shield, current will only pass through the one tripping circuit connected to that shield, and the passage of this current through that tripping circuit will operate only those switches which are necessary for the disconnection of the faulty conductor from the system.

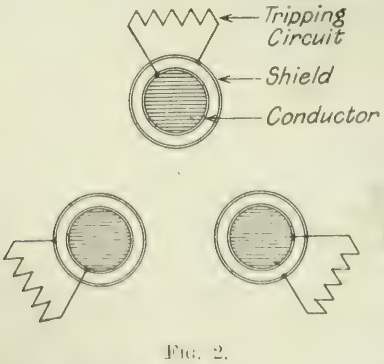

Fig. 2.

As the tripping circuit is not in the path of the main current, it can be made of quite high impedance, and therefore the fault current that will flow on the occurrence of a breakdown to earth or between phases will be limited to a very low value in the initial stages while the switchgear is clearing the fault. This limitation of short-circuit with high impedance in no way interferes with the regulation of the system under working conditions. Owing to the tripping device being external to the path of the main current, the device is perfectly stable—*i.e.*, it will not operate on heavy currents providing the section that it controls is sound.

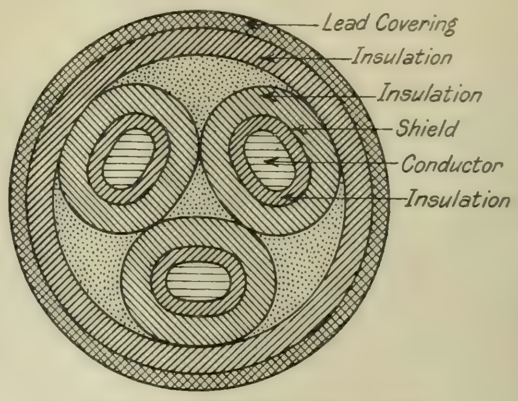

Fig. 3.—0·20 Square Inch Cable.

Fig. 2 illustrates diagrammatically the cores of a three-core cable with the necessary tripping circuits. Fig. 3 illustrates a section of a three-phase cable suitable for this method of protection.

Faults to Earth.

It will be seen from Fig. 2 that should a fault to earth occur, the leakage current will pass through one of the tripping circuits, and this can be made to disconnect the cable at both ends. Should, however, a fault occur between shields, then the fault current will pass through two tripping circuits, and again the cable can be disconnected at both ends. Faults either to earth or between phases will be limited to very low values by the high impedance of the tripping circuits.

In the case of long feeders it will be found preferable to divide the shield at the centre, install tripping circuits at each end of the cable and provide a pilot cable. The operation of the tripping circuit at one end of the cable, due to leakage, would disconnect the cable at that end, and also, through the pilot cable, operate the switch at the other end.

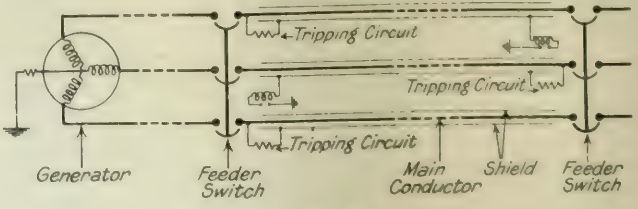

Fig. 4.

Fig. 4 illustrates diagrammatically another method of disconnecting a three-phase cable at both ends. The operation of one tripping circuit, or the opening of a switch at one end, can be made to place a small artificial fault on the shield connected to the conductor at the other end of the cable. The artificial fault current will pass through the tripping circuit and open the switch at the far end.

Switchboard Protection.

This system of protection is also admirably suited to switchboard protection. In future the conductors on all large switchboards will probably be insulated at least lightly throughout their length. It therefore only remains to surround each conductor with a shield wherever the conductors on the switchboard are supported from earth or between phases. The shields surrounding each conductor on any one section can then be connected together, and then through a tripping circuit to the conductor.

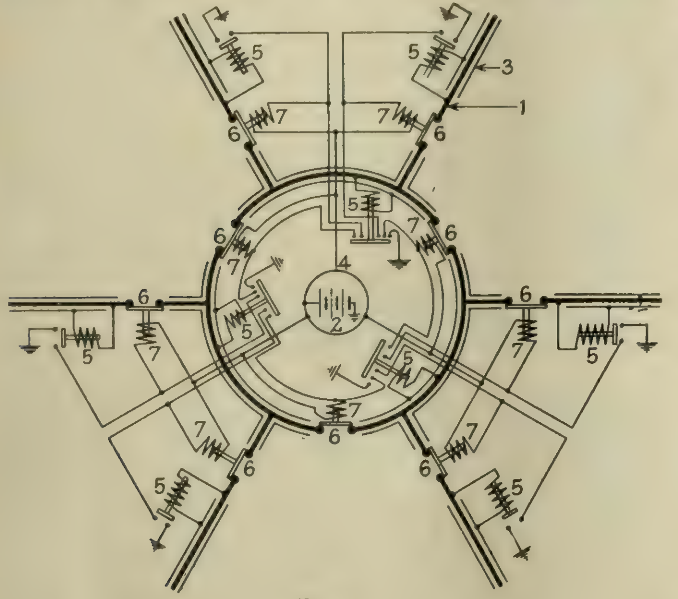

Fig. 5.

1. Main Conductor. 2. Battery for Trip Coils. 3. Shield. 4. Low-tension Wiring for Trip Coils on Oil Switches. 5. Tripping Circuit (H.T.). 6. Oil Switches. 7. L.T. Trip Coils on Oil Switches.

Fig. 5 illustrates a set of 'bus-bars divided into three sections. One phase only is shown. One tripping circuit is sufficient to protect each phase of each section, however many generators or feeders are connected to that section. The low-tension tripping circuits would actually be provided with an insulated return, but an earth return is illustrated for simplicity. In the diagram a continuous shield is shown, but it will be quite sufficient in other cases to provide the shield only where the conductor is supported, providing the shields for each conductor in each section are connected together, and then through the tripping circuit to the conductor.

From Fig. 5 it will be observed that a fault from any shield to earth, or between phases, will instantly operate the tripping solenoid which controls all the switches surrounding that section, and so the section will be completely isolated. If the fault occurs on the far side of the feeder switch, then only the feeder will be disconnected. If the fault occurs on the generator or generator cable, then only the one generator will be disconnected.

Section Isolation.

Providing only one set of 'bus bars is installed, a fault on any one section of the 'bus-bar will isolate that section; but if generators are at the time connected to this section they will also be disconnected. This is the natural result of only having one path of supply from any one generator to any one feeder. But if duplicate 'bus-bars are provided, and they are normally run in parallel, then a fault on one section of the 'bus-bars will immediately isolate one set of bars on that section; but the supply will be maintained from the generators on that section through the other set of 'bus-bars.

Fig. 6 illustrates a section of the 'bus-bars suitable for a large station where duplicate bars are provided. It will be seen that a fault to earth or between phases on one set of bars will not in any way interfere with the continuity of supply. This is obtained by a single tripping circuit for each phase of each section, no matter how many generators or feeders are connected to each section.

Seeing that the only current normally passing through the tripping circuit is the capacity current to the shield, the setting of the tripping device can be adjusted with safety slightly above the capacity current; also, as the whole of the fault current will pass through the tripping circuit, a small leakage will provide the large forces suitable for operating the tripping mechanism. That is, while the tripping circuit can be set to operate at exceedingly low value of leakage current, such low values of leakage current will exert large force on the tripping mechanism.

Capacity Current.

The capacity current to the shield will vary with the voltage of the system, periodicity, length of conductor to be protected, size of conductor and its supports, quite apart from the materials used for insulation; but, even under extreme conditions, the capacity current will be very low. The capacity current on a 20,000-volt 25-cycle three-phase feeder 5 miles long, say 0·20 section, will be of the order of 1½ per cent. of the normal full-load current of the feeders, and on 50 cycles about double this value, so that the tripping circuit could be set with a reasonable margin above these figures. With pilot cable tripping the trip circuits can be set to operate at half these values. The tripping circuits on 'bus-bar sections would rarely require to be set at a higher value than, say, 1 ampere.

Limitation of Short Circuits.

With regard to the limitation of short-circuit, the impedance of the tripping circuit will vary with the voltage of supply, and also the capacity current to the shield. The tripping circuit must be designed with a suitable size of conductor, and the impedance and construction of the same will be such that there will be no possibility of resonance, either with the fundamental or higher harmonics. It is also desirable that the voltage between conductor and shield should be kept reasonably low during normal operation. It will be found that a short-circuit between phases on a feeder can generally be limited to less than full load current of the feeder. A short-circuit to earth or between phases on a 'bus-bar section can generally be limited to considerably less than the normal full-load current of the smallest feeder leaving that section.

It is evident from the above figures that a fault either to earth or between phases on a feeder or on a 'bus-bar section would hardly be noticeable so far as the shock to the system is concerned. The limitation of short-circuits to such low values is the direct result of the position of the reactance. Seeing that it is not in the path of the main current, it can be given a relatively high value, and so faults can be reduced to very low values.

Further, because very little current is normally passing through the tripping circuit, practically no waste of energy is incurred during normal operation in the tripping circuit, and as the tripping circuit has only to withstand the fault current during the time the switches are clearing, the tripping circuit apparatus need be only of quite small dimensions and of small cost. Owing to the limitation of short-circuit to such low values, the opening of circuits containing faults does not impose severe strain on the oil switches.

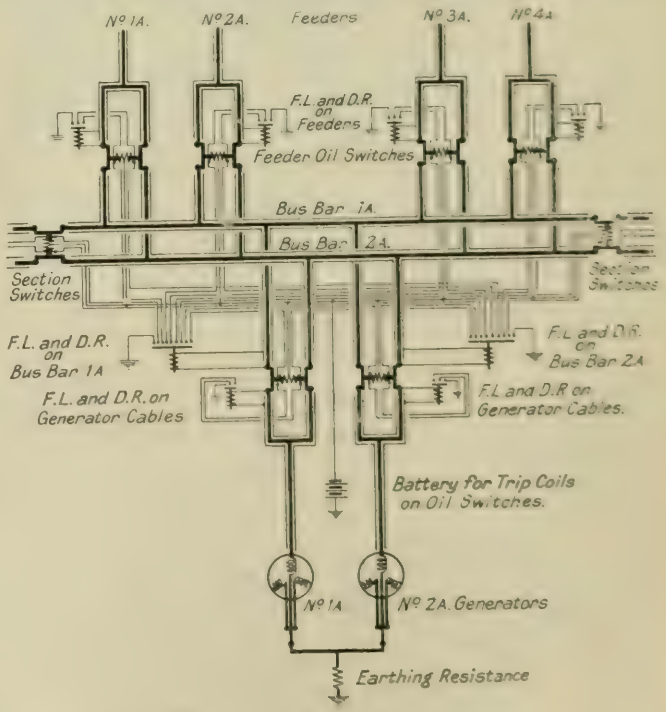

Fig. 6.

Generator Protection.

The possibility of complete protection and limitation of short-circuit from the generator terminals to the feeder ends is a great advance on previous propositions. It is proposed, however, that large generators should be protected in the same way. If this were carried out, then the whole central distribution network of generation and distribution would be completely contained inside a protective shell or shield.

Generators for large power schemes will be designed with few conductors per slot. Fig. 7A is a representative section of a slot (two conductors per slot) of a large generator as usually constructed. Fig. 7B illustrates the section as modified for this system of protection. As the output of such machines is generally limited by the rotor, the slight increase in the size of the slot would not entail any increase in the overall dimensions of the machine, and the cost of inserting the shield would be almost negligible on the total cost of the set.

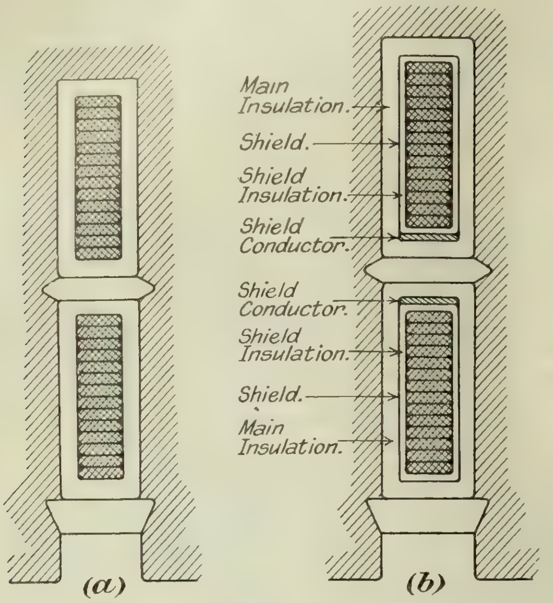

FIG. 7.

The shield round each conductor would consist of copper tape bound over a shield conductor running throughout the length of the machine. The shield as well as the main conductor would be constructed so as to be practically free from eddy loss. The shield on each phase would be connected to its respective conductor through a tripping circuit (*see* Fig. 8), and preferably so that a small difference of potential is maintained between conductor and shield. If the design were such that faults were likely to happen between end turns on the same phase, such faults can be taken care of by connecting as shown in Fig. 8c.

Generators constructed and connected as Fig. 8 would be protected against breakdown to earth and between phases, and the fault current would be limited to very low values. The tripping circuit would be set to operate at currents of less than 1 per cent. of the output. In fact, the device would be so sensitive that it could be used to give warning of increased leakage from the windings before it actually cut the machine off the 'bus-bars. If connected to Fig. 8c, they would also be protected against short-circuits between one half and the other half of the same phase.

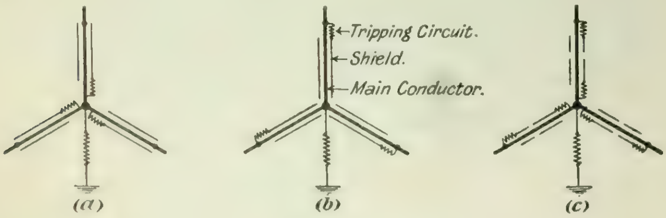

FIG. 8.

The addition of the shield will not have increased the tendency to breakdown; in fact, generators constructed on such lines would be better able to withstand high frequency surges as the insulation between conductor and shield is effective under such conditions, although normally there is little or no stress across the same. The thickness of insulation between conductor and shield should be such that full voltage could be applied momentarily. The insulation between shield and earth would, of course, have to withstand normal voltage under working conditions, and therefore should be capable of withstanding the usual tests.

SMALL MATERIAL DAMAGE.

The material damage to the machine itself in case of a fault would be very small, on account of the extreme sensitiveness of the tripping device and the limitation of short-circuit, and yet there is no chance of the tripping device operating providing the machine it controls is free from fault. The operation of the generator oil switch in case of fault would also reduce the excitation to zero.

It now remains to be seen how this scheme affects the design of existing apparatus and what form the tripping circuit will take. As seen above, generators such as would be installed on the large power schemes lend themselves admirably to this form of protection. Fig. 9 illustrates the shape of coil which is readily adaptable to shielded protection. No radical change from the best practice of to-day would be required.

The manufacture of high-tension cables should present no difficulty, as very similar cables have been widely installed and used in connection with other methods of protection, and the cost should be about the same. The jointing of such cables would be comparatively simple. The three cores would be jointed as in ordinary practice and insulated. The shields would then be joined up over this inside insulation, and then each shield would be given the required treatment to insulate it to earth and between phases.

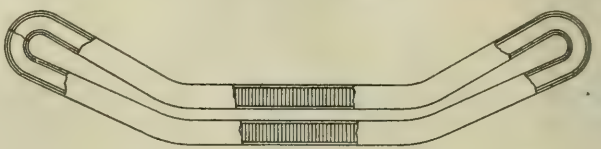

FIG. 9.

SWITCHGEAR DESIGN.

The design of switchgear to suit this scheme should present but little difficulty; but no doubt the details of manufacturers' standards would have to be modified. It would take too long to describe here the various details of construction, but wherever in ordinary construction a conductor either passed through a current transformer or insulator, or is supported from earth or between phases, in this proposed scheme the plain conductor would be replaced with one surrounded, or partly surrounded, with insulation and a shield.

In the case of the completely-enclosed type of switchgear, it would be necessary to insulate the 'bus-bar, then surround it with a shield, and then fully insulate the shield from the internal casing. The exact form of various insulators or insulation must necessarily depend on the individual pieces of apparatus to be protected and the type of switchgear. The tripping circuit is conveniently constructed as a reactance coil mounted on insulators, and through the centre of which passes a small magnetic circuit which would be used for lifting an armature. The lifting of the armature would be used to close the opening coils of all the oil switches surrounding that section protected by the particular reactance coil.

Fig. 10 illustrates one size of what is best called a fault limiting and discriminating relay, and which would form the tripping circuit between the conductor and shield. In Fig. 6 this fault limiting and discriminating relay is shown as a solenoid, and referred to by the initial letters F.L. and D.R. Such a relay would perform the double function of limiting the fault and operating the tripping mechanism. As faults are limited, the system of protection can easily be tested, say, each week-end by placing an artificial fault on the particular part to be tested. For instance, each section

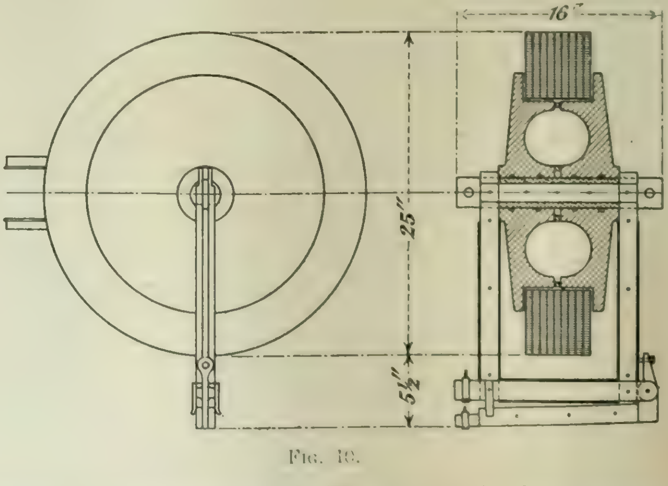

FIG. 10.

of 'bus-bars could be partially earthed, when every switch surrounding that section should open.

Also it will be found that many minor advantages will accrue from the use of this system. When disconnecting and earthing cables for inspection or repair, if the shield is earthed first the possibility of a heavy fault being caused by the earthing of a live cable is removed, as the fault would be limited and the cable would be instantly disconnected. It is also possible to arrange the feeder disconnecting switches, so that an earthed cable cannot be connected to the 'bus-bars except through the fault limiting relay. 'Bus-bar potential transformers can be connected across shields instead of across the 'bus-bars, so that a serious fault in the transformers would immediately result in the disconnecting of the section, but not in an interruption of the supply. Cables constructed in accordance with Fig. 3 would be better able to withstand high-frequency surges than the standard cable, providing the same thickness of insulation exists between shields as would normally exist between conductors on the ordinary form of cables, because the insulation between conductor and shield becomes effective under such conditions.

While this scheme of protection will form a complete system, yet it can also be applied to extensions of existing systems. It is flexible, and can be linked up with other schemes of protection. The advantages that will be obtained by installing this system of protection are :—

1. It is a complete system of protection for the central distributing network, and can embrace generators, the generator cables, oil-switch insulators, current transformers, and all conductors on the main station switchgear, feeders, and the more important sub-station switchgear.

2. It is perfectly discriminating. Schemes can be inter-connected in the most economical manner, yet no portion of the system will be isolated unless that part be faulty.

3. It enables schemes to be laid out so that there are at least two paths to every main distributing point, so that the supply will be maintained there even though a faulty section is isolated.

4. Faults to earth and between phases are limited by the fault-limiting and discriminating relays, so allowing all switches to clear before the fault can develop into a serious short-circuit. Generators are relieved of severe shock, and oil switches are only called upon to open relatively small powers in case of such faults.

5. The apparatus used in connection with this system of protection is of the simplest kind, and none of it is in series with the load. One fault-limiting and discriminating relay per phase is all that is required to protect each section. During normal operation the voltage across the reactance will be very low indeed.

6. As the action of this system of protection depends on leakage current through the tripping circuit, and not on the balanced currents or the proper operation of special relays, there is no chance of the tripping circuit operating on overloads external to the distribution network, and so isolating a healthy section.

7. The device can be tested under actual emergency conditions without practically increasing the load on the system.

8. The chances of breakdown are not in the least increased by the installation of the system ; in fact, the generators, switchboards and cables will be better able to withstand high-frequency surges.

No complicated joints or earthed metal are introduced into the cables, and neither are the number of highly stressed points to earth or between conductors increased.

9. If it is only intended to protect the cables, standard switchgear can be used ; but, of course, if this scheme is applied to the switchboard as well, the oil-switch insulators, current-transformer insulators and other forms of insulators would be provided with shields.

10. It is very rapid and sensitive. In most cases faults of less than 1 or 2 per cent. of the normal full-load current can be isolated.

11. The tripping relay can be designed with a very large factor of safety ; no close setting of relays is required.

12. It enables switchgear to be constructed with duplicate 'bus-bars which will normally run in parallel. A fault on one set of 'bus-bars will isolate that section of the 'bus-bars ; but the supply will be maintained from the generators through the other set of 'bus-bars to the feeders.

The worst arguments that can be levelled at the scheme are that it has not been tried out in practice, and that development would be required ; but that is the case with all new schemes.

The Human Factor in Industry.*

By ALEX. RAMSAY.

The prosperity of an industrial community is largely governed by the efficiency and energy of its wealth-producing classes. Of these the brain-worker is not the least important. To him we owe the comforts and refinements of modern society ; he has been eager to wrest from Nature the secrets she carried in her bosom and mould them to the use of man and the progress of humanity. He has devoted himself with enthusiasm and sacrifice to the patient and laboured elucidation of scientific truths which have added much to the knowledge and resources of the world. He made possible the marvellous productive capacity of a machine and labour-saving age. His place in industry, his training, scope, and encouragement would afford an interesting and profitable study. But the most perfect piece of mechanism is without value unless guided by labour. The most brilliant product of the mind cannot become material until labour has performed its function. The whole structure of industry is ultimately at the mercy of those who work with their hands. Their attitude towards the problems of production is of supreme importance, and inasmuch as that attitude at the moment gives rise to some anxiety, it is to this phase of the subject that attention will be directed.

The Aftermath of War.

The country is still in the aftermath of the war. Over a considerable period it became accustomed to a prodigal expenditure of wealth without particular scrutiny of the value received. Employers and workers alike were dipping into a purse which seemed bottomless ; expectations were high ; rewards were high ; the art of spending was tremendously encouraged. It is obvious, of course, that during this period the nation was disposing not of its revenue but its capital, and that to such a process there must be a definite and speedy end. Moreover, the continued expenditure of capital resources has the effect not only of dissipating wealth but of rendering it impossible to create more. The employers are very rapidly appreciating this truth and taking suitable action ; sections of the workers appear to act as if the national wealth were illimitable and bore no relation to that which is produced.

Industrial and Political Activities.

The activities of the workers are divided in two main channels which are rapidly converging—the industrial and political. In the industrial sphere attempts are made to secure better conditions from the individual employer or group of employers, and in the political to obtain general advantage, and to effect ultimately a fundamental change in the organisation of industry by the nationalisation of the means of production and exchange. These ambitions are perfectly understandable and legitimate, and if the workers believe in them they are justified in pursuing them ; but there is an unfortunate disposition amongst a section of the leaders of the labour movement to regard the employer as one who stands between them and their reasonable aspirations, and who must accordingly be fought by every weapon at command. No apparent regard is paid to the fact that the institutions he represents are the foundations of the State, and that such merely destructive activities immediately react on the prosperity of the community. There is a tendency to seek the fulfilment of the new idea, not by the cumulative effect of sound constructive work, but by the destruction of the present system on which, until something better is evolved, the livelihood of the whole nation depends. In other words, these doctrinaires are consciously at war with the present organisation of industry, and their attitude is expressed in a general encouragement of mistrust, impatience, antagonism, and complete indifference to productive efficiency. It would not be true to say that the bulk of the workers are dominated by this idea, but the application of their unreasoned philosophy leads to very much the same thing.

Power and Irresponsibility.

The past six years have witnessed a tremendous development in the status of labour—against which there is nothing to be urged. Wages have largely increased, hours of work have been lessened, and the organisation of the workers has been enormously strengthened. But with this new sense and experience of power, certain irresponsibilities have resulted which are most disastrous. In a certain industry, for example, subsidised by the taxpayers, the wages have increased 300 per cent., and individual output, it is alleged, has fallen at least 50 per cent. Most of the great trade unions of the country have declared against working a system of payment by result in spite of the most complete safeguard for the inefficient, and in spite of the fact that this system is beyond all question the most effective to induce production and in principle the most equitable to all concerned. Over a considerable period there has been a national embargo on the working of overtime. Avoidable overtime is an evil which cannot be defended. Overtime on a key operation is on occasion an essential, which it is sheer folly in these times to refuse. Overtime to pour a casting to provide work for a gang of men, or to release a cargo steamer to catch a tide, are instances which would have been acknowledged, had there been any disposition to examine the question on its merits; and still demand follows demand for further and increased advantages.

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* Abstract of a Paper read before the Institution of Mechanical Engineers.

These circumstances are not referred to by way of recrimination, but because they indicate an attitude of mind. They indicate that the workers do not believe that the country is now in such a position that only greatly increased production can save it from industrial disaster. They do not realise that their well-being can only be assured, provided they are able to exchange freely the manufactured articles they produce for the commodities which they must obtain from other peoples; and that, too, in competition with other manufacturing communities similarly situated. They do not appreciate the fact that the cost and bulk of our production must determine the cost and bulk of those things we desire to import for our maintenance or comfort, and that to this extent the cost and standard of living would appear to be factors largely governed by themselves. They are holding out both hands to grasp at privilege and do not count the cost

A Dangerous Situation.

This in brief is the pressing problem with which industrial statesmanship is faced. Many of the industries of the country, if not already there, are rapidly drifting into a position which is economically unsound. If the tendency to take out of industry more than is put into it is further pursued, or if the destructive theory is more extensively accepted by the workers that the debilitation of the present organisation is, in itself, something desirable to achieve, there is before the country a period of grave economic crisis and social danger. Industry cannot be subsidised indefinitely by the taxpayers, or carried on out of capital resources, and unless the nation settles down to work and produces what it seeks to enjoy, it cannot escape the disaster resulting from the defiance of such elementary need. It is desirable that some other means than bitter experience be found of demonstrating that it is useless to evolve theories of distribution if nothing exists to distribute, because in the times we face, disillusionment and distress are evils that will not live alone.

Now the probability is that the situation has not got beyond a point where it can be regulated, provided the mind of industry addresses itself to the problem. A remarkable combination of circumstances, due to the war, and necessitating continuous employment at whatever cost, have given the workers an unbalanced perspective and created illusions which, in the nature of things, cannot be maintained. It is unthinkable that a usually well-balanced community would commit economic suicide if it realised what was taking place. The average British workman in his individual capacity is pre-eminently a sane and reasonable being, and he will rise to meet a necessity which he understands. The need for educative propaganda therefore is pre-eminent.

The Square Deal.

It is a first necessity that he should be made to understand that he is getting a "square deal." His spirit of reason can only be approached through his spirit of fair-play. It has been a striking fact that in the seething turmoil of the mining industry, excessive demands have not been justified popularly, on the ground that the miner's conditions of employment were improper, so much as on the ground that he desired a larger share of the profits which he alleged the employers were making. The cotton industry has recently witnessed a financial manipulation whereby stockholders have realised a capital appreciation of remarkable extent. Is it to be supposed that the spinners will be satisfied until they have shared in the spoils? The plain fact is, that the workers are now strong enough to exact a fair proportion of the profits of production, and it would be wise to make it quite clear that the employer shares in that desire. Let the employers attempt to create an atmosphere of goodwill, and reciprocated goodwill can at least be possible

National Industrial Council Potentialities.

If two parties are inseparably associated, and differences arise which cannot be ignored, peace will be best assured by frank and friendly discussion. In this connection the National Industrial Conference was a splendid conception, and it is a great misfortune that its potentialities have not been more fully developed. But the individual can do a great deal. Those acquainted with the problems of management should wherever possible, establish personal contact with the worker, and keep in touch with the world factors affecting the particular product on which he is engaged. But one of the main difficulties of laying an effective case before the men lies in the fact that in a large workshop it is only possible for the directional heads to get into personal contact with a very few individuals. These delegates may be perfectly honest, but it is unreasonable to expect them when reporting discussion to accept the employer's outlook and represent it in convincing fashion. The shop steward cannot be regarded as the best means of propagating information which the employer believes the individual worker ought to know. It is suggested, therefore, that the institution of the factory journal or house organ should be much more extensively developed, either for the individual factory or a group of factories, and that in its columns should take place from time to time a full consideration of the various domestic problems which constantly arise. A wise work's director, who could have a weekly talk with the bulk of his employees through such channels, would achieve a work, the importance of which could not be measured.

Some attempt, too, must be made to demonstrate to the public at large the governing factors on economic questions. It has not been realised, for instance, that the tremendous increase in the price of labour and raw material, is making it impossible for the country to finance the volume of output of which it is capable, with a consequent reduction in the purchasing power of the nation. It is not understood that every increase now made is simply making the evil more pronounced, and defeating the very purpose for which it was designed. Subsidised houses, transport, coal and other commodities have been accepted with the utmost complacency, and a feeling has been created that such political strategies can be substituted for work. There has been no real insistence on the fact that the primary duty at the moment is to produce in the utmost quantity at the cheapest rate, and that instead of the studied indifference experienced, the whole of the community should be mobilised to this end.

Mischievous Interference.

The time has come, too, when the mischievous interference by Government Departments in industrial negotiation should be considerably curtailed. It cannot be eliminated, because the Government is responsible for the maintenance of law and order in the realm; it is the custodian of the interests of those not directly affected by a dispute, and, as such, is an interested party whose voice when necessary must be heard. But it has been proved on many occasions that a Government is too susceptible to outside considerations. Expediency is the only recognisable note of its industrial policy. And where it is quite well known that one party to a discussion will always give way to expediency, the other may well be expected to remain obdurate. The workers are clearly entitled to receive from industry the greatest advantage which industry can afford, but this line cannot be overstepped without grave menace to themselves. There comes a time, therefore, when necessity must govern; and this point can best be determined by the directional heads of industry on the one side and the trade unions on the other.

The Efficiency of the Employer.

Finally, our industrial and social difficulties can be eased by the efficiency of the employer. He it is who in a very real sense has to keep running the wheels of industry, and on him depends to no small extent the economic security of the country. But has the inanimate side of production been reduced to the science it might become, or is industry still instinct with the conservatism of old-established practice? Is the art of production studied or does it simply evolve? Much time and money could be saved if the lessons of experience were anticipated or even supplemented by the training of the schools.

It is advisable that employers should cultivate more the practice of the open door. They should develop a community of interest, interchange ideas, treat each other not as competitors, but coadjutors. No individual is strong enough to withstand the tendencies of the times, and these certainly call for unity of purpose, knowledge and action. The hope of the future lies in the possibility that capital and labour may develop a better understanding and encourage a mutual inclination to further each other's reasonable aspirations. Such an end would have magnificent results, but it will not be attained until the nation consciously strives to bring it about.

The Optophone.

In The Electrician of October 24, 1913, Dr. E. E. Fournier d'Albe gave some details of an apparatus he had invented for converting light into sound, and thus making it possible for the blind to read by producing in a telephone receiver a series of musical notes or musical motifs representing the various letters as these are passed over by the instrument in traversing a line of printing. To this instrument he gave the name of "Optophone." The idea has been modified and developed by Messrs. Barr & Stroud, and we are indebted to them for the following description of the latest pattern of instrument, which depends for its action on the properties of selenium.

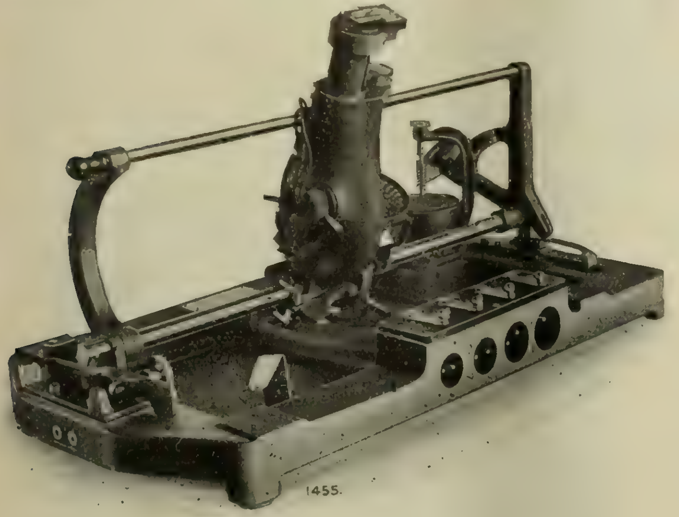


Fig. 1.—The Optophone, with Book Rest removed.

As is well known, if a telephone receiver is connected in series with an electric battery and a porcelain tablet having on its surface two separate conducting lines of graphite connected together or bridged over by light-sensitive selenium, a current will pass through the telephone, and the current will vary as the lighting of the tablet is varied. This prepared tablet is called a "selenium bridge." When flashes of light are thrown on to the selenium bridge at a rate of 256 per second, the current will rise and fall at that rate, and the telephone will sing out the note of the middle C of the piano. If the pulsations of the light are at half that frequency, the telephone will sing out C an octave lower, and with 512 pulsations per second the C one octave higher, and so on. The telephone can, therefore, be made to sing any tune by the proper succession of sets of pulsations of light applied to the selenium bridge.

It will be remembered that in the Optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are passed over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic motif comprising successions of single notes and chords. Printed letters are thus translated by the optophone into a sound alphabet, which can be readily learned.

Arrangement.

The arrangement and a general view of the instrument is given in Fig. 1. The printed page to be read is placed face downwards on a glass plate supported on a suitable stand. Beneath the plate is a tablet of porcelain pierced with an aperture to permit the passage of light upwards, and so through the glass on to the paper. The upper surface of the tablet—round the aperture—is prepared as a sensitive selenium bridge, and connected up to a battery and a telephone. The selenium bridge receives only light reflected from the page. The light used is obtained from a small straight filament electric lamp placed beneath a rotating disc perforated with small holes arranged in five concentric circles near its edge. A diagram of arrangement is given in Fig. 2.

The disc is kept in rapid rotation by means of a small motor driven by current from a secondary battery. Above the disc there is an optical system, which throws on to the paper an image of the lamp filament as it would be seen through the perforations in the disc. By this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala." Each spot is pulsating at a rate corresponding to the number of holes in the circle of perforations to which it belongs multiplied by the number of revolutions per second of the disc. There are 18 holes in the innermost circle, 24, 27, 30 and 36 in the other circles respectively, and if the disc makes 21⅓ revolutions per second, the second circle of holes will produce 512 pulsations of light—corresponding to the vibrations in the musical note C^1. The numbers of holes given above are in proportion to the vibrations in the notes G, C^1, D^1, E^1, G^1 (soh, doh, ray, me, soh). A change in the speed of rotation of the disc of course alters the pitch of the notes—that is, the key in which the motifs are sounded; but the intervals remain unaltered.

The optical system used to produce the image of the holes has a variable minification, so that the length occupied by the scala of five spots may be adjusted to equal the height of the letters to be read, the range of adjustment covering the various sizes of type employed in ordinary printing. The optical system is so designed that the sharpness with which the five spots are focussed upon the surface of the paper is little altered by a change in the minification, but more accurate focussing can be effected by movement of a small lens situated immediately below the selenium bridge. The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, &c., the high G^1 falling on the tops of capitals and of the high letters. The three intermediate spots cover the height of the short letters.

"White Sounding" Optophone.

With an optophone constructed in accordance with the above description, if all the spots of light fall on white paper—the space between two words, for example—all the notes will be sounded together in the telephone, producing a discord. If the scala passes over the letter V, the top note G^1 (high soh) will first be silenced, then E^1, D^1, C^1, D^1, E^1, G^1. Each letter will alter the succession of sounds in a different manner. This arrangement constitutes what is called the "white sounding" optophone.

"Black Sounding" Optophone.

The present improved type of optophone is modified so as to make it "black sounding." In this form white paper is represented by silence, and notes are sounded as the scala passes over the black letters. With this optophone the letter V is represented by the motif (G^1, E^1, D^1, C^1, D^1, E^1, G^1 (s m r d r m s).

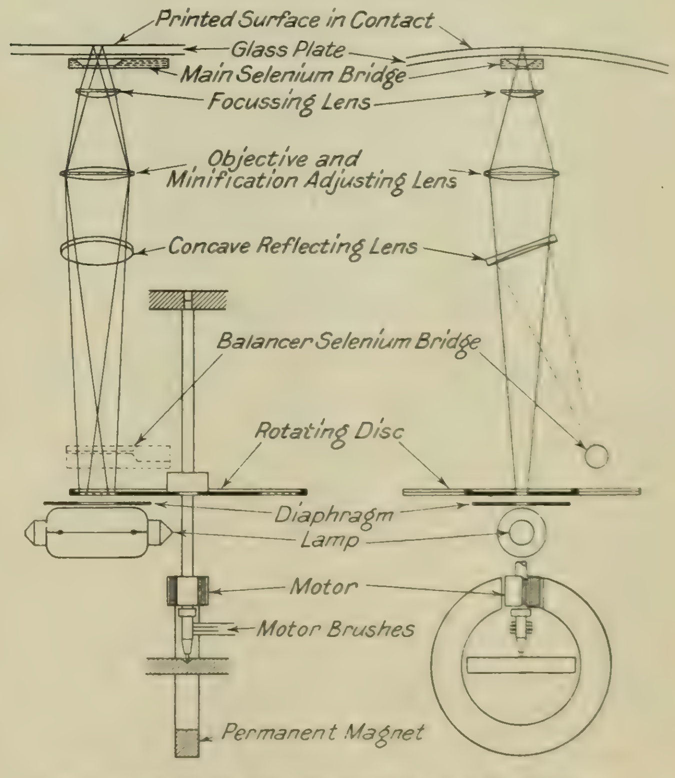


Fig. 2.—Diagrammatic Arrangement of the Optophone.

The "black sounding" is obtained by providing a second selenium bridge, which is called the "balancer" illuminated by a small part of the intermitted light reflected aside before it reaches the paper—and connecting this bridge to the telephone and the battery, so that the current traversing the balancer bridge (Se. No. 2) acts in the reverse direction in the telephone to that of the current through the main selenium bridge (Se. No. 1). One battery is used, and the two selenium bridges are connected one to each end of the battery, and both through the telephone to a selected intermediate junction of the battery in the manner shown. The balancer thus tends to cause the telephone to sound all the notes continuously, and the main selenium bridge that receives the light reflected from the paper annuls the effect on the telephone in respect to any note when the spot of light corresponding to that note falls on white paper. The division of the total voltage of the battery can be varied so that when the whole scala falls on white paper the telephone is silent, and notes are sounded only as the scala moves over the black letters, as previously described.

Mechanical Construction.

The base of the instrument consists of an aluminium casting. It carries the book rest and the various parts of the mechanism. The book rest consists of a metal frame standing on four feet and supporting a curved glass plate on which the page to be read is placed face downwards. Means are provided for clamping down the page, so that it lies in close contact with the upper surface of the glass. Passing under the book rest, from front to back of the base, there is mounted a rocking shaft, the axis of which is coincident with the axis of curvature of the book rest plate. The shaft is tubular, and a slotted rod passes through it for effecting the line changing motion as described below. The shaft carries an aluminium casting, called the "tracer," on which are mounted the electric lamp, the revolving disc and its motor, the optical system and the selenium bridges. The tracer can swing from one side of the book rest to the other.

The lamp-holder is carried at the lower end of the tracer. Above it there is the revolving disc, through the perforations in which the light passes to the main objective, and finally through a small lens near the top of the tracer, above which, again, there is placed the main selenium bridge. Under the objective there is a concavo-convex lens, placed at an angle, which reflects a portion of the intermittent light on to the secondary selenium bridge, called the "balancer," situated in the tracer a little above the disc and to the right of its axis.

When the tracer is swung over to the right-hand side (by means of a handle projecting out in front of the book rest, seen in Fig. 1), a spring situated on the base behind the book rest is bent down, and tends to throw the tracer over to the left. A governor is provided which controls the swinging of the tracer to the left. On the top of the governor box (which is situated behind the left back corner of the book holder) there is a screw with a milled head for controlling the speed of swinging of the tracer—*i.e.*, the speed of passing along the line of printing. The farther this controlling screw is screwed down the slower the tracer swings, and vice versa. When the controlling screw is sufficiently screwed down the swing of the tracer is stopped, but starts again when the screw is slackened back.

An adjustable friction gear is provided for moving the tracer down the page a line space at a time, or up the page one line space at a time if desired for re-reading a line. In the process of reading, when the tracer has passed to the end of one line, the line changer is operated and the tracer swung over, when it automatically traverses the next line.

The line-changing gear is operated by a lever seen at the front of the instrument in Fig. 1. The lever is provided with a stop-screw which is adjustable, and can be set to make the movement of the tracer exactly equal to the line spacing of the printing, when the lever is moved backwards and forwards.

Switches are provided on the base of the instrument for the lamp, the motor and the two selenium bridges. All the controlling parts and the necessary battery connections, &c., are designed with a view to ease of manipulation by blind persons, and after a few lessons little difficulty should be experienced in adjusting and using the instrument.

In the case of the letter V already referred to, the connection of the characteristic tune or motif with the actual form of the letter is readily recognised from the succession of notes. It must not be supposed, however, that optophone reading consists in analysing the sound motifs so as to identify the forms of the letters indicated. When the alphabet has been learned, the motif for each letter is recognised as a whole, and later in the reader's practice, the more extended motifs for syllables and even words will become familiar to his ear. A practised optophone reader will recognise words as readily as a telegraph operator interprets a succession of clicks on the Morse code. The great rapidity that has been attained by hundreds of readers of Morse sounds encourages the hope that equal or greater speed in optophone reading will be attained with practice. Already it has been found that with the latest type of optophone a blind reader, after some practice, has attained a speed of reading of 25 words per minute. In this way all printed works are rendered available to the blind, without the disadvantages of the intervention of Braille or Morse type.

Obituary.

Prof. John Perry, F.R.S.

We regret to record the death of Prof. John Perry, which took place at his London residence on the 4th inst.

Prof. Perry, who was born at Garvagh, in Ulster in 1850, and was educated at the Model School, Belfast, where he won, among other prizes, a silver medal in natural science. He became an apprentice to a local firm, Messrs. Coates, and went through the drawing office and shops. On matriculating at Queen's College, Belfast, he gained a mathematical scholarship, and he graduated in 1870 as B.Eng. with first honours, obtaining the gold medal and Peel prize. He gained Whitworth exhibitions in 1868 and 1869, and a Whitworth scholarship in 1870. His first teaching appointment was at Clifton, and while physics master there (1870-74), he inaugurated the school physical laboratory and workshop. In 1873 he published an "Elementary Treatise on Steam," and in 1874 he was Secretary of the A Section of the British Association. Later in that year he became Thomson scholar and honorary assistant to Sir Wm. Thomson (Lord Kelvin) in Glasgow. He contributed many of the mathematical and physical articles to Blackie's "Cyclopædia." His first scientific Paper, on "The Electric Conductivity of Glass as Dependent on Temperature," was read before the Royal Society in 1875, and, in conjunction with Sir Wm. Thomson, he read a Paper on "Capillary Surfaces of Revolution" before the Royal Society of Edinburgh. In 1875 he went to Japan as Joint Professor of Engineering in the Imperial College of Engineering, where he remained until 1879. In association with the late Prof. Ayrton he did much electrical work while in Japan, and on their return in 1879 Prof. Perry organised the works of Messrs. Latimer Clark & Muirhead, and introduced large tools, machinery for covering wire with gutta percha, &c., and for testing dynamos.

Elliott & Fry.

The late Prof. John Perry, F.R.S.

For his lecture on "The Future Development of Electrical Appliances" he gained the silver medal of the Society of Arts in 1881. He arranged the system of technological examination in mechanical engineering of the City and Guilds Institute, and he delivered a course of Cantor lectures on hydraulic machinery in 1882. In that year he became Professor of Mechanical Engineering and Applied Mathematics at the Finsbury Technical College. In conjunction with Prof. Ayrton he was engineer to the Faure Accumulator Company until the English patents were disposed of to the Electrical Power Storage Company, and jointly they carried out much electric lighting and traction work. Among other places, they lighted the Grand Hotel, Charing Cross, they arranged the driving of tramcars and tricycles, and carried out experiments on accumulators at Liverpool and Paris. They made numerous inventions including multipolar dynamos in 1882, and their meters were the only instruments that gained prizes at Paris in 1889. In fact Ayrton and Perry, who were the pioneers of electrical instruments, invented the first motor meter put on the market. On the death of Prof. Fleeming Jenkin he became engineer of the Telpherage Company, and in 1885 he supervised the erection of the telpher line at Glynde, Sussex. In June, 1885, he was elected a Fellow of the Royal Society. The fruitful partnership with Prof. Ayrton was dissolved in April, 1889, but he continued his inventive and literary career. He wrote many scientific papers and he delivered the Operative lecture at the B.A. Meeting at Leeds on "Spinning Tops." In March, 1896, he became Professor of Mechanics and Mathematics in the Royal College of Science, and subsequently he published several well-known text-books, including "The Calculus for Engineers," "Applied Mechanics," "Steam, Gas and Oil Engines." Many of his lectures and addresses have also been issued in book or pamphlet form.

Probably it is by his work as a teacher and examiner that Prof. Perry will best be remembered, and both at Finsbury and South Kensington he did excellent work. While acting as chairman of the examiners in the seven engineering subjects of the Science and Arts Department, he exercised much influence over methods of teaching. He published several Papers and Addresses on the teaching of mathematics, the training of engineers and on England's neglect of science. Being an Irishman, Prof. Perry had a somewhat aggressive, but stimulating, style, and his Papers and lectures on teaching methods, which have since been widely adopted, provoked much discussion.

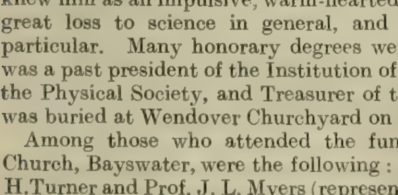
Under the age limit rule, he retired from the Royal College of Science about six years ago. In 1913 he was chosen by the Government to go out to South Africa to investigate the conditions of education there, and to help in the drawing up of a scheme for the foundation of the South African University under the Otto Beit bequest. Prof. Perry's part in the work was accepted by the South African Government in its entirety. During the last few years he gave scientific advice on war, and devoted his mathematical knowledge to the study of gyroscopic compasses. His numerous acts of kindness and help endeared him to all his students. His many friends knew him as an impulsive, warm-hearted Irishman, and his death is a great loss to science in general, and to electrical engineering in particular. Many honorary degrees were conferred upon him; he was a past president of the Institution of Electrical Engineers, and of the Physical Society, and Treasurer of the British Association. He was buried at Wendover Churchyard on Saturday last.

Among those who attended the funeral service at St. Peter's Church, Bayswater, were the following: Prof. W. H. Eccles, Prof. H. H. Turner and Prof. J. L. Myers (representing the British Association), Sir Joseph Larmor, M.P., Sir Napier and Lady Shaw, Sir Dugald Clerk, Prof. A. N. Whitehead and Prof. A. R. Forsyth (representing the Imperial College of Science and Technology), Sir Francis Ogilvie (Research Department), Mr. A. A. Campbell Swinton (Royal Society of Arts); Mr. A. Siemens, Mr. W. M. Mordey, Sir James Devonshire and Mr. R. H. Tree (Institution of Electrical Engineers), Lieut.-Colonel W. A. J. O'Meara (British Science Guild), Sir Alfred Keogh (Governors of the Imperial College), and Prof. H. E. Armstrong.

The Institution of Electrical Engineers was represented at the funeral at Wendover Churchyard by Mr. Roger T. Smith (President), Mr. L. B. Atkinson (President-elect), and by Prof. W. H. Eccles (Vice-President).

Heavy Bus Bar Supports.

In large industrial plants, low voltage distribution is often preferred n spite of the heavy currents involved. Particular attention must, therefore, be paid to the construction and arrangement of 'bus-bars in order to avoid skin effect and heating of the adjacent iron parts due to hysteresis. The accompanying illustration shows the arrangement of a three-phase, 60-cycle, 8,000-amp. 'bus-bar support, in which each phase is split up into four parts, thus, it is claimed, materially reducing the skin effect. The cross-beams holding the 'bus-bar insulators are made of manganese bronze to eliminate heating. These supports have been installed at the Corn Products Plant, Pekin, Ill., and are manufactured by the Delta Star Electric Company, of Chicago.



Heavy Current Bus Bar Support.

Reviews.

Electric Furnaces in the Iron and Steel Industry. By W. Rodenhauser, J. Schoenawa and C. H. Vom Baur. 2nd edition (London: Chapman & Hall.) Pp. xviii. + 429. 17s. 6d. net.

This book was originally translated by Mr. Vom Baur from the German. In the present edition Mr. Vom Baur is responsible for having rewritten the bulk of the work, and, as former chief engineer of the American Electric Furnace Company, he is eminently qualified for so doing. As compared with some other authors, he is not closely identified with any particular type, and therefore we may expect his judgment to be well balanced in discussing the present subject, which abounds in pros and cons.

The first chapter deals briefly with historical matters, and this is followed by three chapters on fundamental principles, on the effects of the electric current, and on alternating currents respectively. There is more reason for chapters of this kind than is often the case in technical books, because the applications are specialised and certain aspects must be emphasised. For example, the use of very large alternating currents involve problems that do not arise in more ordinary electrical engineering. In this preliminary part some of the difficulties and limitations involved in electrothermal methods are clearly indicated.

In Chapter V. we come to the real subject of the book. Here are discussed the general conditions for the operation of electric furnaces, and although the treatment is brief the reader will find this a most useful chapter, for therein are set out the ideals which any electric furnace should fulfill. As set out, these are numerous, being nineteen; and needless to say no existing furnace complies with all of them. The practical plant is necessarily the result of compromise. But it is useful to have the ideal set down, and it enables Mr. Vom Baur in later chapters to discuss each well-known type of furnace in terms of the ideal, and to draw useful conclusions. It is better in this way to make comparisons with the ideal than to compare one imperfect, though excellent, type against another.

In Chapter VI. arc furnaces in general, including the subject of electrode losses, are discussed, after which we come to the consideration of each furnace in detail. The first is the Stassano, which, although a pioneer, has not proved very generally acceptable. Then follow the Héroult and Girod in succession, and here we come upon the oft-debated question of the advantages and possible dangers of the bottom electrode. It is shown that the purely resistance-heating can only be a small proportion of the whole. The conclusion is reached that the different manner in which the current flows in these two furnaces causes different effects, not due to more or less resistance-heating, but to differences in the circulation phenomena. The bottom electrode does not seem to have been accompanied by the difficulties which its opponents prophesied.

When we come to the induction furnace, we find a type of plant which in many respects is ideal, but which has certain inherent defects. Although these have been largely overcome in the Röchling-Rodenhauser design, it may be doubted if the induction furnace will prove a serious competitor to the various types of arc furnace now available, except, perhaps, in Germany. The successful working of this furnace appears to demonstrate that the temperature of the slag is sufficiently high for the purpose of refining.

A chapter is devoted to the electric-shaft furnace for iron smelting. This is an interesting application, but any serious extension cannot be expected except in countries where fuel is scare, such as Scandinavia. It is there that the most important progress in this direction has been recorded.

In a short chapter Mr. Vom Baur deals critically with various less known types of furnaces, and then lays stress upon the importance of the cost of electric power. As stated, the electric furnace has proved in a short time its importance, because it has rendered possible the production of the very best finished steel from low-priced material.

Part II. of the book consists of two useful contributions, one by Dr. Rodenhauser on the materials used in the construction of furnaces, the other by Mr. J. Schoenawa on the electro-metallurgy of iron and steel. The latter includes a number of thermal calculations of the total reactions taking place in the electric furnace, showing the efficiencies attained, but we confess to some scepticism in regard to such calculations, more particularly when they are taken to seven significant figures in calories!

We have only noticed two misprints. On page 99 the *resistivity* of graphite should be *conductivity*, and on p. 223 some figures such as 0·5 per cent. should be 50 per cent.

Our readers will gather that the work is one which well repays careful perusal. W. R. Cooper.

Efficient Boiler Management. By Chas. F. Wade, A.M.I.E.E. (London: Longmans, Green & Company.) Pp. xiv.+266. 12s. 6d. net.

In view of the known inefficiency of many industrial steam-raising plants, the little volume on boiler management which Mr. Wade has produced should form a useful addition to the works manager's library. The book is methodically arranged and written in simple language and loses none of its value to the practical man by the avoidance of high technicalities and obstruse calculations.

Mr. Wade very rightly starts at the beginning of all steam-boiler efficiency problems—the selection of suitable fuel and the practice and theory of coal combustion. He passes gradually onwards through all the necessary stages of furnace design, feed water purification, steam generation, flue gas analysis, superheat and maintenance of plant, giving useful hints and instructions regarding the plant's most efficient operation at every stage.

It is possible, of course, to criticise minor details in this book, and, as a case in point, it would be interesting to know what stoker makers would have to say to the suggestion that "the walls (of the furnace) in any case should be frequently sliced with cutting bars specially made for the purpose." This seems rather contrary to recognised automatic stoker practice. Exception might also be taken to the author's suggestion that chain grate stokers have been erected in a sloping position as a means of obtaining greater efficiency. But these, after all, are minor points, and do not seriously detract from the value of the work.

Mr. Wade's chapters on the performance of boilers, containing full details with regard to the necessary data to be obtained in making boiler tests, and the best means of applying the results obtained, are particularly interesting and useful; while his chapter on the organisation and equipment of a modern boiler plant is certainly one of the most valuable in the volume, and can be confidently recommended to the study of all works managers desiring a model and up-to-date equipment. The section dealing with the examination of boiler plant for defects and losses is also exceedingly well arranged, and will well repay careful perusal.

The author pays considerable attention to the question of the "human factor," and frequently refers to the importance of promoting and maintaining the interest of the operating staff in connection with their duties. Thus, for instance, in connection with the general instructions for conducting a boiler trial, we find that one of his axioms is to "make suitable preparations for refreshment and relief of the various assistants employed"; and, although to some this may appear an unnecessary precaution, human touches of this description undoubtedly greatly add to the efficiency of a staff.

Mr. Wade's work has the great advantage of being quite up to date, containing as it does references to the most modern systems of handling coal and ashes, very complete details regarding flue gas analysis apparatus, steam flow meters, and many other modern adjuncts to the boiler house.

The book is copiously illustrated, and forms a thoroughly up-to-date review of the latest appliances in connection with steam raising and accessories for obtaining a maximum economy in the boiler house; while the system of indexing and subdivision of chapters makes ready reference to matters of detail particularly easy, and adds considerably to the merits of a thoroughly useful work. Percy E. Rycroft.

Production Economique de L'Electricité dans les Regions Industrielles. By F. Courtoy. (Paris and Liége: Librairie Polytechnique Ch. Beranger.) Pp. 304. 30 fr.

The book under notice was about to appear in August 1914, when the declaration of war caused the postponement of its publication. But, as it has been impossible for the author to predict with any accuracy the ultimate values which the various costs will attain, he, therefore, has made no attempt to bring up to date the large amount of data relating to costs, &c., but has published the "pre-war" figures without any revision.

It would appear that, in writing the book, the author had in mind chiefly the conditions involved in the economic production of electrical energy in Belgium, and, in particular, in the Liége basin. As a result, although steam, gas and oil installations are fully discussed, hydro-electric installations are not dealt with.

The subject matter is divided into four main parts, the first being an introduction, and the last giving a concise statement of the conclusions arrived at. The second part deals with the demand for electrical energy, and the third—by far the major part of the work—is devoted to considerations involved in the economic supply of electrical energy, and especially to the factors influencing the linking-up of generating stations in industrial areas. In this connection, brief descriptions are given of the power supply scheme in Northumberland and Durham, and of typical systems in Germany and France, and the problem of the economic supply of energy in the Liége basin is discussed in very great detail.

The author has divided the subject matter into a liberal number of appropriately headed paragraphs, and the general arrangement and printing are all that could be desired. The absence of an index somewhat detracts from the convenience of using the book, although it must be admitted that the table of contents is given in very great detail.

The book may be commended to the notice of all engineers concerned in the supply of electrical energy in industrial regions as being a valuable addition to the literature of the subject.

Shorter Notices.

Electric Welding and Welding Appliances. By Herbert Carpmael, A.M.I.C.E., A.M.I.E.E. (London: Constable & Co., Ltd.) Pp. xii.+128. 18s. net.

This is a book containing a number of articles which have been published in the "Engineer." The author introduces his subject with a short chapter summarising electric welding developments, the remainder of the work being mainly occupied with description of various systems, processes and apparatus now used. The book is of interest rather than value to the manufacturer who desires information as to the most suitable method of carrying out a specific operation, and the system of frank advertisement, which is followed throughout, will be considered advantageous by many, though objectionable to some. Most of the descriptive matter appears to be obtained direct from various forms or their catalogues, rather than being the outcome of the author's practical experience.

Viewed in the light of experience, however, many of the claims made on behalf of the processes and apparatus of some of the firms mentioned should be accepted with great reserve, and developments are so rapid that even some of the authorities quoted cannot be relied upon.

While, therefore, the book is a praiseworthy attempt to give information upon a subject of great importance in modern engineering, it can hardly be regarded as a sound book of reference.

Mathematical Tables. By W. E. Dommett and H. C. Hird. (London: James Selwyn & Co.) Pp. 78.

Five-Figure Logarithms and Trigonometrical Functions. By W. E. Dommett and H. C. Hird. (London: James Selwyn & Co.) Pp. 38. 1s. 6d. net.

The 38 pages of the second of these two small volumes is an extract of the corresponding number of pages of the first of the volumes, and their subject matter is sufficiently indicated by the titles. The remaining pages in the first volume contain tables for the chord and arc of the circle, for degrees of angle and for inclinations, for gradients, tapers and angles, tables giving the square, cube, fourth power, fifth power and logarithm of the first 250 natural numbers and the square root, cube root, root of the fifth power, the reciprocal and the logarithm of the reciprocal of the same numbers. There are also tables giving fractions as decimals, inches in decimals of a foot, and other similar conversions. The final tables deal with the various relations of circles and spheres and the rather unusual detailing of days in decimals of a year of 365 days is also to be found. The information is accurate and the books are well got up. We suppose there is a sale for these ever-recurring tables in different forms, but it is hard to believe they are all necessary.

The Practical Electrician's Pocket Book and Diary 1920. (London: S. Rentell & Co., Ltd.) Pp. lxxv.+588. Price 2s. 6d. net.

One of the results of the war seems to be the later publication of the annual electrical pocket books, while the ever-increasing demand on our space prevents our noticing them until a further interval has elapsed. "The Practical Electrician's Pocket Book," however, hardly requires such adventitious aid to prosperity as a review. It will be sufficient to say that this year the book has been carefully revised and that as a result it is 40 pages larger than last year. The new sections deal with electric welding, furnaces, porcelain grip fuses and meters. The wiring tables have been arranged in conformity with the new specifications of the Engineering Standards Committee, but the old tables have been retained for purposes of reference. The sections dealing with illumination and with the details of public electricity supply have been enlarged.

The Romance of a Great Factory. By C. M. Ripley. (Schenectady: The Gazette Press.) Pp. 204. $2.

This is an account of the various activities in that busy hive of industry, the factory of the General Electric Company, at Schenectady For each copy sold 10 cents. are paid to the funds of the Schenectady G.E. Mutual Benefit Association, which Association provides its members with Health, Accident and Life Insurance for an average subscription of about 7 cents. per week. In an introduction Dr. C. P. Steinmetz thinks the reason "art and poetry cannot flourish in our cold engineering age" is because our writers are out of touch with the twentieth century. There is more romance in a modern factory than there ever has been in the history of the past. The author's work is an elaboration of this text. The various operations carried out are described from the "human" point of view in a style which is essentially modern. There are sugary periods in plenty. "Sob-stuff" abounds. That there is no sentiment in business ceases to be true when it comes to describing factories. With Dr. Steinmetz we prefer Homer. We think he could have done more with his material than Dr. Ripley has done.

Talks with Workers on Wealth, Wages and Production. (London: Isaac Pitman & Sons.) Pp. xvi.+124. Price 2s. net.

This is a reprint of a very interesting series of articles which recently appeared in "The Times Trade Supplement" with the avowed object of making clear the interdependence of Labour, Capital and Brain in the modern state. As the eminent divine did not see why the devil should have all the good tunes, so the author preaches the necessity of propaganda for counteracting the Bolshevik tendencies which are now, unfortunately, if not common, at least too vocal. The spirit of mischief now abroad prevents the nation from settling to work, and while the present unrest is largely artificial, it cannot be allowed to grow unchecked. From this point of view alone the book is worth reading.

Radio Research.

The Department of Scientific and Industrial Research has now established four sub-committees to assist the Radio Research Board in the investigation of problems in connection with the work of the Board. The constitution of the Board and sub-committees is as under:—

Radio Research Board.

Admiral of the Fleet Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S. (chairman); Commander J. S. C. Salmond, R.N. (representing Admiralty); Lieut.-Col. A. G. T. Cusins, C.M.G., R.E. (War Office); Wing Commander A. D. Warrington Morris, C.M.G., O.B.E. (Air Ministry); Mr. E. H. Shaughnessy, O.B.E. (G.P.O.); Prof. Sir J. E. Petavel, K.B.E., F.R.S. (National Physical Laboratory); Prof. Sir Ernest Rutherford, F.R.S.; and Prof. J. S. E. Townsend, F.R.S.

Sub-committee A (on the Propagation of Wireless Waves).—Dr. E. H. Rayner, ScD. (chairman); Prof. E. H. Barton, D.Sc., F.R.S.; Major J. R. Erskine Murray, D.Sc.; Prof. H. M. MacDonald, F.R.S.; and Prof. J. W. Nicholson, D.Sc., F.R.S.

Sub-committee B (on Atmospherics).—Colonel H. G. Lyons, D.Sc., F.R.S. (chairman); Mr. A. A. Campbell Swinton, F.R.S.; Prof. S. Chapman, F.R.S.; Major H. P. T. Lefroy, D.S.O., M.C., R.E.; Mr. G. L. Taylor, F.R.S.; Mr. R. A. Watson Watt; Mr. C. T. R. Wilson, F.R.S.

Sub-committee C (on Directional Wireless).—Mr. F. E. Smith, O.B.E., F.R.S. (chairman); Mr. M. P. Hinton; Capt. C. T. Hughes, M.C., R.E.; and Capt. J. Robinson, M.B.E., R.A.F.

Sub-committee D (on Thermionic Valves).—Prof. O. W. Richardson, D.Sc., F.R.S. (chairman); Mr. E. V. Appleton; Capt. S. Brydon, R.E.; Capt. H. L. Crowther, R.A.F.; Prof. C. L. Fortescue, O.B.E.; Mr. B. Hodgson, M.Sc.; Prof. F. Horton, D.Sc.; Major A. G. Lee, M.C., R.E.; Mr. H. Morris Airey, C.B.E., M.Sc.; Mr. R. L. Smith-Rose; and Prof. R. Whiddington, D.Sc.

Electrification of an Aeroplane Works.

Of the many difficult problems which this country was called upon to face during the war, those connected with the mass production of aeroplanes were perhaps the most urgent. That they were solved satisfactorily, in common with many other varieties of war-time problems, became more and more apparent as the struggle was prolonged.

A factory which contributed its full share to the success achieved in this direction was that managed by Messrs. Crossley Motors, Ltd., at Heaton Chapel, near Stockport. Being designed and equipped throughout on the most modern principles, it is not difficult to understand the prominent part played by the vast organisation which sprang up so rapidly. How extensive this organisation was will be readily realised by a brief consideration of a few leading particulars.

The main buildings are divided into two principal groups, separated by a covered roadway nearly a quarter of a mile in length. On the one side is the main erecting shop, consisting of 18 bays of a total length of 1,040 ft. and a width of 283 ft. The buildings on the opposite side of the road comprise administrative offices, transformer and switchboard room, and the various workshops. Of these, the machine shop [illegible] alone is 483 ft. long by 223 ft. wide. Close to these two main blocks of buildings an excellent canteen and club rooms are situated, and at the far end is an athletic ground. From this it will be seen that welfare work is given its right place in the general organisation. Considerations of health were also carefully studied when the workshops were in course of design. This is shown both by the spaciousness of the buildings and the excellent light available by day and night.

Power is obtained from the Manchester Corporation Electricity Department, and is supplied at a pressure of 6,600 volts, 50 cycles, which is transformed down at the works private sub-station to 420 volts, and fed to the switchboard through isolating switches. This is a 12-panel board, consisting of the incoming power panels (isolating switch and main), seven power distribution, two lighting panels and one spare. Each power feeder panel is provided with an oil switch having three overload coils and one no-volt coil. The overload coils are operated by current transformers, and each coil is provided with a time-limit fuse. Chart recording ammeters, integrating watt-meters and indicating ammeters are also provided on each power panel. Paper insulated cables are used for taking the power from the switchboard to distribution boards, which are of the "Handguard" fuse type. It is interesting to note at this point that a total of 50 miles of cable and wire were used at the installation, varying from 1 sq. in. to 7 23 S.W.G., the whole of this having been manufactured at the Pirelli-General Cable Works, Southampton. From the distribution boards, V.I.R. cables in heavy gauge conduits form the leads to the motors.

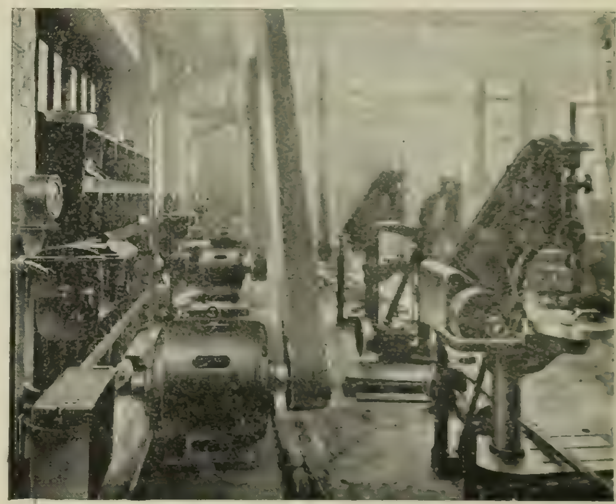


Fig. 1.—Three 40-h.p. Motors in the Millwright's Shop.

It would be wearisome to give in detail all particulars of the motor drives. Suffice it to say that in all there are upward of 70 "Witton" motors, standardisation being adopted as far as possible; 22 of these motors are of 40 h.p., the remainder varying between 20 h.p. and 1 h.p. These latter are for small fans and tools. Most of the 40 h.p. machines are used for driving various sections of the machine, mill-wrights' and joiners' shops, &c. An example is shown in Fig. 1.

Special arrangements had to be made for hot air, also air for ventilating purposes. Especially interesting are the 32 30-in. G.E.C. propellor fans for the ventilation of the wood conditioning and other special rooms. These fans are driven by 1 h.p. totally enclosed motors running at 600 revs. per min. An illustration showing two of these fans in the dope-room is reproduced in Fig. 2.

Alternating current is used wherever possible, but naturally a certain amount of continuous current is required. A 27-kw. motor generator set has therefore been installed, and one of its main functions is the charging of batteries for electric trucks, which have been widely adopted for yard transport. It also charges the batteries used on the automatic telephone installation which is fitted throughout the works. The motor generator set consists of one motor and two generators direct coupled. The generators are so coupled up to the charging switchboard that they can be coupled electrically in series or parallel giving two ranges of voltages.

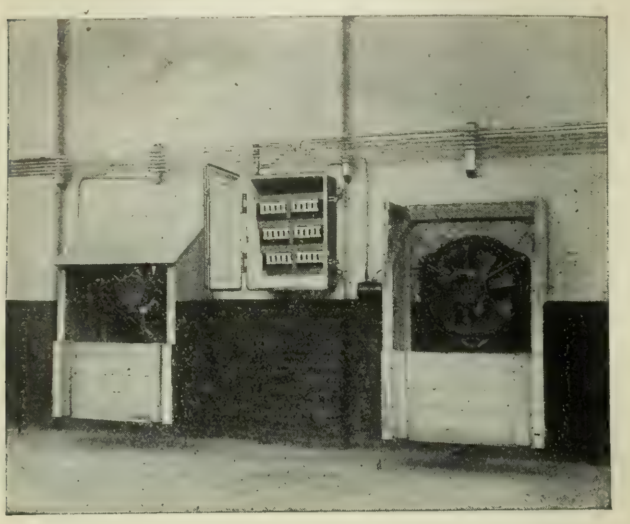


Fig. 2.—1-h.p. Propellor Fans and "Handguard" Fuse Box in the Dope Room.
(There are 20 of these fans provided.)

Reference has already been made to the excellent lighting system. Here again an excess of detail might prove monotonous. The general principle decided upon was a large number of lamps of fairly low candle-power well elevated from the floor. In the aggregate, considerably over 1,000 Osram Lamps were required; 350 of these were Atmos type (gas filled) lamps consuming 200 watts; 360 were Atmos type (gas filled) lamps taking 100 watts; 120 were 60 watt; 250 were 40 watt; and 50 were 30 watt.

Fig. 3.—The Central Covered Way, Showing the Runway Hoist which is Driven by "Witton" Motors.

From first to last the whole of the electrical plant and equipment installed, together with the various accessories, were manufactured in one or other of the works of the G.E.C., and the whole of the installation work was carried out through the company's Manchester Branch.

The various illustrations are from photos taken through the kindness of Messrs. Crossley Motors, Ltd. They naturally could not be taken till after the Armistice, and at the actual time of taking much of the material was stacked in special lots for Government sales. This accounts for the apparent lack of activity noticeable.

An Explanation of the Effect of an Iron Core in a Transformer.

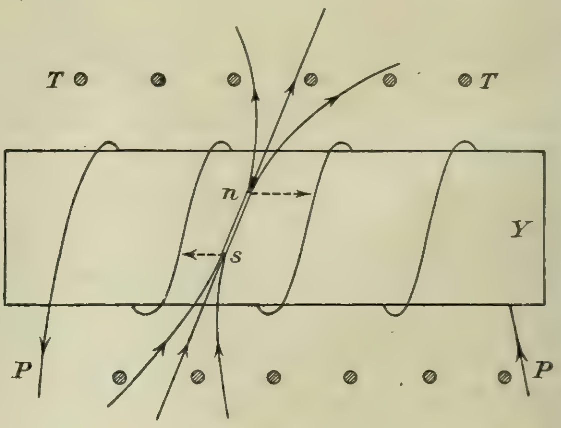
By **F. W. JORDAN, B.Sc.**

The ordinary explanation given in text books of the effect of an iron core in a transformer is one which appears to me to be somewhat vague and inconsistent with Faraday's idea of the mode of production of induced currents. I have for several years offered the following alternative explanation to elementary students, and it has usually been received without disapproval.

It is usual at the outset in considering electro-magnetically induced currents to impress upon the student that the difference of potential between the ends of a moving conductor is proportional to the rate of cutting of the lines of induction of the magnetic field. Various modifications of Faraday's original experiments are sufficient to demonstrate the truth of this law.

The action of an air core transformer can be explained by stating that during the growth and decay of the primary current the secondary turns are cut by the lines of induction which travel through air with a finite speed.

The introduction of an iron core leads to an enormous increase of both the self-induced current in the primary coil and the induced current in the secondary coil. In the figure the iron core *Y* is overwound with the primary coil *PP* and the secondary coil *TT*, shown in section to simplify the figure.



This additional induced P.D. at the terminals of the secondary coil, which is produced by the insertion of an iron core, can be accounted for by supposing that (1) the iron core in the unmagnetised condition consists of a disorderly aggregate of molecular magnets, and (2) these are turned round into partial alignment with the magnetising field during the growth of the primary current. It is usual in a first course of magnetism to show several experiments in support of this molecular theory of the magnetic structure of a magnet, and it is therefore not inappropriate to introduce it here.

It is clear that during the motion of any one of these molecular magnets *n s*, the lines of induction from its poles will sweep across the turns of the primary and secondary coils. The directions of the induced currents in these coils can be obtained by the application of the law of Lenz or Fleming's rule. It can thus be shown that the self-induced current in the primary coil is opposed to the primary current and the current in the secondary coil is in the opposite sense to that in the primary coil.

This explanation is consistent with Faraday's original conception of the mode of production of these currents and gives a mental picture of the changes which take place during the growth and decay of the primary current.

There seems to be keen competition at present between the nations as to which of them shall have the MOST POWERFUL RADIO-TELEGRAPH STATION. Recently the claim was made by the United States, but later France asserted that her new station at Bordeaux would be biggest. Now it is announced that the Radio Bureau of the Swedish Telegraph Department is working out a plan for the erection of a large wireless station in Sweden to deal with traffic with the United States. The proposed station will be able to maintain constant communication, by night and day, with North America, and will have such a great range that during favourable atmospheric conditions it will be able to embrace practically the entire globe. The Riksdag has already appropriated two million kroner for this purpose.

Some Notes and Views on Telephone Work.

A Paper on the above subject was read by Mr. A. C. Greening at a recent meeting of the London Centre of the Institution of Post Office Electrical Engineers.

In his introductory remarks, the author presented some figures from fitting works carried out in the London area in 1919, totalling 150,018, of which 58,766 are new circuits. 664,014 man-hours have been consumed, and, on the average, 10·8 works per man-hour executed. The labour way-bill, excluding cost of supervision, is approximately £44,000. During the war, 446 non-multiple circuits, involving 12,809 working circuits, were provided for Government departments, and 38 circuits of the multiple type, involving 16,130 working circuits.

The author next described the operations of the fitting centre, and the procedure adopted in regard to the issue of advice notes, whereby track is kept of initiation and progress of work undertaken. The technical side of fittings work is next described under such heads as leading-in wires, junctions between external and internal wiring, protection, selection of internal wire-run, building chutes, positions of telephones, fixing of apparatus, &c. The wiring in large buildings on a permanent plan is now an important feature, and accurate forecasts of requirements for a future 8–15 years are prepared. Two classes have to be considered :—

(*a*) Direct service from the public exchange when the building has many tenants.

(*b*) Service from a local private exchange when the building is occupied by one firm or company.

This leads to the discussion of the use of auxiliary cases. Other points discussed include standard circuits, and it is remarked that the alleged necessity for intercommunication in buildings leads to the installation of much plant that is very little used. For residential buildings, parallel instruments are preferred, and if the private user would accept this view it would materially improve the public service.

A special account was given of the methods adopted for the delivery and collection of subscribers' apparatus, one of the difficulties being the economical treatment of work outside the more densely populated districts. Two light experimental motor vans have given encouraging results as compared with horse-driven vehicles.

The last point considered is the question of the training of operators, and the author is in favour of supplementing the somewhat limited education which attendance at an elementary school conveys.

Merchant Shipping (Wireless Telegraphy) Rules.

The following Rules have been made by the Board of Trade under the Merchant Shipping (Wireless Telegraphy) Act, 1919, and will come into force on the 1st prox. :—

For the purposes of the Rules ships are divided into three classes, viz. : Class I., Ships carrying 200 persons or more which are not engaged in the coasting trade (*i.e.*, trade exclusively carried on between ports in the British Islands) ; Class II., Ships carrying 50 but less than 200 persons and ships engaged in the coasting trade carrying 50 persons or more ; and Class III., Ships carrying less than 50 persons. In reckoning the number of persons the normal crew shall be regarded and the maximum number of passengers permitted to be carried by the passenger certificate of the ship.

The installation shall comply with the requirements of the International Radiotelegraph Convention, 1912, as modified by any other international agreement (and in particular the International Convention of Safety of Life at Sea, 1914), or of any international agreement by which the Convention of 1912 may be superseded.

The installation shall be of the spark or interrupted continuous wave type.

The installation shall include a normal installation and an emergency installation, except that where the normal installation complies with the requirements of this rule as to emergency installations as well as those as to normal installations a normal installation alone shall suffice. A normal installation must be capable of transmitting clearly perceptible signals from ship to ship over a range of at least 100 nautical miles by day under normal conditions and circumstances. An emergency installation must include an independent source of energy capable of being put into operation rapidly and of working for at least six continuous hours with a minimum range from ship to ship of 80 nautical miles for ships of class I., and 50 nautical miles for ships of classes II. and III., and such independent source of energy must be capable of being worked for at least six continuous hours independently from the source of propelling power for the ship, the steam supply system, and the main electricity supply system. An installation shall be deemed to comply with the above requirements as to range if it is able to maintain communication on a 600 metre wave at a range of one and a half times the number of nautical miles hereinbefore respectively prescribed over sea by day with a P.O. standard station when employing a receiver without amplification devices.

There shall be provided between the bridge and the wireless telegraph room means of communication by voice pipe, telephone or other means, and an operator or watcher when on duty shall not leave the wireless telegraph room to deliver messages or to call his relief.

If not fitted with an approved automatic apparatus for registering the signal of distress—(i.) a ship of Class I. shall carry the following certificated operators, and while at sea a certificated operator shall be always on watch :—(*a*) Voyage exceeding 48 hours from port to port, three operators, of whom one shall hold a first grade certificate and not more than one a third grade certificate ; (*b*) voyage exceeding 8 but not exceeding 48 hours, two operators, of whom one shall hold a first or a second grade certificate ; (*c*) voyage not exceeding 8 hours from port to port, one operator who shall hold a first or a second grade certificate. (ii.) A ship of Class II. shall carry the following, and either a certificated operator or a certificated watcher : (*a*) one operator with a first or a second grade certificate and two watchers ; (*b*) one operator with a first or a second grade certificate and one watcher ; and (*c*) one operator with a first or a second grade certificate.

(iii.) A ship of Class III. shall carry one operator who shall hold a first or a second grade certificate.

In the event of an automatic apparatus for registering the signal of distress being approved by the Board of Trade and the Postmaster General a ship of class III. shall be fitted with such apparatus unless the duration of the voyage on which it is employed does not exceed 8 hours from port to port, but in such a case the operator shall be on watch during the whole voyage.

If fitted with automatic apparatus for registering the signal of distress approved as aforesaid, a ship of class I. shall carry certificated operators as follows : (*a*) voyage exceeding 48 hours, two operators, one of whom shall hold a first grade certificate ; (*b*) voyage not exceeding 48 hours, one operator with a first or a second grade certificate. (ii.) A ship of class II. or class III. shall carry one operator who shall hold a first or a second grade certificate. Provided that if a ship of class III. is fitted with an automatic apparatus for registering the signal of distress and with an automatic apparatus for registering the ship's own distinguishing signal, both of which have been approved by the Board of Trade and the Postmaster-General, the operator shall not, while the ship is more than 150 nautical miles from any coast station, be required to be on watch at the times specified in the schedule to these Rules.

Operators shall be graded into three grades in accordance with rules to be made by the Postmaster-General with the concurrence of the Board of Trade and watchers shall be certificated by the Postmaster-General. Until graded in accordance with such rules, (i.) an operator who holds the Postmaster-General's first class certificate of proficiency and who has had three years' experience as an operator may be employed as if he held a first grade certificate, but if an operator holding a first grade certificate is available an operator holding a first class certificate shall not be so employed on a ship of class I. which is required to carry three operators ; (ii.) an operator who holds the Postmaster-General's first or second class certificate of proficiency and who has had one year's experience as an operator may be employed as if he held a second grade certificate ; (iii.) an operator who holds the Postmaster-General's first or second class certificate of proficiency and who has had less than one year's experience as an operator may be employed as if he held a third grade certificate.

A schedule to the Rules gives the times of watch for ships required to carry one or two operators.

By an Official Decree of June 10 last the Costa Rica Executive has been authorised to expend 250,000 colons in the installation of a radio-telegraphic or radio-telephonic station in the capital of sufficient power to obtain direct or indirect communication with the places in the world where radio-telegraphic, radio-telephonic, cable-graphic or telegraphic public offices have been opened. It is also proposed to establish smaller stations in distant regions of the national territory, but preferably in Osa, Puntarenas, Liberia and Siscaola. Decree No. 34 of the 10th April last has been ratified, thus making the wireless telegraph and telephone services public utility and State monopolies.

The Austrian Cabinet has decided to subscribe one-fifth of the capital of the Upper Austrian Water Power & Electricity Company, which is to be 50 million kronen, and also to participate to the extent of 40 million kronen in the guaranty for a 200 million loan (from the banks). The rest of the capital will be subscribed and the guaranty borne by the province of Upper Austria, the municipality of Linz, the Linz-Urfahr Tramway & Electricity Company and the Austrian Waffenfabrik.

A Bill, recently introduced into the Constituent National Assembly, provides for the Electrification of 650 km. of the western part of the State Railway System by June, 1925, at a cost of 5,096 millions of crowns, to be raised by loan. An additional length of 1,135 km. of line is to be electrified by a later date.

The Telephone Service.

The Select Committee on Telephone Rates, which has adjourned until after the Recess, held two sittings last week.

Mr. H. Shaw, secretary of Newcastle Chamber of Commerce, severely criticised the existing service, and said that the proposed increased charges were mainly due to Government inefficiency. He agreed that for the present the charge must be increased, on the ground that they were continually urging the Government to practise economy and to abolish subsidies, so that each undertaking under Government control might pay its way. Efficiency would never be obtained under Government control, and we were now being asked to pay for Government inefficiency. When the Post Office took over the National Telephone Company the services of men of wide commercial and expert knowledge were not retained, and we were now suffering from this short-sighted policy. The Association of Chambers of Commerce was of opinion that the method of conducting the telephones by means of a bureaucratic system was most wasteful, and the service was slow and obstructive. If it were carried on by a business company the present chaos would never occur, and it would not not be necessary to suggest such increases in charges as were proposed. As money had to be raised he preferred that the flat rate and message rate should be increased, and the measured rate might be dropped. With regard to the message rate, the telephone officials kept their accounts well, but there always would be errors until an automatic recorder was introduced, and he was sure that if the Government offered a premium for such an invention one would be produced in three months. He considered 7,000 calls per annum a fair number of calls for a flat rate charge. He also complained of calls being interrupted by operators, and of the "engaged" signal being received when it was known that the wire was not engaged.

Sir William Peat stated that since the Post Office took over the telephone service the depreciation fund had increased fairly regularly. In 1912 the fund put aside was £1,400,000 and the expenditure on renewals was £435,100, and in the following years also considerably larger sums were set aside than were expended on renewals. During the war period the sum set aside was much the same figure, but it was not until 1919 that they began seriously to overtake the renewals which ought to have been done in the war years. The net result was that the anticipated necessary renewals for 1920 came to £1,100,000 and in 1921 to £2,700,000. He believed that plant would cost the Post Office from 200 per cent. to 300 per cent. more than it would in pre-war years. The theory adopted was that the depreciation fund should be increased, so that at the end of the effective life of the renewed plant they would have the cost of it in the depreciation fund. He had no objection to the suggestion that owing to the high prices something extra (£200,000) should be put aside out of revenue for depreciation. He did not anticipate that the price of labour or material would come down at present, and therefore they could not go on with the Post Office telephones paying as at present, unless they were prepared to face a loss on the telephones. Subsidising the telephones meant subsidising commerce, and he thought subsidies should be abolished altogether.

B.T.H. Thermostatic Metal.

The fact that B. T.-H. Thermostatic Metal bends in response to the slightest change of temperature, and that the degree of curvature is always a definite, measurable and absolutely reliable quantity, explains its ever-widening application for temperature control and indication and for operating thermostatic devices. Though in appearance a homogeneous metal, it is actually a duplex strip, formed of two metal strips having widely different coefficients of expansion. The two metals are welded together along their entire length and are inseparable under normal working conditions. When the duplex strip is subjected to change of temperature one half will expand or contract more quickly than the other, causing the strip to bend. Thermostatic Metal is said to be far more sensitive to heat than the ordinary thermometer or any previous form of thermostat. A single degree of temperature change will affect its curvature to a measurable extent and its response is practically instantaneous. When the metal bends it exerts a considerable force, frequently amounting to several pounds, which can be predetermined and accurately measured. This force is sufficient for the direct operation of levers, the opening and closing of ventilators, &c. Thermostatic Metal may be used with advantage for the following general purposes:—To remedy loss of mechanical efficiency due to temperature change, to open or close an aperture by heat control, to measure temperature, to regulate a furnace damper, to control the heat of a gas or electric oven, to open or close electrical contacts when the temperature changes, and also for various scientific instruments.

For apparatus which it is desired to make independent of temperature variations, thermostatic metal will provide the necessary compensation, and for apparatus which depends for its operation upon temperature change, it is a reliable and consistent form of control. Mechanically, the metal is a single strip which can be cut, stamped or machined, and it is supplied in various thicknesses from 0·015 to 0·25 inches in section. Information as to the characteristics and applications of the metal may be obtained from the British Thomson-Houston Co.

Commercial Topics.

Patents under the Treaty of Peace.

The Board of Trade have issued Rules, with scales of fees payable, under the Trading with the Enemy Acts and the Treaty of Peace Act, 1919. These Rules came into force on the 19th ult., and applications for consent to any assignment of or a licence under a restored patent, for the revision of the terms of a licence, or for the expropriation or sale of a restored patent, must be made on the prescribed forms.

An order has also been made by the Board of Trade directing the Custodian of Enemy Properties to divest himself of patents previously owned by German nationals, in accordance with the provisions of Article 306 of the Peace Treaty with Germany.

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Sparking Plugs for Western Canada.

H.M. Trade Commissioner in Winnipeg (Mr. L. B. Beale) reports that there is an opening for sparking plugs in the Western Canadian market. Competent authorities estimate that the number of motor cars in use in Western Canada will approximate to 200,000 by the close of the year, so that the volume of trade in automobile accessories must be considerable. The Commissioner has forwarded to the Department of Overseas Trade copies of catalogues and price lists of spark plugs manufactured by a New York firm, together with a copy of a table of sizes of spark plugs for tractors and cars in Western Canada. Sparking plugs entering the Dominion are dutiable under the Canadian Customs tariff as follows: British preferential tariff, 15 per cent.; intermediate, 25 per cent.; general, 27½ per cent. It is said that there are several reliable agents in Western Canada who are desirous of securing the agency for a sparking plug of British manufacture. Mr. Beale's address is 610, Electric Railway Chambers, Winnipeg.

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A "World's Market" in Paris.

The Federation of British Industries announces that it has undertaken the direct representation for Great Britain and the Dominions of the Paris "Marche du Monde." The idea of establishing a "World's Market" in Paris was conceived in 1919, and we learn that the scheme has now come very close to realisation. The site for the building is being cleared, and contracts for its erection have been placed. Already a number of American, French, Italian and other Continental, as well as some British firms, have reserved space in the "Marche du Monde" when completed. Briefly, the idea of the promoters is to systematise and centralise international commerce by erecting in Paris a great commercial centre, in which the manufactures of all nations can be permanently exhibited under one roof, and therefore readily accessible to buyers visiting Paris. It will enable the prospective buyer to find the firms and goods he wishes to see congregated under one roof; to make his choice from the products of many countries, with a fraction of the time, energy and expense entailed in visiting isolated firms scattered through a multitude of towns in a dozen different countries. Conversely, it will enable the manufacturer not only to reach many more buyers, but to get into direct touch with them, and at the same time to cut down his expenses. Further information may be obtained on application to the "Marche du Monde" Exhibition Section of the Federation of British Industries, 39, St. James's-street, London, S.W.1.

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Developments in Australia.

A report prepared by Mr. S. W. B. McGregor, H.M. Senior Trade Commissioner in Melbourne, gives some statistics of the principal Australian imports and exports in recent years and some useful information concerning industrial developments. The farmers' co-operative movement is becoming increasingly important and aims at the purchase direct from overseas manufacturers of all machinery, stores, &c. In regard to foreign competition with the United Kingdom, it is stated that a number of American firms, inexperienced in overseas trade, have entered the Australian market, and in many cases the methods adopted have not been satisfactory to Australian firms. On the other hand, there is a certain push and enterprise in American methods which appeals to the Australian, and which, combined with greater experience in overseas trade, may render that country a serious competitor. It appears probable that future American competition will be felt more particularly in machinery, electrical machinery and apparatus, small tools, hardware, manufactured metals, motor-cars and lorries, &c. Japanese methods of trade and quality of goods supplied have continued to be unsatisfactory. It is probable that Japan will lose the bulk of her import trade into Australia, created during the war and amounting in 1918-19 to £8,203,725. The war has given a great stimulus to the manufacturing industries of Australia. Comparing the years 1913 and 1917, the number of factories decreased from 15,536 to 15,179, the number of employees decreased from 337,101 to 321,670, but the horse-power used increased from 442,154 to 560,261. The total value of output increased from £161,560,763 to £206,386,646. There have been considerable developments since 1917; several new works have been erected and extensions of existing factories carried out, but the resources of Australia are so great that there is ample room for the expansion of her manufacturing industries and at the same time for a great increase in her requirements for British goods.

In the various States of the Commonwealth, but more particularly in New South Wales and Victoria, steps are being taken to develop water-power resources, utilise brown coal, &c., and there should be a brisk demand for electrical machinery, motors, cables and apparatus for several years.

Electricity Supply.

ALDERSHOT Urban Council have received sanction to borrow £7,000 for new feeders.

DARTFORD Urban Council have received sanction to a loan of £12,106 for the electricity undertaking.

TONBRIDGE Urban Council have decided to adopt electric lighting for all the dwellings to be erected under the housing scheme.

The offer of the Dumfries Electricity Supply Company for street lighting has been accepted by Maxwelltown Town Council.

BLACKBURN Council has entered into a contract with Messrs. Jos. Cort (Darwen), Ltd., for wiring the municipal houses in Green-lane.

MAIDSTONE Council will supply electric current to the paper mills of Townsend, Cook & Company and to Preston Hall, Aylesford, in Malling Rural area.

BURNLEY Council have received sanction to borrow £101,659 for a 3,000 kw. set, three water-tube boilers and other plant at the generating station.

ROCHDALE Electricity Committee is entering into an agreement to provide additional supplies of current for the adjoining area of Littleborough.

PORTISHEAD Urban Council have consented to the North Somerset Electric Supply Company changing the system of supply from direct to alternating current.

The Isle of Ely County Council have authorised PETERBOROUGH Corporation to extend its electricity supply area to the parishes of Stanground North, Whittlesey Rural and Whittlesey Urban.

CANNOCK Urban Council, which proposes to obtain a bulk supply of electricity from a neighbouring authority, has sent out between 500 and 600 circulars to local traders and residents in order to ascertain the probable demand for power and lighting.

CROYDON Corporation has decided to apply the new schedule of increased salaries for the technical staff at the electricity undertaking as from June 1 last. The effect of the new scale is to increase the total of the salaries from £5,922 per annum to £7,188.

MONTGOMERY Council has been negotiating with an engineer for the erection of electricity works, but the scheme has fallen through, owing to difficulties in connection with the raising of capital. A motion to adopt a municipal scheme was rejected by the Mayor's casting vote.

LEITH Town Council has accepted the Whitley award as to the salaries of officials, and the electrical engineer (Mr. A. P. Rutherford) will, in future, get £891. 4s. per year, instead of £630, and the tramways manager (Mr. F. A. Fitzpayne), £818. 14s., compared with £570 at present.

A Local Government Board inquiry was held at PORTRUSH on Friday last into the application of the Urban Council for sanction to borrow a sum of £15,000 for the purpose of erecting electricity supply works. Evidence was given by Mr. W. Pleasance, A.M.I.E.E., consulting engineer, and a representative of the Dhu Varren residents urged the immediate inclusion of that district in the electric lighting area.

HAMILTON Corporation has decided to revise its agreement with Edmundson's Electricity Corporation for the maintenance of the electricity undertaking. The company will pay an increased rate of interest and sinking fund (8½ instead of 6¼ per cent.) for the money (£4,000) expended since June, 1914, but it will be permitted to increase the maximum price to that named in the original Provsional Order.

A conference of representatives of the electricity undertakings in the WEST RIDING (AIRE AND CALDER) ELECTRICITY DISTRICT was held at Bradford last week, Mr. Wilfred Turner, chairman of the Bradford Electricity Committee, presiding. All the authorities invited to attend were, with the exception of one or two of the smaller authorities, represented, including Barnsley, Batley, Bradford, Dewsbury, Elland, Halifax, Hebden Bridge, Heckmondwike, Holmfirth, Honley, Huddersfield, Ilkley, Keighley, Leeds, Morley, Shipley, Spenborough, Todmorden and Wakefield. It was decided to prepare a scheme for the district, and a subcommittee of eight was appointed to prepare a draft.

In presenting the report of the Electricity Committee to TORQUAY Corporation last week, Mr. J. Taylor said the committee found it impossible to carry on with the WHITLEY COUNCIL. Awards were coming along so fast that they did not know how to deal with them. If the men's unions were not satisfied they could tell them to take their men away; the people of Torquay would have electricity all the same. The time had come when the Council must take a firm stand on the wages question. The Council has, therefore, decided to withdraw from membership of the Whitley Council so far as the electricity undertaking is concerned.

The following increases of salary were granted: Mr. G. B. Dent, station superintendent, from £250 to £310 per annum; Mr. A. J. Waring, main engineer, £250 to £300; three charge engineers, £220 to £250; one junior engineer, £195 to £225.

An inquiry was held at KINGSTON-ON-THAMES last week into the application of the Corporation for sanction to borrow £15,200 for the electric supply department. Part of the money is required for chain-grate stokers and £9,200 is to be spent in laying high and low tension mains in the heart of the town for supplying current on the three-phase system, including the cost of converting consumers' plant. It was explained that there would be a transformer station close to the works and pillars for transforming purposes en route. The Electricity Commissioners have been asked to sanction the introduction of the three-phase system.

Some of the local authorities in North Wales are disappointed at the inclusion of Chester and Crewe in the NORTH WALES & CHESTER ELECTRICITY DISTRICT. Speaking at the meeting of the ANGLESEY County Council last week, Mr. H. R. Davies said it was essential that North Wales should have some safeguard. It was no use attempting to oppose the scheme, but they must see that their rural districts should be so safeguarded that should they develop industries in future, electric power and light from the area centre should be available for them on reasonable terms. It was, therefore, decided to ask the County Councils of North Wales to send delegates to a conference to see what could be done to safeguard the interests of North Wales. Anglesey County Council is willing to contribute towards the cost of engaging legal and engineering experts.

A curious, though somewhat serious, position has arisen at OLDHAM owing to the refusal by members of the local branch of the E. T. U. to connect up any work done by either plumbers or non-unionists. The Electricity Committee has received complaints from persons who want a supply of current. Several consumers have been waiting for a supply of current since March, and at least one has been without light for some weeks because he took down his gas fittings on the promise of being connected to the supply main.

In explanation of the position the Mayor stated last week that quite a number of new firms had been established in the town and 37 houses had been wired by various electricians, who, according to the Union, were employing non-union labour. Some of the installations had been put in by plumbers who were not authorised and some by non-unionists. The men were strongly against connecting anyone who had had the work done by such men. Out of the 37 cases involved there was a prospect of at least 27 being connected within a reasonable time. It was rather a delicate matter and the committee seemed to be in an awkward position. The union men also took up the standpoint that some of the employers had not the necessary knowledge of the work and they ought not to be called upon to connect, but he (the Mayor) considered they should dictate who should or should not enter the electrical trade, and if a man employed trade union labour they ought to work along with him. Eventually the Mayor, the vice-chairman and the engineer were appointed a subcommittee to see the local union on the matter.

Last week MANCHESTER City Council decided to enter into a seven years' agreement with Mr. S. L. Pearce, engineer and manager of the electricity department, and he will receive, in addition to a regular salary of £2,500 per annum, a yearly sum of £1,000 for special services as consulting engineer.

Ald. Dagnall explained that the arrangement would be reconsidered at the end of the seven years, and that the £1,000 extra payment for each year did not carry with it any superannuation rights. Mr. Pearce was appointed chief engineer in 1903, and the output in the intervening period had increased about six times, whilst during the whole of that time the electricity undertaking had not cost the ratepayers one penny. The electricity committee considered that he should be retained to carry out the work of the Barton Station, upon which he had spent many months of work, and he (Ald. Dagnall) thought the committee's recommendation a business-like proposition.

The accounts of MANCHESTER ELECTRICITY DEPARTMENT for the year ended March 31 show, revenue £1,197,199 (compared with £906,529 in previous year) and working expenses were £765,357 (£640,704), leaving a balance of £431,842 (£265,825). Interest required £93,262 (£85,816), sinking fund £153,216 (£145,076) and instalment of loan repaid £8,145 (£7,925). The sum of £30,211 (£29,997) has been placed (as a normal contribution) to renewals suspense account, and £19,660 in respect of part cost of war emergency renewals, while income-tax required £39,714 (£34,413), the net result being a profit of £87,634 (against a deficit of £37,402). Maximum supply demanded, excluding supply from batteries, was 82,150 kw. (65,050 kw.). The Kelvins generated were 241,776,060 (235,258,030) and sold 182,419,070 (184,675,190).

The Electricity Committee states that at the Stuart-street Station Messrs. Babcock & Wilcox have completed the installation of the third and fourth water-tube boilers, and a further contract for two similar boilers has been placed with the same firm for erection in the spring of 1921. Messrs. Richardson, Westgarth & Co., in conjunction with their sub-contractors (the Metropolitan-Vickers Electrical Co.), have completed the contract for the installation of a 25,000 kw. turbo-alternator and condensing plant, and this set was put into commission in December, 1919. A contract has been placed with the Metropolitan-Vickers Electrical Co. in conjunction with the English Electric Co. for a 6,500 kw. turbo-alternator for delivery in September next, and a further contract has been let to Messrs. Richardson, Westgarth & Co. (with Messrs. C. A. Parsons & Co.) for an 8,000/10,000 kw. turbo-alternator and condensing plant for delivery by June, 1921. For the Barton Station contracts have been placed with the Metropolitan-Vickers Electrical Co. for two 25,000 kw. turbo-alternators; Richardsons, Westgarth & Co. for two condensing plants; Babcock & Wilcox for four 100/120,000 lb. water-tube boilers, and W. J. Jenkins & Co. for coal and coke conveyors. Important extensions have been carried out during the year at Dickinson-street (2,400 kw. motor converter), Oldham-road (1,050 kw. rotary converter), Polygon (1,050 kw. rotary) and Bennett-street (1,050 kw. rotary converter). Further contracts have been placed with Bruce Peebles & Co. and the Metropolitan-Vickers Electrical Co. for two 1,500 kw. motor converters and one 2,000 kw. motor generator for Dickinson-street; two 1,600 kw. motor converters for Moss Side; one 1,500 kw. motor converter for Withy Grove; one 1,500 kw. motor converter for Knott Hill; and two 1,500 kw. motor converters for Sherborne-street.

Electric Traction.

Fast Ham Council has been authorised to borrow £8,373 for equipments for 10 new tramcars.

St. Helens Tramway Committee has decided to lease the tramway from the Brooks Bridge to the King's Arms to Liverpool Corporation.

Darlington Corporation has resolved to postpone the proposed extension of the tramway route from Market-place to Bank Top.

Southampton Council has increased the salary of the tramway manager and engineer (Mr. Dobson) from £700 to £900 a year, rising by two annual increments to £1,000.

The Joint Industrial Council of the Tramway Industry has agreed to the re-grading of the Rotherham tramways, and the basic rate of the employees' wages will be increased by a halfpenny per hour from March 29 last.

The Lanarkshire Tramways Company has completed the purchase of the County Council's tramway line between New Stevenston, Bel shill and Uddingston. The company has paid £30,489 15s. 9d., or one-half of the sum expended by the Council on the undertaking, the remaining half being due on May 15 next.

Glasgow Corporation is recommended by the Special Committee on wages to refuse the recent application of the Municipal Employees' Association for an increase of 10s. per week for all workers in the traffic section of the Tramways Department. The present maximum is £3 18s. and the minimum £3 10s. per week.

Hull Corporation has agreed to a recommendation to permit old-age pensioners to travel free on the tramcars between 9.30 a.m. and 4 p.m. and after 7 p.m. Mr. E. S. Rayner, the manager, estimates that there are 5,000 old-age pensioners in the city, and allowing three return journeys per week for each, the cost would be £10,400 per year.

The skilled men, including members of the E.T.U., employed at the Hylton-road repair shops Sunderland, have been on strike for some time in order to enforce their demand for 12 days' annual holiday with pay. The Highways Department of the Corporation had already granted the concession to their skilled employees, and a special committee now recommend, as a compromise, an annual holiday of seven days with pay.

Bradford Corporation has adjourned the consideration of a revised scale of tramway fares. For the present year there was a surplus of £44,828, out of which £30,000 was to be devoted to relief of rates. The probable expenditure on renewals for the next five years is estimated at £1,222,000, and therefore increased fares are necessary, especially as the Tramways Committee anticipate a deficiency of £62,200 next year on the present basis.

According to the arbitrator's award, the Middlesbrough, Stockton and Thornaby Corporations will have to pay £390,455 14s. 1d. to the Imperial Tramways Company for the Tees-side tramways, in addition to a sum for stores as valued at the date of transfer. The Corporations must also pay the cost of the reference and of the award. The total sum expended on capital account was £282,948. The company's claim was £563,340, and the Corporations offered £281,766.

Councillor E. Turner, chairman of the Middlesbrough Tramways Committee, states that as soon as the Corporations obtain possession of the system the Middlesbrough service will be increased by running additional cars of the latest type. New 'bus routes would be established and various tramway extensions embarked on.

The lightning strike of Brighton tramway employees, which took place on the 6th inst. and lasted four days, has been settled. The cause of the strike was the grading of the undertaking for wage purposes by the Industrial Council. Brighton was put in Grade 2, while Bournemouth and Protsmouth are in Grade 1, which gives the employees an extra 1s. a week. The Corporation proposed to refer the dispute as to grading to a special meeting of the District Council on condition that the men returned to work at once. This proposal was refused and the drivers and conductors demanded an unconditional undertaking to be placed in Grade 1. Ultimately the Committee offered to consider the grading question on its merits and this was accepted by the men. The National Industrial Council has intimated that though the decision of the District Council was correct in principle the Corporation would be justified in dealing with the claim upon special local considerations.

An important statement regarding tramway track reconstruction and fares was made at last week's meeting of Liverpool Corporation by Mr. F. C. Wilson. He said the reduced estimate for renewing 19 miles of track (work considered essential this year) and other things amounted to £318,197, and he estimated that this year they would be spending over £310,000 on the track. On the reserve and renewals fund they expected a total expenditure before the end of the year of £310,250, and, as they had now only £284,000 in the fund, they were overspending by £25,900. In order to provide a fund sufficient to cover the cost of renewals and depreciation a sum equal to 3d. per car mile (¼d. per passenger) must be set on one side, for if the money was not got in fares it would mean pretty nearly 1s. in the £ on the rates. There was now no margin of reciepts over expenditure, and they were carrying people at a loss. They estimated they would have to spend £1,200,000 in the next five years on the track and rolling stock. The undertaking was a losing concern and the travelling public should pay for their rides.

Ald. Robinson suggested that the responsibility for the financial chaos of the tramways was due to the practice of allocating profits for the alleviation of rates instead of putting more to renewals and reserve.

Imperial and Foreign Notes.

In his report on the Electrical Engineering Branch of the New South Wales Public Works Department for the past year, Mr. W. Corin, chief electrical engineer, states that contracts for electrical machinery let early in 1916 are still uncompleted. Lists are given of surveys made since 1914 of rivers in connection with 15 different hydro-electric projects, of numerous river gauging stations established primarily for power purposes, and of the power to be obtained on various rivers ranging from 145,000 h.p. on the Snowy and 80,000 h.p. on the Clarence, to 335 h.p. at Jerusalem Creek. Some information is given as to the possibilities of the various schemes. On the recommendation of Mr. Corin and Mr. de Burgh, who advised that consideration should first be given to the Burrinjuck and to the Gilmore Creek and Nymboida schemes, as they could supply electricity for pumping, power and lighting in the towns of the south-eastern tablelands and adjacent irrigation areas, a bill has been prepared to cover the initial works, which include duplicate 2,500-kw sets for Burrinjuck, and three 400-kw. sets for the Nymboida. It will be possible to connect the Port Kembla power station, via Moss Vale and Goulburn, with the Burrinjuck development, so that in years when water-power is most abundant maximum use may be made of hydro-electric power, thereby affecting a saving of coal at Port Kembla. Mr. Corin also thinks it advisable to connect up with the Railway Commissioners' power stations, for which frequency changers would be used, and to have a State transmission system from which a wholesale supply of power could be furnished to all municipalities or other public bodies within its reach. Particulars are also given of minor hydro-electric projects, and of municipal electricity schemes. In regard to the Port Kembla undertaking the two 1,500 kw. steam turbo-alternators, to replace the sets taken over for war purposes, were only ready for shipment at the date of the Report. The motors connected aggregate about 1,800 kw., and the maximum load was 560 k.v.a.

Various municipal and other schemes for the development of electricity supply are being projected, and among recent projects are the following: Wanganui Borough Council recently decided to borrow £250,000 for the erection of hydro-electric works at the source of the Wangashu River, about 30 miles from Wanganui. Interim reports indicated that the source would give 2,600 h.p., but it is now stated that by the constructing of a dam on the river 6,000 h.p. can be secured. The scheme provides for a submerged power station in the dam, which is said to be the first of its kind in the British Empire.

The Swedish Government has allocated a sum of 23,000,000 crowns for the Electrification of Stockham—Goteborg Railway. This is the preliminary to the electrification of the whole of the State Railways.

The local authorities of the Seine Department have approved the proposal to repurchase a number of local omnibus and tramway concessions, including the following tramways:—Seine Department, South Paris, East Paris, Left Bank of Seine and Nogeant.

In order to provide independent telephone communication the German Government has laid a cable between E. Prussia (Tenkitten) and the Pomeranian Coast (Lebal), a distance of about 170 kilometres. It is claimed that this is the biggest telephone cable in the world.

Under an amending Law, which came into operation on April 1, specifying municipal (octroi) taxes payable upon articles imported into Greece, the following goods are subject to taxation at the rates mentioned: Telegraph wires, 10 drachma per 100 okes (£1.17s. 7d. per cwt.); copper and brass wire, 20 dr. per 100 okes (£3. 5s. 2d. per cwt.); dynamos and inseparable accessories, 5 dr. per 100 okes (18s. 9d. per cwt.); rails, points, &c., for railways, 3 dr. per 100 okes (11s. 3d. per cwt.).

The United States Government has prevented the Western Union Telegraph Company from completing the work of laying a submarine cable between Barbados and Miami (Florida) owing to a dispute as to landing rights. The cable, which was being laid by the cable ship "Colonia" (owned by the Telegraph Construction & Maintenance Company), would connect with the British cable from Barbados to South America. The Government's action has been taken in order to prevent the landing of the cable before the meeting of the International Communications Congress at Washington on Sept. 15. The Western Union Company had applied for permission to land the cable on the Florida coast, pending determination by the State Department as to whether the terms of its contract with the British company would not further extend the alleged British monopoly of cable rights in Brazilian waters. The controversy is really one between the Western Union Company and the State Department.

Educational.

The school of rubber technology has been re-established at the Northern Polytechnic Institute (Holloway, London), and it will be under the direction of Dr. P. Shidrowitz. Day and evening classes will be held during the forthcoming session.

Sir James Benjamin Ball, chief engineer of the L.B. & S.C. Railway, presented the certificates to students of the Crystal Palace School of Engineering last week. He urged students to cultivate the power of observation, to think with their eyes as well as their brains. He elieved that we were on the eve of great developments in all branches of engineering. It was up to the engineer to devise methods for the mechanical handling of materials to overcome the heavy cost of labour. The railways had got to pay, and in railway engineering there was a great field open for brains and energy.

Miscellaneous.

The next British Industries Fair will be held between Feb. 21 and March 4, 1921, at the White City.

The Home Secretary has made General Regulations under sec. 86 of the Coal Mines Act, 1911, to apply to all mines, and relating to precautions against coal dust and spontaneous combustion of coal, additional provisions as to rescue, the use of electricity on the surface, &c.

From figures given by the Postmaster-General in answer to a question in Parliament, we learn that the number of telephones per 100 of the population is approximately as follows: United Kingdom (in 1919), 2·0; Norway (1917), 4·4; Sweden (1919), 6·4; France (1919), 1·0; Germany (1914), 2·2; Italy (1919), 0·3; and United States (1919), 13·6.

Burnley and District Building Employers' Association has suggested to the Electricity Committee that the Corporation should obtain powers to examine the qualifications of electricians and others undertaking electrical work in the town, so as to prevent unqualified and unskilled persons doing the work. The Committee, however, recommend that no action be taken, as the Corporation can refuse a supply where the lines, fittings and apparatus are not in good condition.

An inquest was held at Redcar on the 4th inst. on Harry Martin, a plater's helper, who was killed by an electric shock at the Warrenby Steelworks. Deceased and a boilersmith were completing repairs to an electric crane, and instead of asking the electrician, Martin inquired of a fitter in the driver's cab if the switches were out. All those in the cab were off and the fitter, thinking that these cut off the current from the whole crane, replied "Yes." A switch on the top of the crane was on, and almost immediately Martin collapsed. The Coroner, in returning a verdict of "Accidental death," said deceased was slightly to blame for not having found a responsible man before beginning work.

The Annual Outing of the employees of Thos. Firth & Sons, Ltd., the well-known Sheffield steel manufacturers, took place during the August Bank Holiday week. The firm have always taken the keenest interest in the welfare of their workpeople and have for many years assisted them to spend a day either at the seaside or in the country. On this occasion a democratic vote was taken, and it was decided to travel to Matlock Bath by road. Over 1,000 people were carried, necessitating a fleet of more than 40 large motor coaches, so large a number that the police ordered it to proceed to Matlock in two sections and by different routes. A thoroughly enjoyable day was spent, typical of the excellent relations which have always prevailed between the firm and its employees.

On Aug. 4 the Royal Assent was read to the following new Acts of Parliament: Airdrie and Coatbridge Tramways Order Confirmation, Dunfermline and District Tramways Order Confirmation, Tramways Orders Confirmation, Swansea Corporation, Wrexham District Tramways, St. Anne's-on-the-Sea Urban District Council, Gelligaer Urban District Council, Bootle Corporation, Bridlington Corporation, Nottingham Corporation, Pontypridd Urban District Council, Portsmouth Corporation, Rhondda Urban District Council, Wolverhampton Corporation, Halifax Corporation, Leigh Corporation, Central London and Metropolitan District Railway Companies (Works), Blackpool Improvement, Hastings Tramways, Edinburgh Boundaries Extension and Tramways, Coventry Corporation, London County Council (General Powers), Lowestoft Corporation, Sheffield Corporation, Southampton Corporation, Manchester Corporation, Derwent Valley, Calver & Bakewell Railway.

We have received from the publishers a copy of "Who's Who in Engineering," edited by Mr. John E. Sears, C.B.E. This is the sort of book that every editor likes to have. It forms a useful kind of memory on paper, and enables him to check dates and biographical details when it comes to writing obituaries of famous men, or discovering exactly where it was the less famous went to school. Unfortunately, the 1920-1 edition is by no means all it should be, and we sincerely hope it will improve. At present it is chiefly remarkable for those it includes, and more remarkable for those it leaves out. For instance, neither the President, the President-elect nor the immediate past-president of the Institution of Electrical Engineers, or the Chief Electricity Commissioner find a place! Such omissions can, however, be easily rectified, and we hope that no time will be lost in doing so before the next edition.

Mr. S. J. Peachey, of the Manchester College of Technology, has recently discovered a New Process for Vulcanising Rubber. It is claimed that the process is a true vulcanisation (as distinct from the sulphur chloride treatment), and yields a product entirely comparable with that obtained from the Goodyear process. It eliminates the use of heat, and to a great extent the use of mechanical pressure. It employs two gases, both of which can be produced on a large scale at a cheap rate. It is rapid and simple, and the manufacturer can employ organic filling agents such as leather waste, sawdust, shoddy waste, &c., which cannot be used with the hot process. In this manner a number of cheap and highly-durable materials may be fabricated from the various wastes, and employed as floor and wall coverings, boot and shoe manufacture and other purposes. In addition, coal tar dyestuffs, and even natural dyes, which, with a few exceptions, are destroyed by the "hot cure," can be introduced into mixings to be cured by the new process, and delicate tints and shades, hitherto unobtainable, are produced. Already some samples of daintily coloured floor coverings, fancy leathers and felts have been produced in the laboratory, the appearance and finish of which are said to be excellent. Several pairs of boots have been soled with leather reformed from waste by the new process, which can be extended to the vulcanisation of rubber in solution. If a solution of rubber in benzole or naphtha be saturated or partly saturated with hydrogen sulphide and mixed with a solution of sulphur dioxide in the same solvent, the liquid sets in a few moments to a stiff jelly, and on eliminating the solvent by evaporation a fully vulcanised rubber is obtained. The use of the mixed solutions for producing perfectly vulcanised seams and joints has proved highly satisfactory in practice, and inner tubes repaired in a few moments by the new process have an excellent life.

Imports.—The following are official values of electrical machinery, material and apparatus imported into this country (*a*) during June, 1920, and (*b*) the aggregate figures from Jan. 1 to June 30, with increase or decrease compared with corresponding periods of 1919:—

Electrical machinery, (*a*) £95,068 (increase £43,313), (*b*) £499,033 (increase £210,971); telegraph and telephone cables, submarine, (*a*) nil, (*b*) £50 (increase £50); other than submarine, (*a*) £1,175 (increase £700), (*b*) £3,633 (decrease £4,220); telegraph and telephone apparatus, (*a*) £14,533 (decrease £23,178), (*b*) £70,010 (decrease £65,590); other electrical wires and cables, rubber insulated, (*a*) £182 (increase £182), (*b*) £11,104 (increase £8,138); with other insulations, (*a*) £11,272 (increase £11,272), (*b*) £45,782 (increase £36,779); carbons, (*a*) £7,233 (increase £6,062), (*b*) £60,305 (increase £46,221); glow lamps, (*a*) £2,403 (decrease £13,395), (*b*) £19,353 (decrease £185,943); arc lamps and electric searchlights, (*a*) £321 (increase £321), (*b*) £2,840 (increase £2,840); parts of arc lamps and searchlights (other than carbons), (*a*) £422 (decrease £2,775), (*b*) £6,601 (decrease £30,003); batteries, (*a*) £5,288 (decrease £1,761), (*b*) £32,768 (increase £7,388); meters and measuring instruments, (*a*) £12,702 (increase £10,667), (*b*) £36,872 (increase £17,617); switchboards, (*a*) nil, (*b*) £993 (increase £37); electrical goods and apparatus unenumerated, (*a*) £68,841 (increase £69,925), (*b*) £304,157 (increase £95,007). Total of electrical goods and apparatus other than machinery and uninsulated wire, (*a*) £124,372 (increase £48,020), (*b*) £594,468 (decrease £71,679).

Exports.—The exports of electrical machinery, material, &c., (*a*) during June, 1920, and (*b*) from Jan. 1 to June 30, with increase or decrease compared with corresponding periods of 1919, were as follows:

Electrical machinery, (*a*) £173,614 (increase £45,231), (*b*) £959,166 (increase £310,071); including railway and tramway motors, (*a*) £3,203 (increase £1,709), (*b*) £19,311 (decrease £5,562); other generators and motors (*a*) £115,415 (increase £34,810,) (*b*) £552,618 (increase £192,909); and electrical machinery unenumerated, (*a*) £54,996 (increase £8,712), (*b*) £387,237 (increase £122,724); telegraph and telephone cables, submarine, (*a*) £416,853 (increase £377,863), (*b*) £1,037,201 (increase £795,138); other than submarine, (*a*) £89,615 (increase £43,034), (*b*) £492,319 (increase £317,060); telegraph and telephone apparatus, (*a*) £81,509 (increase £51,191), (*b*) £556,149 (increase £399,520); other electrical wires and cables, rubber insulated, (*a*) £140,762 (increase £44,734, (*b*) £747,632 (increase £459,141); with other insulations, (*a*) £205,486 (increase £101,456), (*b*) £1,007,813 (increase £682,846); carbons, (*a*) £10,650 (increase £10,365), (*b*) £51,636 (increase £48,199); glow lamps, (*a*) £27,520 (increase £10,409), (*b*) £103,086 (increase £36,458); arc lamps and searchlights, (*a*) £2,484 (increase £2,321), (*b*) £8,973 (increase £2,421); parts of arc lamps and searchlights (other than carbons), (*a*) £341 (decrease £9), (*b*) £5,395 (decrease £1,916); batteries, (*a*) £39,734 (increase £6,059), (*b*) £223,565 (decrease £17,860); meters and measuring instruments, (*a*) £34,904 (increase £23,351), (*b*) £185,159 (increase £89,434); switchboards, (*a*) £9,695 (increase £6,499), (*b*) £44,055 (increase £27,050); electrical goods and apparatus unenumerated, (*a*) £152,807 (increase £45,355). (*b*), £783,147 (increase £251,721). Total of electrical goods and apparatus, other than machinery and uninsulated wire, (*a*) £1,212,360 (increase £722,628), (*b*) £5,246,130 (increase £3,089,212).

Business Items, &c.

Douglas Wild and Martin Booth, electrical engineers, &c., 117, Stalker Lees-road, Sheffield, have dissolved partnership.

The British Thomson-Houston Company has purchased land at Chesterfield for the erection of a factory for the manufacture of electric lamps, fittings, &c.

The negotiations between the directors of Stewarts & Lloyds, Ltd., and the directors of Alfred Hickman, Ltd., for the amalgamation of the two companies have been concluded.

The North British Electric Welding Company, Ltd., is being wound up voluntarily, and Mr. Wm. Gilchrist, 30, George-square, Glasgow, has been appointed liquidator, with authority to enter into an agreement with the North British Premier Electric Welding Company, Ltd., now in course of formation. Claims to Mr. Gilchrist by Sept. 30.

By an order made in an action in the Lancashire County Court on July 14 it was declared that the partnership between John W. Jacques, Robt. Caisley, and Fredk. W. Kenward (trading as Caisley, Jacques & Company), electrical engineers, &c., 2, Devonshire-place, Grange-over-Sands, ought to stand dissolved as from June 8.

Owing to the extension of their business Messrs. Bromell Patents Company, Ltd., 64, Darnley-street, Glasgow, have changed the name of the Company to W. Crockatt & Sons, Ltd. The management will remain as at present, Mr. W. Crockatt continuing as managing director. The extensions of works in progress will give increased manufacturing facilities and the company are opening a new department to undertake gear cutting, spurs, bevels, worm wheels, &c. The technical and clerical staff have been increased and they are in a position to deal with inquiries of all kinds for engineering plant, tools and materials.

Catalogues, Price Lists, &c.

Descriptive List No. 8,027 of the British Thomson-Houston Company, Ltd., is devoted to an illustrated description of the G.E. 200K. Traction Motor. This type has been developed for standard gauge, but it can usually be adapted for one of 4 ft. It is a split frame motor of the ventilated, interpole type, and embodies all the features most suitable for present day traction requirements. It is used by a great number of Municipal Authorities and Tramway Companies in this country. The pamphlet gives details of the design and construction of the motor, with sectional drawings, dimensions, &c.

The British Electric Transformer Company, Ltd., have issued a Spanish edition of their catalogue of electric radiators, ovens, hot-plates and other cooking and heating apparatus. The weights and measurements are given in the metric system, but in the accompanying price list the prices are given in sterling. We suppose this is unavoidable in the present state of the exchange with South American countries, though intending customers like to see figures in their own currency. There should be a good demand for the company's products in Spain and in South and Central America, and the company is to be commended for their enterprise and progressive ideas. The French edition of the company's catalogue is out of print, but a new one is in preparation.

A number of trade pamphlets and leaflets have recently been issued by the General Electric Company, Ltd. These include the revised catalogue prices (No. L. 2335) of electric bells and accessories and of "Freezor" electric fans (V. 2333), as well as an illustrated pamphlet on the "Koolah" fan (V. 2338). The revised prices cancel previous list prices and are not now subject to any advance. A fourth pamphlet of eight pages, entitled "Efficiency," is a most artistic and effective production. Well printed in colours and nicely illustrated, it gives brief particulars of some of the Company's leading manufactures—power plant, switchgear, cables, electric measuring instruments, the "Osram" lamp and the "Magnet" cooking and heating apparatus.

The Chloride Electrical Storage Company have recently issued the section of their catalogue relating to "Exide" Batteries for Starting, Lighting and Ignition purposes. The company have a lengthy experience in the manufacture of storage batteries, and the "XC" type of cell, which is described and illustrated in the catalogue, is designed to give the maximum power for a minimum weight and bulk. The output of plates manufactured by the company and its allied company (the Electric Storage Company, of Philadelphia) is said to be one million per week. Details of the construction of "Exide" cells are followed by a description of "XC" batteries, specifications of a number of batteries for six-volt and 12-volt systems, lists of motor cars and the XC batteries suitable for them, &c. We learn that owing to the large number of batteries that are being turned out it has been possible to effect a considerable reduction in the prices quoted in the previous list. The Company has a repairs and service department with a competent staff of inspectors and erectors. The system of service is being extended and Service depots are being established to meet the growth of the motor car industry and of the increased use of Exide batteries.

Institution Notes.

The annual conference of the Municipal Tramways Association will take place at Cardiff from Sept. 15 to 17.

At the annual meeting of the North of England Institute of Mining and Mechanical Engineers at Newcastle, on Saturday, the report showed an increase of nine members on the previous year and a credit balance of £681 7s. 5d. A paper was read on the electric welding of a corroded boiler shell, by Mr. A. Kenneth Dawson, and demonstrations were given of the electric welding of the fore part of a Lancashire boiler which was fractured, and also some coal-cutter screws. Col. F. R. Simpson was elected president for the ensuing year.

The Society of Radiographers was registered on Aug. 6 as a company limited by guarantee, the word "limited" being omitted from title by licence of Board of Trade, for promoting the science and regulating the practice of radiography. The first directors are: F. Herman-Johnson, M.B., R. Knox, M.B., S. Melville, L.S.A., Dr. G. H. Orton, M.A., Sir Archibald Reid, K.B.E., C.M.G., Prof. S. Russ, Dr. W. H. Eccles, J. S. Highfield, C. C. Paterson, O.B.E., A. A. Campbell Swinton, F.R.S., Dr. R. M. Walmsley, F.R.S.E., C. H. Wordingham, C.B., R. G. G. Blackall, C. O. Forder, H. Henry, H. Turner, G. F. Westlake and F. E. Doran. Solicitor: O. W. Bristow, 1, Copthall buildings, E.C.

Personal and Appointments.

Dr. L. V. King has been appointed Macdonald professor of physics at M'Gill University, Toronto.

Mr. J. A. Wishart, burgh electrical engineer of Motherwell, has resigned, in order to take up a position in Western Canada. He is leaving early in September.

Mr. Alan Kirk has resigned his position as engineer with Messrs. V. G. Middleton & Company, Ltd., to start in practice on his own account as an Electrical Quantity Surveyor with offices at 14, Victoria-street, London, S.W. 1 (Tel. Victoria 5128.)

Mr. R. Ferguson, the northern manager for Messrs. Hays, Hunter & Standen, Ltd., is joining the Mycromet Mfg. Company, of Oldham, who have equipped their works with a thoroughly up-to-date plant for manufacturing electrical accessories.

Tenders Invited and Accepted.

Warrington Corporation want tenders by Sept. 7 for surface condensing plant. Specification from Borough Electrical Engineer.

Southampton Corporation require tenders by Sept. 1 for an electric travelling crane to lift from 30 cwt. to 2 tons. Particulars from the Borough Engineer.

Edinburgh Corporation want tenders by Sept. 6 for converting plant for Portobello generating station and sub-stations (specification 26). Specification from the Engineer, Dewar-place, Edinburgh.

Kinghorn Corporation require tenders by Aug. 24 for electric wiring, &c., in 32 houses to be erected at Glamis Castle site, Kinghorn. Schedules, &c., from Mr. W. B. Wyllie, 196, High-street, Kirkcaldy.

Manchester Electricity Committee require tenders by Aug. 24 for a steam turbine-driven boiler feed pump for Stuart-street station. Specification from Mr. F. E. Hughes, Town Hall, Manchester.

Oban Corporation require tenders by 5 p.m. Aug. 16 for Electric Lighting Work in 12 houses to be erected at Mossfield, Oban. Schedules, &c., from Mr. Luke Falconer, jun., 22, Alexandra-place, Oban.

The date for the receipt of tenders by the Spanish Ministry of Development for the construction and working of an electric railway from Madrid to Valencia has been extended to Sept. 3.

The Department of Public Works of the Spanish Ministry of Development require tenders by Sept. 21 for the construction and working of an electric tramway from Mantaro to Argentona, in Barcelona Province.

Portsmouth Corporation invite tenders for a 4,000 kw. turbo-alternator and two water-tube boilers. Specifications from the Acting Engineer and Manager, and tenders to the Town Clerk by Aug. 25.

Croydon Corporation invite tenders for the supply and installation of a new feeder cable for the tramways department. Specifications from the Tramways Manager, and tenders to the town clerk (Mr. J. N. Newnham) by 11 a.m. Sept. 8.

Tenders are invited for the equipment and running of electricity supply works at Cape Coast and tramways at Coomassie (Gold Coast). Further information from the Secretary for Works, Accra. Tenders to the Colonial Secretary, Victoriaborg, Accra, by Sept. 1.

Tenders are wanted by August 31 for porous cells and jars (1,627), bronze wire (1,629) and covered and braided wire (1,633) for the Australian Commonwealth Postmaster-General's Department, and (by Sept. 7) for the supply of telephones and cable, Schedules 1,634 and 1,635. Tender forms from the Office of the High Commissioner, Room 406, Australia House, Strand, W.C. 2.

The N.S.W. Department of Public Works, Sydney, require tenders by 2 p.m., August 30, for switchgear, lighting arresters and power factor improvement apparatus for Avon Dam (Sydney Water Supply. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.

The Salvage Committee of the city of Birmingham invite tenders for the supply of two 100 kw. 440-volts d.c. compound-wound steam-driven generating sets, with surface condenser and switchboard. Specifications from the superintendent, Mr. Jas. Jackson, Council House, Birmingham, to whom tenders are to be delivered by Sept. 1.

Bradford Corporation invite tenders for the supply and erection of Boiler House Equipment, including Buildings, Water-tube Boilers, Economisers, Induced Draught Plant, Feed Pumps, Coal Handling Plant, and Piping Systems. Specifications, &c., from the city electrical engineer, Mr. Thomas Roles, and tenders to the town clerk, by Sept. 9.

Manchester Corporation require tenders by Aug. 30 for supply and laying of 33,000-volt 3-phase trunk feeders, pilot cables and telephone cables (specification B7); and by Sept. 20 for 33,000-volt, 19,500-k.v.a., 3-phase static transformers, house service and testing transformers (specification B8). Specifications from Mr. F. E. Hughes, Town Hall, Manchester.

Blackpool Corporation invite tenders for the supply and erection of two water-tube boilers, superheaters, economisers and mechanical stokers, &c.; two induced draught plants with steel chimneys, fans, &c., and coal hoppers and coal and ash elevators and conveyors. Specifications from the borough electrical engineer (Mr. Charles Furness), and tenders to the chairman of the Electricity Committee by Aug. 27

Canterbury Corporation has accepted the tender of Messrs. Newton for an electric water van, at £1,423.

Heston and Isleworth Urban Council has accepted the tender of the General Electric Company for the supply of a 350 kw. rotary converter and switchgear for £3,889.

Contracts have been secured by the Enfield-Ediswan Cable Company for the supply of cable to Aylesbury Corporation, and for a 12 months supply of cables and house services to Stoke Newington (London) Borough Council.

Glasgow Tramways Committee again recommend the acceptance of the tender of the United States Steel Products Company for the supply of 10,000 tons of steel tramway rails at £250,000. It will be remembered that at the last meeting of the Corporation it was decided to refer back the question as the standing orders relating to trade union wages had not been complied with. Only two tenders were submitted, and the American offer was about £30,000 less than that of a British firm. The agent for the American firm has now written stating that the labour conditions were satisfactory, and it was, therefore, decided to reaffirm the recommendation to give the contract to the American company.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1916 Specifications.

145,093 Clarke. Inductances for wireless telegraphy and allied uses and the manufacture thereof. (23/3/16. Complete accepted, 4/2/20. Patent sealed, 4/2/20.)

1918 Specifications.

144,742 Vickers Ltd., Mackness, and Broughton. Systems for driving hoists, rolling-mills, and electric locomotives. (19/12/18.)

1919 Specifications.

123,724 La Valette. Means for fixing a magneto brush-holder to a gear wheel. (27/2/18.)
123,983 Blackhall. Magnetic chucks. (26/2/18.)
125,375 Arquembourg, Joret et Cie. Magnetos. (3/4/18.)
129,267 Nielson. Combined electric lamp and alarm clock. (3/7/18.)
131,879 Dubilier Condenser Co. Electric insulation testing-devices. (26/8/18.)
133,306 Levy. Anti-parasitic receiving and selecting system for telegraphy and telephony with or without wires. (1/10/18.)

Relates to a method for anti-parasitic reception of sustained electric waves and selection from damped waves, in which undamped sustained oscillating energy arising from the sustained waves is separated from damped oscillating energy or aperiodic impulses arising from the damped waves and parasitic currents or waves by causing these energies to propagate on wave propagating systems, such that the damped energy gives a free travelling wave, and the sustained energy gives stationary waves in permanent state on them, and by utilising this condition for the selection of the energies.

135,177 Siemens & Halske Akt.-Ges. Receiving-arrangements for electric waves. (18/6/18.)

Relates to a receiving arrangement for electric waves, having a superposer and rectifier arrangement which produces a combined or group frequency at or above the limit of audibility, in which arrangement the wave-current obtained in the rectifier is converted into alternating current, and the latter is then rectified for the formation of the signal, after having been reinforced in a reinforcing device arranged between the two rectifiers.

135,464 Bouchardon. Generators of high-frequency oscillations for wireless telegraphy. (21/11/18.)

Relates to the combination of an arrangement for maintaining continuous high-frequency oscillations by means of a generator of polyphase current feeding a number of double anode valves with cathode rays, which number of valves is equal to that of the phases, with the arrangement for transmission of Hertzian waves described in patent No. 18,009 of 1914, for obtaining mixed stations of wireless telegraphy in which the same polyphase current generators are employed for actuating either a spark set or a valve set, the passage from one mode of transmission to the other being rapidly effected simply by the operation of a certain number of switches.

136,143 Stenquist. Metal alloy for the armourings of electric cables. (5/12/18.)
137,846 Francois. Electric hand-irons. (12/3/18.)
138,107 Akt.-Ges. Brown, Boveri et Cie. Controllers for electric railways operated by means of high-voltage direct current. (21/1/19.)
138,342 Siemens Schukertwerke Ges. Magnet coils. (19/10/18.)
142,434 Delta. Electrical ignition plug. (29/4/19.)
143,759 Ile. Electric-plug connectors and lampholders. (6/8/19.)
143,779 Bradshaw. Electrically-driven talking-machines, (22/9/19.)
143,795 B.T.-H. Co. & Trechman. Electric switches. (6/11/19.)
143,797 Eiken. Appliances for regulating the hardness of Röntgen-ray tubes. (14/11/19.)
143,806 Bechoff. Electrical circuit controllers. (24/12/19.)
143,807 O'Leary. Electrical toy motors. (30/12/18; divided application on 141,105.)
143,945 Bruce Peebles & Co. & Hunt. Dynamo-electric machines. (20/1/19.)
143,946 Fawdry & Dawson. Supporting-device for overhead electric wires. (19/8/19.)
143,949 Western Electric Co. Electric signalling systems comprising amplifying or repeating apparatus. (20/1/19.)

Relates to a signalling system in which a plurality of switching stations are connected by a transmission line or lines with which signalling current amplifying apparatus is associated intermediate said switching stations, and in which a line extended to one of said switching stations may be extended to said transmission line by an operator thereat, and that means associated with said transmission line responsive to the taking for use of said transmission line at said switching station controls said amplifying apparatus independently of the signalling current to be amplified and over a transmission path independent therefrom.

143,958 Krag-Moller. Electro-mechanical pocket lamps. (24/2/19.)
143,980 Stirk & Stirk. Direct-current motors and generators. (10/3/19.)
143,985 Edman. Electric lamps for motor vehicles or for other purposes. (11/3/19.)
143,993 O'Neil. Contacts of electrical switch gear. (17/3/19.)
144,009 Hamlyn. Electrical switches. (28/3/19.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

March 1.

6,117 Bishop & Chadwick. Electric trackless tramcars, &c.
6,142 Smith. Contact breakers for magneto electric, &c., machines.
6,150 J. H. Tucker & Co. & Line. Switches.
6,180 Railing & & Nobbs. Electric heaters, fires, &c.
6,196 B. T.-H. Co. & Clinker. Frequency indicating and measuring instruments.
6,198 & 6,199 Hastings. Automatic selective telephone system.
6,221 Metropolitan Vickers Electric Co. & Field. Electric machines.
6,222 Burgess Battery Co. Dry batteries. (13/3/19, U.S.)
6,228 Igranic Electric Co. (Cutler Hammer Mfg. Co.). Controllers for electric circuits.
6,229 Igranic Electric Co. (Cutler Hammer Mfg. Co.). Electro magnetic brakes.

March 2.

6,249 British Insulated Helsby Cables, Ltd. & Bayles. Electric cables.
6,250 Norton. Ironclad switches and switch fuses.
6,255 Rippingille. Fittings for metallic electric conduits.
6,257 Bayley & Taylor. Fittings for holding incandescent electric lamps.
6,267 Le Sucur. Electrolytic cells.
6,272 Small & Smith. Generators and motors.
6,303 Bultemann. Mode of cementing electric conductors with non-conductors.
6,318 Siemens & Halske Akt. Ges. Call signal arrangements for field telephones, &c. (4/3/16, Germany.)
6,344 Ferat. Electric machines. (6/2/18, France.)
6,345 Ferat. Electric machines. (15/10/19, France.)
6,346 Ferat. Magnetos. (14/1/18, France.)
6,347 Ferat. Magnetos. (18/2/18, France.)
6,369 Feldkamp. Incandescent lamps.
6,400 Russell. Renewal of incandescent lamps.

March 3.

6,403 Grieve & Offord. Electro magnetically-controlled lock system.
6,480 Brothers. Interlocking device for electric switches.
6,492 Hill & Shotter. Electrical instruments.
6,504 Armstrong. Brushholders for dynamos and motors.
6,542 Automatic Telephone Mfg. Co. Battery charging systems. (11/6/19, U.S.)
6,543 Automatic Telephone Mfg. Co. Code-signalling systems. (30/6/19, U.S.)

Companies' Reports, &c.

The directors of the Clyde Valley Electrical Power Company announce an interim dividend of 2½ per cent., less tax.

The Mansfield & District Tramways, Ltd., has declared an interim dividend of 3 per cent. (7 1 5d. per share), less tax, on the ordinary shares for the half-year.

Brompton & Kensington Electricity Supply Company, Ltd., has declared an interim dividend for the half year to June 30 on the ordinary shares at the rate of 9 per cent. per annum (less tax). compared with 7 per cent. in 1919.

The City of Buenos Ayres Tramways Company (1904), Ltd., has declared a dividend of 1s. 3d. per share (5 per cent. per annum), for the three months ended June 30 last.

The directors of the Bristol Tramways & Carriage Company have declared an interim dividend for the half-year ended June 30 at the rate of 3 per cent. on the ordinary shares.

The net revenue of the Shawinigan Water & Power Company for the year 1919 was $1,473,743, after transferring $300,000 to depreciation reserve. Dividends amounting to the usual 7 per cent. per annum have been paid; $220,000 placed to sundry reserves, and $30,550 carried forward.

The directors of the County of London Electric Supply Company, Ltd., have declared an interim dividend on the preference shares at rate of 6 per cent. per annum for the half-year ended June 30, and an interim dividend on the ordinary shares for the same period at the rate of 5 per cent. per annum, both less tax.

The directors of the Vera Cruz Electric Light, Power and Traction Company, Ltd., have declared a dividend of 5 per cent. (1s. per share) for the half-year, making 10 per cent. for the year. A sum of £15,000 has been placed to depreciation and reserve account, and £23,398 carried forward.

The City Electric Light Company, Ltd. (Brisbane) reports that, after making additions to the franchise and purchase sinking fund, and renewal and contingencies account, the credit balance for the year ended Jan. 31 was £42,519, which, with amount brought forward, makes £42,934. Out of the year's profits the directors paid an interim dividend in September, and a further dividend of 5 per cent. was declared on the ordinary shares, leaving £431 to be carried forward.

At the recent meeting of the Anglo-Continental Mines Company, Ltd., the chairman (Mr. W. Turner) announced that steps were being taken to develop the water-power of the Kurra Falls. A representative of Messrs. Vickers Limited, who had visited the falls, estimated that 5,500 h.p. would be available. That would be in excess of their own requirements, but with suitable plant they could give a supply of electric power to the mines for many miles around. Further investigation would be required, but they had made application to the Nigerian Government for a concession to use the falls for generating electric power and to sell power to the mines.

For the half-year ended June 30 the surplus of receipts over expenses of the Tyneside Tramways and Tramroads Company was £2,667, which, with balance brought forward (£2,238) makes a total of £4,905, and after deducting interest on mortgages, &c., there remains £3,459, to which has been added £3,000 from the special reserve account. The directors propose to pay a dividend on the preference and ordinary shares at the rate of 5 per cent. per annum (less tax), to place to reserve for renewals £1,500, and to carry forward £1,010 15s. 11d.

Dr. J. T. Merz, who presided over the meeting on Tuesday, said that though there was an increase of £4,500 in the traffic receipts, the expenses had increased by over £8,000, and they had had to draw upon the permanent reserve to the extent of £3,000, against £1,500 last year. The reserve fund now stood at £40,900, but they had only £29,000 available because they had used up a large amount of the reserve for capital purposes. They would make an issue of £12,500 5½ per cent. bonds. In their new Act they got the three points they asked for—the right to increase the fares (which were being increased, roughly, from 1d. to 1½d.), to issue loan capital bonds in proportion to the share capital, and the right to run motor omnibuses.

At the thirteenth annual convention of the Canadian Electrical Association, which was held in Montreal on June 16, 17 and 18, Mr. A. Monro Grier, K.C., of the Canadian Niagara Power Company, was elected president; Messrs. P. T. Davies (Montreal), A. P. Doddridge (Quebec) and L. W. Pratt (Hamilton), were elected vice-presidents. The secretary-treasurer is Mr. Eugene Vinet, of the Shawinigan Water & Power Company, Montreal. The Committee on meters, reporting on watt-hour meters which are sealed in Canada by the Government for a period of five years, after which they must be re-tested and re-sealed, suggested that, in view of the small percentage of meters found to fall outside Government requirements, the sealed period be extended to 8 years, and also that meters be sealed and tested in situ owing to damage to jewels caused by the removal of the meter. In the report on overhead lines, it was stated that the Shawinigan Water & Power Company and its associated companies had standardised on 2,300 volt distribution and had distributed handbooks among their staff covering standards of low voltage line transmission in cities and towns, and also transformer practice. The result of the standardisation was that the amount of material carried in stock was simplified and reduced. For instance, four-pin cross-arms hitherto carried in 12 different sizes are now stocked in only one size, and reductions in sizes of bolts, braces and other materials have also been effected.

New Companies.

A. & R. BROWN, LTD. (169,463).—Private company. Reg. Aug. 6, capital £125,000 in £1 shares, to take over the business carried on at Liverpool, as "A. & R. Brown," to carry on the business of founders, engineers, tool makers, metal workers, machinists, electrical and water supply engineers, &c.

CENTRAL ELECTRICAL ENGINEERING COMPANY, LTD. (169,436).—Private company. Reg. Aug. 4, capital £100 in £1 shares, to acquire the business carried on as the Central Electrical Engineering Company, and to carry on the business of electrical and mechanical engineers, &c. J. H. Horner is sole director. Reg. office: 26, Paradise-square, Sheffield.

CHARTERHOUSE WORKS, LTD. (169,369).—Private company. Reg. July 30, capital £30,000 in £1 shares, to take over the business carried on by W. P. McCarthy at Charterhouse Works, Coventry, as Guest & Company, to carry on the business of general, mechanical and electrical engineers, metal stampers, machine tool makers, &c. First director: W. P. McCarthy.

CLARKSON, BROTHERS, LTD. (169,223.)—Private company; reg. July 23, capital £10,000 in £1 shares, to carry on the business of motor, electrical and general engineers, ironmongers, &c. First directors are C. E. Clarkson, R. A. Telford, F. H. Clarkson and W. Jackson. Reg. office, Olympia Garage, Ings-road, Wakefield.

DELCO-REMY, LTD. (169,225.)—Private company; reg. July 23, capital £50,000 in £1 shares (30,000 7 per cent. cumulative preference), to take over the business of automobile and electrical engineers carried on by W. H. Johnson and W. O. Kennington as Walter H. Johnson, to adopt agreements with the said vendors and General Motors Corpn. First directors are W. H. Johnson, W. O. Kennington, A. P. Sloan, jun., E. E. Eby, J. H. Wilson and R. M. Emslie. Reg. office, 14, Panton-street, Haymarket, S.W.

GRATZE, LTD. (169,151).—Private company. Reg. July 30, capital £30,000 in £1 shares, to carry on the business of electrical mechanical, automobile, aeronautical and marine engineers, manufacturers of and dealers in electric, telegraphic, telephone and other appliances, &c. Permanent directors are: E. V. H. Gratze (managing director) and F. Clayton. Reg. office: 44-6, Whitfield-street, W. 1.

S. A. IMPULSE STARTER, LTD. (169,303.)—Private company; reg. July 27, capital £600 in £1 shares, to adopt an agreement with J. R. M. Stanfield and J. F. Adye, to develop patents mentioned therein (not defined). First directors are J. R. M. Stanfield and J. F. Adye, B.Sc. Reg. office, 79, St. Mary-street, Cardiff.

KINETIC ORGAN BLOWER COMPANY, LTD. (109,204.)—Private company; reg. July 22, capital £500 in £1 shares, to take over the business of electrical and general engineers and manufacturers of and dealers in electric, water and other engines and apparatus for blowing organs, air compressors and exhausters, lately carried on by the Kinetic Company, Ltd., at Lincoln Permanent directors are W. Mobbs, C. Rawding and R. G. Chatfield. Secretary, W. Mobbs. Reg. office, Kinetic Works, Swanpool Court, Lincoln.

MOTOR INVENTIONS LTD. (169,385)—Reg. July 30, capital £10,000 in 10s. shares, to carry on the business of manufacturers of and dealers in motor locks, magnetos, magneto parts, &c. Sec. (pro tem.): J. E. Bracher. Reg. office: 30, Ludgate-hill, E.C.4.

RADIO CLUBS, LTD. (169,130).—Reg. July 19, capital £10,000 in £1 shares, to establish, maintain and conduct clubs for wireless telegraphists, cable operators and others, &c. First directors are: E. R. Tuck, E. A. Watkinson and C. J. McCarthy. Secretary: G. W. Pacy. Reg. office: Hastings House, Norfolk-street, Strand, W.C.

SCINTILLA, LTD. (169,261.)—Private company; reg. July 26, capital £5,000 in £1 shares, to carry on the business of electrical, mechanical and automobile engineers, manufacturers, importers and contractors for the supply of, and dealers in magnetos and ignition devices, &c. The first directors are G. Boveri, J. Schnyder, and A. C. Ehorall.

SURREY SCIENTIFIC APPARATUS COMPANY, LTD. (169,385.)—Private company; reg. July 28, capital £5,000 in £1 shares, to carry on the business of electricians, electrical engineers, manufacturers of electrical apparatus, &c. Reg. offices, 101A, High-street, Mortlake, S.W. 14.

TODMAN RYALL & COMPANY, LTD. (169,218).—Reg. July 22, capital £15,000 in £1 shares, to carry on the business of manufacturing electrical, mechanical, motor and general engineers, &c. Solicitors: Geo. Reader & Co., 35, Coleman-street, E.C.

WILSONS & LANGLEY, LTD. (169,433).—Private company. Reg. Aug. 3, capital £20,000 in £1 shares, to adopt agreement with L. Van Oppen, to develop the business recently carried on by Wilsons & Berry Ltd., and to carry on the business of manufacturers of engines, motor cars, motor bodies, founders, mechanical and electrical engineers, &c. Permanent directors are L. Van Oppen and G. Langley. Solicitor, E. A. Clifford, Dock House, Billiter-street, E.C.

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Forty Years Ago.

(The Electrician, August 14, 1880.)

Newcastle.—The authorities at Newcastle have agreed to allow the representatives of the United Telephone Companies to lay underground wires for telephonic purposes.

Bradford.—The works of the new reservoir are being lighted by two of Mr. Crompton's lamps, so that the labour goes on continuously. It is said that the lamps are of 12,000 c.p. each.

Cabling and Politics.—Sir Bartle Frere's recall, which was decided upon, communicated and made public all within a couple of days, would have occupied six weeks (allowing for the transit of despatches both ways by post) previous to the laying of the South African cable.

Lamps for Electric Light.—M. L. Cemandot suggests the use of spun glass as an effective method of procuring the diffusion of the electric light. He uses a lamp with double glass walls, between which he places the spun glass. Experiments have been successfully made at large warehouses of the Louvre at Paris.

The Institution of Mechanical Engineers.—The president of the Institution of Mechanical Engineers, Mr. E. A. Cowper, in his inaugural address at the late meeting at Barrow-in-Furness, referred to the various aids received by engineers, and among others he commented on telegraphic communication in the following: "Telegraphs then came to our aid, to facilitate the interchange of information, and particularly did ocean telegraphs help greatly in the more important communications between continents. I must not here dwell upon the immense variety of telegraph instruments and appliances, whether acting by codes, read by the eye or by the ear, or writing by hand, or recording by a line; but the great acceleration accomplished by duplex and quadruplex signalling, through one wire in both directions, has been a marked improvement of our own age, and contrasts strongly with Prof. Wheatstone's original four wires, with the rails of the railway (as was supposed) for a return wire."

Prices of Metals, Chemicals, &c.

Tuesday, Aug. 10.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£109 0 0	—	—
Electro Wirebars...	,,	£117 0 0	£1 0 0	—
H.C. wire basis......	per lb.	1s. $4\frac{7}{16}$d.	$\frac{1}{8}$d.	—
Sheet	,,	1s. $5\frac{7}{8}$d.	$\frac{1}{8}$d.	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. $9\frac{7}{16}$d.	$\frac{1}{8}$d.	—
Brass 60/40—				
Rod, basis	,,	0s. $10\frac{3}{4}$d.	—	$\frac{1}{8}$d.
Sheet, basis	,,	1s. $4\frac{1}{4}$d.	$\frac{1}{2}$d.	—
Wire, basis	,,	1s. $3\frac{7}{8}$d.	$\frac{1}{8}$d.	—
Iron—				
Cleveland Warrants	per ton	£11 10 0	—	£0 7 6
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£40 0 0	£0 10 0	—
Foreign or Colonial	,,	36 15 0	—	£0 10 0
Tin—Ingot	,,	280 0 0	£11 10 0	—
Wire, basis	per lb.	0 3 $7\frac{1}{4}$	$1\frac{3}{4}$d.	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 8d.

Sodium Chlorate.—Per lb. $5\frac{1}{4}$d.

Rubber.—Para fine, 1s. $9\frac{3}{4}$d.: plantation 1st. latex, 1s. $10\frac{1}{2}$d. per lb.

Shellac.—T.N. Orange, 670s.–675s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and rubber prices by Messrs. W. T. Henley's Telegraph Works.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics."—"The Air Ministry Tests"; "Duralumin"; and "Ballooning for All."

"The Cabinet Maker."—"How to Deal with Woodworm"; "Instruction in Cabinet Making at High Wycombe" (illustrated); and "Flush Veneering of Large Doors."

"The Chemical Age."—"The Preparation of Catalysts," by A. A. Pollitt, M.Sc.; and "A New Era in Gas Supply," by John T. Sheard.

"The Fruit-Grower."—"The Aspidistra as a House Plant"; "Jam Combine and Fruit Prices"; and "The Agricultural Bill."

"The Gas World."—"Thermal Efficiencies of Gas and Electricity," by G. W. Helps; "An Arbitration for the Municipalisation of two Company Gas Undertakings"; and the Gas News of the week.

"Hardware Trade Journal."—"Labour Saving in the Foundry" (XIV.); "The Elusive Order" (II.); "Leather Trade Notes."

"Ways and Means."—"The Good in the Enemy," by the Editor; "Handicraft and Learning," by Professor J. J. Findlay; and "A Specialist Medical Service for Employees," by H. Cooper.

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Notes.

An Electrical Research Association.

ANY methods whereby we may add to our knowledge of electrical phenomena are always to be welcomed, and at no time more than at the present. The means adopted to ensure this development may be divided into two classes, according as to whether they are undertaken with a view to adding to our general knowledge or whether they have the ulterior, but very necessary, object of increasing the commercial possibilities of certain materials or devices by augmenting what we already know about their properties. The second class of investigations may be conveniently included under the heading of industrial research and is one upon which a good deal of time, money and enterprise may usefully be expended at the present time. We are, therefore, glad to see that the Electrical Research Committee which, it will be remembered, was established in 1917 to take charge of all the electrical researches initiated by the Institution of Electrical Engineers and the British Electrical and Allied Manufacturers' Association, is about to be registered at the Board of Trade as an Association with the object of promoting research work in the electrical and allied trades and with power to establish laboratories and carry on experiments to that end. A research scheme has been approved by the Department of Scientific and Industrial Research, and when the registration is completed grants may be obtained from this Department, thus enabling the very useful work which has been carried on under the direction of Mr. E. B. WEDMORE to be effected in a more satisfactory way. This should add to the scope and value of an Association which is worth all the support the industry can give it.

The "Electric-Gas" Argument.

THE figures recently put forward by Sir DUGALD CLERK regarding the relative thermal efficiencies of electricity and gas have received a good deal of criticism from those representing two schools of thought. In the first place, there are those who think that his figures require modification, and in the second there are those who consider that even if his figures are correct there are many other factors of equal, if not greater, importance to be taken into consideration before the deductions he makes can be correctly drawn. A prominent critic in the first class is Mr. GEORGE HELPS, whose views were propounded in our Correspondence columns a few weeks ago and from whom we have now received a further lengthy statement in reply to a letter of Sir DUGALD CLERK's which appeared in our issue of July 16th.

The Point and Some Figures.

As Mr. HELPS expresses it the point is briefly this: "In the electricity generating process 100 heat units in raw coal have to be fed to the steam generators to produce about 7·6 units for the use of the consumer of electricity. Comparably, says Sir DUGALD, 100 heat units are used in the carbonisation process for every 45 units present in the gas delivered to the consumer, including an allowance for transmission loss. Therefore, says Sir DUGALD, the thermal efficiency of gas to that of electricity is as 45 to 7·6 or 5·9 times as great." But Mr. HELPS points out that in the case of electricity the coal is entirely consumed in the process, while in the case of gas, for every 100 heat units in the raw coal only about 27 per cent. are available in the gas, while about 44 per cent. are left in the coke and the tar, and therefore the thermal efficiency of gas to that of electricity is as 27 to 7·6, or, say, 3·5 times as great.

The Two Efficiencies.

SIR DUGALD CLERK is, however, by no means shattered by this bombardment of arguments and does not see fit to change his mind. In a reply to Mr. HELPS, of which, through the courtesy of the "Gas World," we have been allowed to see an advance proof, he adjures Mr. HELPS to distinguish between the efficiency of carbonisation and the efficiency of gas generation and informs him that he still confuses electro-dynamic transformation in an electric motor with the efficiency of thermo-dynamic transformation in a gas engine. But Sir DUGALD is rather hopeless of getting Mr. HELPS to see his point of view, for he concludes that he is "obviously incapable of following his (Mr. Helps') mental processes." We should not wonder if that is what Mr. HELPS feels about Sir DUGALD CLERK. At any rate, a sort of stalemate seems to have supervened and our interest in the points raised is rapidly waning.

The Extension of Patents.

A recent judgment of Mr. Justice Sargant decided some important points on the construction of the Patents and Designs Act, 1919. An application was made under Sec. 7 of the Act by the owner of certain patents granted in 1911 and 1915 (Davidson's patents) for an extension of their periods as the war had prevented the exploitation of the patented processes, and thereby loss and damage had been suffered. It will be noticed that the application was made a long while before the expiration of the patents, and the question was therefore raised as to whether any alteration had been made in the practice hitherto prevailing, that a petition for an extension should only be made about six months before the date of the expiry of a patent. In the course of a long and carefully considered judgment Mr. Justice Sargant decided that there was strong *prima facie* ground for concluding that extensions by originating summons under Sec. 7 of the 1919 Act should also be sought at or about the same period, and the effect of sub-section 6 of the section was merely to give the Court a certain discretionary power.

Reasons for Judgment.

The Judge pointed out that there might be many cases in which the Court would have regard solely to the loss and damage suffered by the patentee, but there might also be other cases where the remuneration had been altogether excessive, or where the patentee had been quite inert, or where the prolongation might be likely to be injurious to the industry of the country, or where there were other circumstances unfavourable to extension; and in the latter cases the Court might not be justified in arriving at its decision by considering solely the loss or damage suffered. Therefore, he held it was, in general, impossible to decide in what way the Court should exercise its discretion until a patent had nearly expired. Further, the reference in sub-section 6 to loss or damage must be taken to refer to loss or damage suffered during the whole term of the patent, and not merely to that suffered during a portion of that period. It might well be, that in certain cases, though a patentee had down to the present time suffered loss or damage owing to the war, such loss or damage might prior to the expiration of the patent be made good in whole or part, or even be converted into a gain, by reason of subsequent circumstances also arising out of the war. The patentee should not be able to select such a time for his application as would enable him to prove the maximum amount of loss and obtain the maximum extension of his patent. A system under which applications of the kind should be entertained at a comparatively early period in the life of a patent would result in the prolongation of a large number of patents, with very little ultimate benefit to the patentees, but with considerable inconvenience to the public. Many patents which seemed in their early years to be worth an application for extension might, towards the end of their natural lives, be recognised as being obsolete, or superseded, or otherwise not worth the trouble and expense of such application. As a general rule, applications under the new sub-section should, like those under the previous practice, be made quite a short time before the expiration of the patents. As the applications were the first of their kind and the practice had not hitherto been settled he did not dismiss them, but directed that they stand over generally, with liberty to restore at a later date.

Increase of University Fees.

We regret to learn that circumstances have forced the authorities of six of the modern universities to raise their tuition fees; and it is probable that other universities will be compelled to take a similar step. The salaries of the academic staff have had to be increased, though even now stipends are inadequate; there have been large increases in the price of chemicals and instruments for laboratories, and nearly every item of expenditure is much in excess of the pre-war figure. Hitherto this country has been behind the United States, Germany, and some other countries in the number of its university students, and, therefore, we hope that the tuition fees will not be advanced to such an extent as to act as a deterrent to those who could benefit from the course of advanced instruction given in a university. We should like to see more generous support of these invaluable institutions by manufacturers and by local authorities. We cannot afford to be behind any other country in promoting and developing higher education and scientific research, and, therefore, every attempt should be made to assist universities and university colleges to tide over the present difficult time.

Details of the Increases.

We understand that at Birmingham University it is only intended to raise the fees payable by new students by 25 per cent., but the examination fees will, probably, be increased by a similar percentage. At Manchester and Bristol the increase will be 33⅓ per cent., and at Leeds, Sheffield and Durham 25 per cent. At Liverpool all students will have to pay 33⅓ per cent. more than hitherto, and it is anticipated that the University of London will adopt a 50 per cent., and Wales a 33⅓ per cent. increase. We are glad to see that the proposed increase is a moderate one and that, with one exception, it will be confined to new students. Of course, there is no legal impediment to prevent the raising of fees to all students, but the parents of young men usually enter their sons at a university on the basis of a certain expenditure being required, and we think that equity demands that nothing should be done to upset this understanding.

University Grants.

The fact that if Institutions of a University standard are satisfactorily to carry on the important work that they are designed to do they must be provided with funds for the purpose is recognised to some extent by the present Government, and the Chancellor of the Exchequer therefore proposes to ask Parliament to increase the Treasury "grant-in-aid" from £1,000,000 to £1,500,000 in next year's Estimates. This advance, though at first sight it seems an improvement, is really only another of those paper transactions in which officials so delight, for the Universities already receive the latter amount, and all the new proposal would do is to make a sum of £500.000 which is now non-recurrent re-current. That is, there is no real advance at all, but a slight improvement in the security of tenure. At the present time this is not enough. For at no time has money for University Education been a greater necessity than it is now. The teaching staff is being grossly underpaid, buildings are falling into disrepair, the supply of books, equipment and consumable stores is stinted, it is difficult to carry on even the ordinary work, and almost impossible to carry on advanced studies or research work. Indeed, the state of things is such that many of the activities of these Institutions will soon have to be curtailed for lack of sufficient funds. It is a case where the Government must be made to realise how serious matters are and to take steps to provide adequate funds if not in order that most necessary work may be carried on, then as a thank offering for all the Universities did in ensuring the successful prosecution of the war. It is but one more example of the inability of bureaucracy to distinguish between necessary and unnecessary expenditure.

The Shortage of Scientific Workers.

RECENT articles and correspondence in our columns show that there appears to be a shortage of scientific workers both in the commercial and educational worlds. Mr. BUTLER BURKE has been deploring the fact that so many research students from the universities choose the teaching profession, whilst Mr. PALEY YORKE promptly retorted that the greatest difficulty was being found in attracting a sufficient number of men to that profession. Presumably, then, the total number of men being trained for scientific work is insufficient, and in these sophisticated days the probable reason is not far to seek. Neither in the commercial nor in the educational worlds has the scientific worker received the financial recognition which he surely deserves, and if the majority of the research students from the university have chosen the teaching profession, it was a choice of two evils, and not a measure of popularity, nor yet a desire to tread "the primrose path of dalliance" which does not exist. On the commercial side, the scientific worker has in the past too often been regarded as a sort of human slide rule—a useful thing to have about; or as a weird and unnatural being, who knows all sorts of wonderful things except how to make money and sell goods. He is tolerated and even patronised, as a poor relation to whom a post is given out of charity. That attitude is undoubtedly disappearing rapidly, and the war has certainly shown, or should have shown, all those who have any understanding the value of scientific research. We expect, therefore, to find a wider and more generous recognition of the value of the scientific worker; but when young men see that the buying and selling of goods is pre-eminently the way of earning even what may be called a reasonable livelihood they are not likely to be induced to join the ranks of scientific workers either on the industrial or on the educational side. Let us hope that both the education authorities, on the one hand, and the captains of industry on the other, will see their way clearly to offering sufficient financial inducement to attract men to the ranks of scientific workers. Otherwise, the prospects of scientific development—which means industrial development and national development and national prosperity—will be very unfavourable indeed.

Eyestrain in Cinemas.

A REPORT on the above subject has recently been presented to the L.C.C. by a Joint Committee appointed by the Illuminating Engineering Society, on which the Council of British Ophthalmologists, the Physiological Society and the cinema industry were also represented. The Committee also received the assistance of several officers of the L.C.C. The chief question dealt with is that of undue proximity of seats to the screen. This appears to be a source of eyestrain, chiefly on account of the inconvenient upward tilt of the eyes—a condition liable to cause fatigue, especially in young children, who usually occupy the less expensive front seats. The Committee suggest that the "angle of elevation" of vision to the top edge of the pictures should not exceed 35 deg., and a limit is also set to the lateral angle of view to the side edge of the picture. The recommendations are based on observations in a number of cinemas in London, and appear to be moderate and judicious. Other points discussed include the effect of flicker and defects of film or projecting apparatus, and the provision of diffused artificial illumination during the performance. It is pointed out that, by suitable distribution of light, sufficient artificial illumination can be provided without detriment to the appearance of the picture. It is satisfactory to see the cinema industry co-operating in an inquiry of this nature, which, we feel sure, will be to their ultimate benefit by raising the standard of performance in this country.

Low-level Street Lighting.

WE have become so familiar with the idea of lighting streets by means of sources mounted on posts at a relatively high level that other methods are scarcely considered in this country. An interesting installation recently described before the Illuminating Engineering Society in the United States does, however, show that there *are* other possible methods, although in this case the circumstances were exceptional. The street in question is a causeway running along the length of the dam of the Kensico Reservoir in New York State. For some reason, the architectural specifications for the dam would not permit the use of poles. Accordingly the lighting was effected by lamps in panels let into the sides of the parapet, and also units concealed in circular pavilions at the sides of the road. The roadway is approximately 2,200 ft. long and 26 ft. wide, and the parapet lamps are mounted 26½ in. above the road surface. A photograph shows the appearance of the roadway at night regarded from one end. The complete invisibility of the light sources is a pleasing feature. The horizontal illumination along the centre of the road appears to average about 0·06 ft.-candles. The lamps are staggered, and the photograph suggests a somewhat patchy effect on the pavement, although the illumination in the middle of the road seems uniform. No doubt the relatively small width of the road renders possible a method which could hardly be used on wide thoroughfares; but the idea seems to deserve attention as a method of lighting roadways crossing bridges, on terraces, and in similar cases where lamps can be conveniently concealed amidst parapets or other architectural embellishments.

Nitrates from Sumatra.

THE artificial nitrate industry is one of the first which we may expect to see established near water-power developments and away from the coal fields. It requires large quantities of electrical energy at a load factor approaching closely to 100 per cent., and the principal raw material necessary is generously provided by the circumambient atmosphere. The only difficulty is the transport of the finished material, but in many cases this can easily be overcome. It is therefore not surprising to find that many countries remote from districts where natural nitrates are to be found are turning their attention to the employment of hydro-electric power for this purpose. Among the latest of these is Sumatra, where a concession has been granted by the Dutch East Indian Government for the diversion of the Moesi River near the town of Despetch through a short tunnel, and thence into the Indian Ocean a little north of the port of Benkoelin. It is believed that about 150,000 H.P. can be developed at the low cost for turbine plant of £8¼ per kilowatt, while the cost of power per kilowatt-year will be about £1, which seems reasonable enough, even when the high load factor is considered. A start will be made by the erection of a subsidiary station of 50,000 H.P., which it is hoped will be in operation within two years.

The Commissioners and Garden Cities.

THAT certain liveliness which is now becoming manifest with regard to housing also produces another problem for the consideration of the Electricity Commissioners. There seems no reason to doubt that most of the new houses will be fitted with electric light, and where the colony is being built in or near an area where there is already an electricity supply no special difficulty will arise. But there are other cases where matters are not quite so easy. Plans are being prepared for the development of garden cities in what is now the country, and the erection therein of what may be called modern middle class houses presumably well equipped with labour saving and labour preventing devices of which electric lighting and electricity for "other uses" will be the chief. These garden cities are many of them being built at considerable distances from existing electricity supply mains, and in former days we have no doubt the development would have included the erection of a small generating station for supplying the electrical needs of the inhabitants. But to allow this to be done now would be to run contrary to the implied policy of the Electricity Commissioners, a policy which we feel sure is the correct one. In the meantime these colonies will soon be requiring electrical energy. Will they be allowed to erect a temporary station or will they be permitted to form exceptions to the general rule? We shall be interested to see.

Calculation of Antenna Capacity.

Some years ago we published an article by Prof. G. W. O. Howe giving methods for the calculation of capacities of elongated flat-topped antennas, composed of parallel wires, and giving tables and curves making possible the easy determination of the capacities of small antennas of this type. Subsequently Prof. Howe gave similar formulæ for umbrella antenna, and the subject also received attention from Mr. Louis Cohen, while formulæ for elongated parallel wire antennas giving results comparing very closely with those of Prof. Howe were published some time ago by the Bureau of Standards. Unfortunately, the calculations are more or less laborious and are not of general application. It is, therefore, fortunate that Mr. Louis W. Austin has now discovered that the capacity of all antennas not too elongated in shape and with the wires not too widely spaced can be represented by the formula

$$C=(45a+0{\cdot}885\ a/h)\ 10^{-5}$$

Where C is the capacity, a the area and h the mean height. This equation is in reality the sum of the usual expressions for the capacity of a disc in space and of that for a two-plate condenser, disregarding the edge effect. It is also interesting to note that this formula appears to represent the capacity of plate condensers in general for all values of plate separation, provided one of the plates is earthed. This question is of great theoretical and practical importance, and we are glad to learn that Mr. Austin is extending his investigations to a verification of these relations for both circular and elongated plates.

The Work of Parliament.

Parliament has adjourned until October 19th, when an autumn session will open, without advancing the Electricity (Supply) Bill beyond a first reading in the House of Commons. It is, therefore, quite within the bounds of possibility that little further will be heard of this measure this session, and we shall have to wait until next year, or even longer, before this consolidating enactment becomes law. This, we think, is a pity. We ourselves are in favour of a great deal of what this Bill seeks to legalise though there are others who oppose its provisions. But what is required most urgently is not a legalising of this or that policy, but settlement and peace and quiet. For the rest, the session has been barren enough for the engineer and the commercial man. The Mining Industry Bill has become an Act, after the Ministry of Mines had been scotched, as has also the Overseas Trade (Credits and Insurance) Bill, in spite of considerable criticism. A new Profiteering Act has been passed, and the Finance Act has laid an almost overwhelming burden on the industries of the country. An attempt to protect our "key" industries from dumping failed, and the need for economy has not yet been realised. The one bright spot has been the relaxation of control, which we hope to see carried still farther.

The Employment of Ex-Service Men.

The appeal made by Earl Haig on behalf of 190,000 unemployed ex-service men, an appeal which has been supported not only by H.M. the King but by all shades of political and industrial opinion, is one that cannot fail to generate a spark of compassion in the breasts of all those in whom contact with the grindstone of this world has not entirely erased those finer elements which compose all that is best in human nature. The case is a distressing one. Many of these men left good positions to serve their country, to return in shattered health to find their positions filled. Others went straight from school into the fighting forces, to return to find that they had lost five years experience and gained five years in age. It is difficult to know which of these two positions is the harder. But in the dealing with them both the State and the industry have too often forgotten their obligations to those who not so long ago were heroes, and while proffering an empty sympathy have in the stress of present day affairs neglected to give that active help which is the one thing that is sorely needed.

The Reasons for Neglect.

There seem to be two reasons for this which blend together to form one. Employers feel that business is not a charity. The healthiest and most experienced men do the best work. To employ any others is to reduce the efficiency and add to the already heavy expenses of business. Employees, as represented by the Trade Unions, do not feel that they can relax their rules, even on such an occasion, without admitting a principle which may before long undermine their constitutions. The result of this is equally deplorable in both cases, nay it is shameful in a nation which prides itself on the pureness of its ideals, and the extent of its civilisation. This attitude must be changed. For this is no charity, but a duty. As Sir Frederick Milner, than whom no one has done more in this great cause, truly says: "As a nation we are inclined to be both selfish and forgetful, but at the bottom our hearts are in the right place." The first clause is unfortunately too true, we hope that the next few weeks will prove the second equally correct.

Engineers as Directors.

Without a suspicion of vainglory the engineer may justly pride himself on having contributed more than any other section of the population to the expansion of our knowledge and the employment of the methods whereby scientific phenomena are made available for general use. To give examples of this would be to insult our readers' intelligence, but the generality that life, as we understand it at present, without engineering, would come to a standstill, contains more of truth than many other similar fascinating statements, and what is more, loses its verity if a word representing any other form of human activity is substituted for "engineering." It is therefore surprising to find how little that engineering knowledge is taken advantage of in the composition of Boards of Directors and other similar bodies. We do not ask that departmental stores largely devoted to the materialisation of the mysteries of feminine fashion should include an engineer on their boards or that an engineer should be an essential factor in the management of a theatrical combine or a cinematograph trust, though those responsible for the control of such undertakings might do worse than enlist the aid of a man possessing such knowledge, but it does seem in a great degree extraordinary that so many purely engineering concerns should include no engineer among their directors. For while it seems an axiom that no board is complete without a financier, a lawyer, and even a member of one or other of the Houses of Legislature and, we do not doubt before long we may add, a member of the Labour party, yet to include an engineer is to take a step so rare as to brand those doing so with the stigma of originality. We do not seek to enquire why this should be so, but we do think it is a mistake. At a time when knowledge, energy and enterprise are necessary for the development of the electrical engineering industry, to exclude the engineering element from the directorate is to cling to a policy which never had much worth and is now as useless as it is unnecessary.

An Interesting Departure.

The electric accumulator comes into its own at the Irthlingborough iron ore mines of the Ebbw Vale Steel, Iron and Coal Company. These mines were recently officially inaugurated by Lord Ashfield of Southwell, and consist of a bed of iron ore 15 ft. thick and estimated to contain some 45,000,000 tons. To extract this ore, which occurs as a carbonate of iron, of oolithic structure and blue, grey or green in colour, a tunnel has been driven into the hillside. The mine is worked on the pillar and staff system and an electric drilling machine supplied with current from accumulators carried on a special truck at the rear of the machine is used to drill the holes in the face of blasting. The ore is then loaded into 3-ton steel trucks, which are hauled by a 9 h.p. tractor also driven by accumulators to collecting sidings in the tunnel whence they are hauled to the calcining plant by electric locomotives deriving their current from an overhead trolley wire. It should be added that the calcining kilns are charged by electrically operated machinery, and indeed that the fullest use of electrical equipment is made throughout the works. The electrical accumulator should therefore have a great chance of proving its utility under somewhat arduous conditions, a chance that we have no doubt will lead to satisfactory results. Tractors of the kind employed have, of course, been used before and are receiving an ever increasing application. But this is, we believe, the first time accumulators have been used for driving drills in this way, and we shall watch the results of the experiment with interest.

Housing and Transport.

Both those whose business it is to reorganise the housing and those whose business it is to reorganise the transport of this country seem to find it equally difficult to get down to real work. There is a tremendous lot of action and a great deal of energy is obviously being expended, but nothing much of any use is the outcome, and the unbiased onlooker is forcibly reminded of the antics of the ancient gladiator enveloped in a net as he watches the pathetic struggles of those concerned to formulate a scheme that will really produce houses in a reasonable time in the numbers now required, or to arrange for the collection and delivery of goods and the transport of passengers expeditiously, efficiently and cheaply.

A Muddle for Solution.

The whole thing is indeed a muddle out of which we suppose, as is our habit, we shall emerge sooner or later after the expenditure of an amount of energy, time and money out of all proportion to the work done. But while both housing and transport are, taken by themselves, what may be called simple muddles, in their present condition they together form a complex muddle, the solution of which is no less urgent than is the solution of the two separate components which go to make it up. In fact, considered in one way, though it is regrettable that neither muddle shows any real signs at present of being adjusted, it is certainly an advantage that houses have not been built in any great numbers while transport remains in its present parlous condition. The reverse, of course, does not apply.

Improved Transport First.

For, to anyone who considers the housing problem as it presents itself now a days in the neighbourhood of London or any other large town, it is obvious that to provide fresh residences for the growing population houses must be built further and further from the centre of the existing towns; or, in other words, that the area now covered by buildings must be extended. It follows, therefore, that there will be a shifting of the population from the centre to the circumference and a growing need for better transport facilities to bring that population in from its "dormitories" to work each morning and to carry it in the reverse direction each evening. The only way that this tidal flow can be avoided is by the erection of what are usually known as garden cities.

Garden Cities No Solution.

The development of such an idea, however, predicates too great a change in our present arrangements to be effected anyhow but gradually. Nor owing to the magnitude of the work involved does it provide a speedy solution of our present difficulties.

It is therefore most important that along with this presumed erection of multitudinous houses should go schemes for the development of the transport systems of the country.

Electrification a Necessity.

Considered from this point of view the outlook is not rosy. As we pointed out a short time ago, the railways have about reached the limit of the "bread and butter" traffic they can carry, and the only way to provide for the increase in passengers which will certainly follow any great development in housing is by carrying out adequate schemes of electrification. So greatly are we confident that this view is the correct one that we see with the greatest regret the abandonment by the London & South-Western Railway of the proposed extension of their electrified lines, and the delay on the part of the Committee recently appointed by the Ministry of Transport to issue its report. We are glad on the other hand to see that the question has been receiving attention in other quarters and that various proposals have been made to the Light Railways Commissioners for passenger lines to link up the new residential quarters with the business and manufacturing areas.

The Effect of Increased Fares.

The matter is also complicated by the new increase in railway fares. This places a further burden on the householder who is obliged or who prefers to live in the outer districts, and may retard that movement away from the inner districts which is so desirable in the interests of the better health of the population.

A Close Connection.

It is therefore highly important that these two questions of housing and transport should be considered not only separately but in their relation to each other. For urgent though each problem is, it is essential that the solution of transport portion should not be allowed to lag behind that of housing, or we may be landed in worse difficulties than we are at present.

The worst phase of the whole question is that those who would gain most by improved housing and who will suffer most inconvenience by lack of transport facilities are standing in their own light. For there is no doubt one of the obstacles in the way of housing development is the ca'canny policy adopted by workers in the building trades, while a similar policy among workers in other trades is equally delaying improvements on our railways by forcing up prices, retarding delivery and making the raising of capital difficult. It is a great pity that this should be so, but with the workers taking up their present attitude it seems almost too much to hope that more enlightened methods may be adopted in the general as well as in the particular interest.

Reduction in the Temperature of a Wire when Covered with Insulation.

By ALEC. B. EASON.

This article discusses a fact known to some scientists, but perhaps not realised by the ordinary engineer, as it is so contrary to expectations. Considering two cases, one in which a bare wire carries current, and the other in which the same wire is insulated, it is often thought that the bare wire will be the cooler, assuming that the surrounding conditions and current are kept constant. This is a mistaken idea if the wire is small, say less than 5 mm. This point becomes of practical interest if one is considering the likelihood of a wire in a multiple-wire cable (of small gauge wires) fusing under overloads. The wires will, in general, fuse outside the cable in the portions where the wires are fanned out on to connections, assuming that only one or two wires are carrying the overload fusing current. Another result is that a fine wire resistance may remain cooler if covered with insulation than if kept bare. The physical reason for this fact is that the *surface resistivity—i.e.*, the difference of temperature between the hot wire or hot insulation and the surrounding cool air required to transmit unit amount of heat per unit area (this is denoted by K')—is very considerable, unless the body is in a forced draught, and the bigger the surface the less will be the temperature difference to transmit a fixed amount of heat.

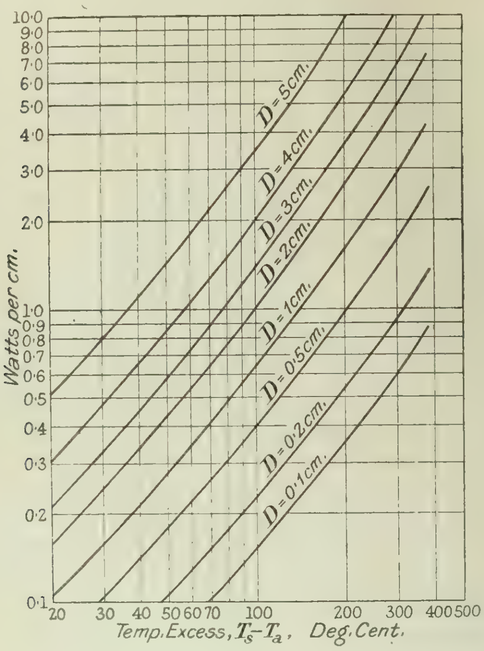

FIG. 1.

The fact that bare wire is usually hotter than insulated wire can be proved simply in the following manner: Take some cotton, rubber or silk-covered wire about 23 S.W.G., and make a circuit of (*a*) length of bare wire, (*b*) a length of single insulated wire, (*c*) a length of twisted insulated wire, and (*d*) a coil of insulated wire. Put 30, 40 or 50 amperes through the series; usually the bare wire will fuse and the others remain only charred. If the coil was very tightly wound, and each wire of the pair carried the current, the wire might fuse in the coil; but if only one wire carries current in the coil, the wire will probably fuse in the bare portion.

The following example will give some idea of the temperatures in bare and insulated wires. Suppose a bare copper wire 0·1 cm. in diameter lies in still air and carries a current of 42·5 amperes, its temperature will be about 400°C.; if the wire is now covered with insulation 0·2 cm. thick, of such material that its *thermal resistivity* (which is denoted by K, the reciprocal of its thermal conductivity) is 300°C., so that the external diameter is 0·5 cm., the temperature will be about 280°C., and the outside temperature of the insulation will be about 180°C. These temperatures are approximate only. (K= centigrade degrees required to drive 1 watt through a centimetre cube of the insulation).

The reason for the reduction of the wire temperature can be theoretically demonstrated as follows: We wish to find the expression for the temperature of the wire (denoted by T_c) in relation to the temperature of the air (denoted by T_a). There is a fall of temperature between the wire and the outside surface of the insulation ($=T_c-T_s$) and a fall of temperature between the insulation and the air ($=T_s-T_a$). The magnitude of the first portion is given by

$$T_c-T_s=\frac{WK\log_e(D/d)}{2\pi} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

T_c = the temperature of the wire in degrees Centigrade.

T_s = the outside temperature of the insulation in degrees Centigrade.

W = the watts conducted through the insulation per centimetre length of the cable.

K = the thermal resistivity in degrees Centigrade.

D = the outside diameter of the insulation in centimetres.

d = the diameter of the wire in centimetres.

The magnitude of the second portion of the fall of temperature—viz., T_s-T_a—is found from the equation

$$\text{Watts emitted from the hot surface}=\pi Dk'(T_s-T_a) \quad . \quad (2)$$

where k' is a coefficient giving the *average amount* of watts emitted per 1°C. for the range of temperature T_s to T_a for the particular size of cable being considered. k' is not a constant independent of T_s and of D : K', the *surface resistivity*, $=1/k'$. From a scrutiny of the reports upon the emission of heat from wires, it seems that the rate of heat loss in still air per centimetre length of a cylindrical body can be put

$$\text{Watts}=AD(T_s-T_a)=0{\cdot}0029\,D^{0{\cdot}6}(T_s-T_a)^{1{\cdot}18} \quad . \quad . \quad (3)$$

The values of A, n and p are approximate. For values, see Fig. 1. The temperature excess of the wire above the air is $(T_c-T_s)+(T_s-T_a)$; the later term is often greatly in excess of the former, and it can be reduced considerably by increasing D; the former term may be only slightly increased by such increase in D, and thus the total excess of temperature can be reduced by increasing D. The values of K', the apparent surface resistivity per unit area, if the law just mentioned is

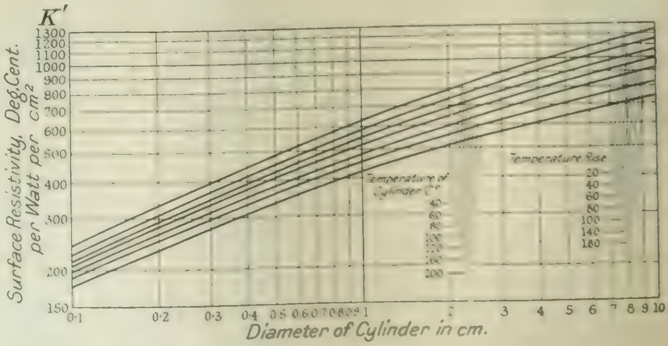

FIG. 2.

the correct one, vary as shown in Fig. 2, and are found from the equations

$$\text{Watts}=\pi D(T_s-T_a)/K'=0{\cdot}0029D^{0\cdot6}(T_s-T_a)^{1\cdot18} \quad . \quad . \quad (4)$$

$$K'=343\pi D^{0\cdot4}(T_s-T_a)^{0\cdot18}. \quad . \quad . \quad (5)$$

The values of K' given by Hirobe, Melsom and Booth, &c. (*see* bibliography attached), hold quite well for certain size cables, but should not be used indiscriminately.

k'=watts emitted per square centimetre per 1°C.
K'=Centigrade degrees per watt per square centimetre.

	k'	K'
Separator rubber	0·00270	371
Jacket rubber	0·00235	425
Vulcanised rubber	0·00236	424
Cotton tape	0·00232	432
Cotton braid, good	0·00215	465
Cotton braid, poor	0·00217	460
Lead	0·00145	690
Lead	0·000875	1,140
Lead	0·001540	650
Rubber, V.I.R.	0·001080	928
Lead, ordinary	0·00081	1,220
Lead, painted black	0·00110	905
Cotton covering	0·00129	770
Steel braided armour	0·00155	645
Lead	0·00083	1,210
Lead	0·00110	905

The scientific fact of the reduction of temperature arising by covering wires with insulation has been dealt with by Porter (" Phil. Mag.," Vol. XX., p. 511, 1910), Russell (" Phil. Mag.," Vol. XX., p. 729, 1910), Melsom and Booth, who follow Forbes (" Jour." Inst. Elec. Eng., Vol. XLVII., p. 728, 1911). Porter, Forbes and Booth assume that the difference of temperature between the surface of the insulation and the air—T_s-T_a—is directly proportional to the watts emitted, and inversely proportional to the diameter. This would be true if the surface resistivity K', by which is meant the Centigrade degrees required to transmit 1 watt per second per square centimetre from the hot body to the cold air, were a constant, independent of the size of the body and of the difference of temperature between the body and the air. K' is the reciprocal of the watts emitted per 1°C.; and the watts emitted per 1°C. will not be the same if the hot body is at 40°C. with air at 20°C., and if the hot body is 100°C. and the air at 20°C. The watts emitted per 1°C. in the latter case will exceed those emitted in the former case. K' also varies with the size of the body; the heat emitted per unit area is not the same for a 1 mm. wire and for a 5 cm. (2 in.) pipe.

Returning to Porter's theory, if K' is assumed to be independent of T_s-T_a and of D, the minimum value of T_c-T_a is given when $D=2K'/K$. Porter then gives the following values of D, choosing K'=800°C. for various insulating materials; thus, glass 16·2 cm., rubber 2·6 cm., paper 2·0 cm., silk 1·4 cm. The factor d, giving the diameter of the wire carrying the current, does not occur in the equation for D, and therefore it is immaterial what size wire is carrying the current when one is simply trying to determine the minimum temperature with various thicknesses of insulation for a particular wire. The size of wire will affect the value of the minimum temperature; but any wire covered with silk until the outside diameter of the cable was 1·4 cm. would be cooler than such wire bare or covered with silk, so that the outside diameter was less than 1·4 cm., *provided that* (1) Porter's assumption were true and (2) the wire of cable was in still air. If the wire is in a draught of air, the surface resistivity K' will be considerably reduced, and the diameter D to give minimum temperature rise will be reduced.

Now let us find the value for D to give the minimum rise, knowing that K' depends on both T_s and on D.

$$T_c-T_a=(T_c-T_s)+(T_s-T_a) \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$=\frac{WK}{2\pi}\log\;(D/d)+\left(\frac{W}{AD^m}\right)^{1/p}. \quad . \quad . \quad . \quad (7)$$

After differentiating this with regard to D, we get a minimum T_c when

$$D=\frac{(W)^{(1-p)/m}}{(A)^{1/m}}\left(\frac{2\pi}{K}\cdot\frac{m}{p}\right)^{p/m}=\left(\frac{447}{K}\right)^2\frac{}{W^{0\cdot3}}. \quad . \quad . \quad (8)$$

Numerical values of D for particular cases are as follows:—

When W= 0·01, 0·10, 1·0, 10·0 watts per cm.
When K=1000, D=1·0, 0·5, 0·25, 0·13 cm.
When K=500, D=4·0, 2·0, 1·0, 0·50 cm.

The probable value of the watts generated in the wire can be determined when the current is known and the resistance of the wire at T_c is known. Even though the watts are not known accurately, the likely value of D can be found, as W only enters as $W^{0\cdot3}$.

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[Copies of the undermentioned works can be had from THE ELECTRICIAN Offices, on receipt of published price, plus postage.]

" Organisation of Industrial Scientific Research." By C. E. Kenneth Mees, D.Sc. (London: Hill Publishing Co.) Pp. ix.+175. 12s. net.

" The Elements of Electro-Technics." By A. P. Young. (London: Sir Isaac Pitman & Sons.) Pp. viii.+348. 7s. 6d. net.

" Steam Turbines." By J. A. Moyer. (London: Chapman & Hall.) Pp. xi.+496. 4th Edition. 21s. net.

" The How and Why of Radio Apparatus." By H. W. Secor (New York: Experimenter Publishing Company.) Pp. 160. $1.75.

" Elements of Radiotelegraphy." By E. W. Stone. (London: Crosby, Lockwood & Son.) Pp. vii.+267.

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" Space, Time & Gravitation," By A. S. Eddington. (London: Cambridge University Press.) Pp. vii.+218. 15s. net.

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* This is not the title of the Paper but refers to its contents.

A Powerful Three-Phase Locomotive.

Interesting Design for use on Italian State Railways.

Some few years ago the Italian State Railways placed an order with the Tecnomasio Italiano Brown Boveri of Milan for eighteen large locomotives for use on lines which were nearly level, but had numerous curves. The war retarded the construction of these locomotives, but all of them have now been delivered.

The locomotives had to conform to the following conditions: Line voltage, 3,000 to 3,700; frequency, 15 to 17; number of traction motors, 2; number of driving wheels (coupled), 6; number of bogie wheels, 8; diameter of driving wheels, 1,630 mm.; diameter of bogie wheels, 960 mm.

The motors must be capable of developing, at the circumference of the driving wheels, the following tractive efforts for one hour with a voltage of 3,300 and a frequency of 16.7, and with four different speeds:

Synchronous speed km./hr.	Tractive effort kg.	Power P_1 H.P.	Power P_2 H.P.
37.5	9,000	1,250	690
50	8,000	1,470	[illegible]
75	7,350	2,040	1,130
100	6,000	2,220	1,235

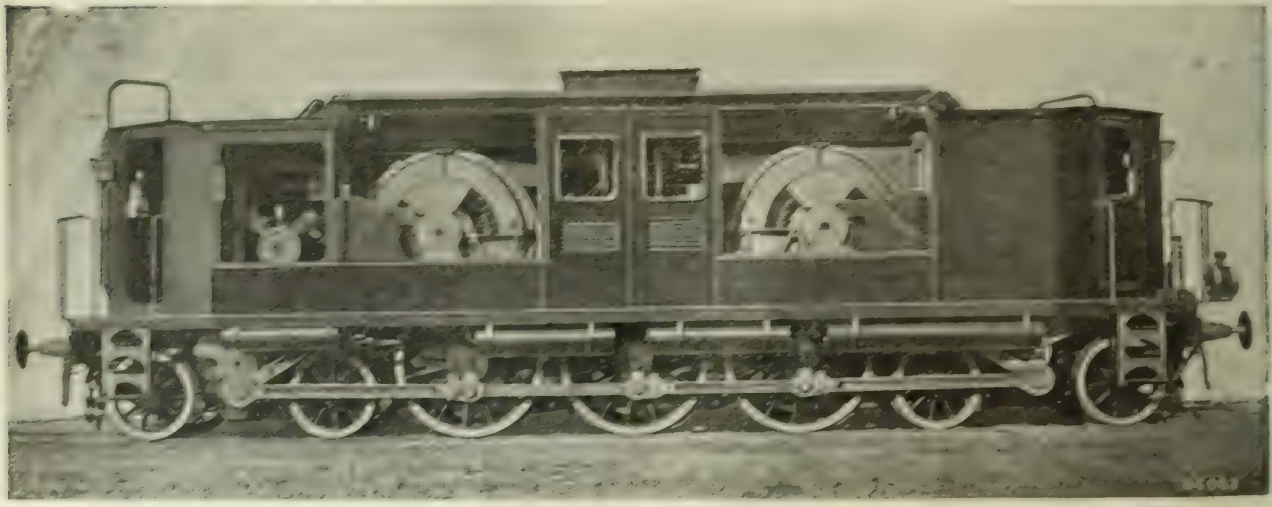

FIG. 1.—GENERAL VIEW OF TYPE E 331 THREE-PHASE LOCOMOTIVE FOR ITALIAN STATE RAILWAYS.

The value P_1 gives the total power developed at the rim of the driving wheels, and P_2 the shaft output of each motor, assuming the efficiency of the transmission to be 90 per cent.

In addition, the locomotives have to be capable of developing at starting a traction effort of 12,000 kg. at the rim of the wheels, representing, with an adhesion coefficient of 0.25, the maximum that can be developed on good rails without slipping.

Further, each locomotive has to be able to: (1) Accelerate a 330-ton* train† up a slope of 12 in 1,000, with a mean acceleration of 0.052 m./sec.², from rest to a speed of 75 km./hour. Allowing 12 per cent. for rotary inertia, the corresponding traction effort is 6,300 kg. when v=0, and 6,250 kg. when v=75 km./hour. (2) Accelerate a 163-ton train† from rest to a speed of 100 km./hour up a slope of 3.5 in 1,000 in 180 seconds. The corresponding acceleration is 0.154 m./sec.², and the tractive effort 4,360 kg. at starting and 3,470 kg. at 100 km./hr. (3) Effect, at intervals of three minutes, 20 successive accelerations of a 335-ton* train† up to a speed of 37.5 km./hour on a track having curves of 180 m. radius, and gradients not exceeding 3 in 1,000, without the temperature rise of the motors or any part of the equipment exceeding 75°C. above the surrounding air. Finally, a condition which has influenced in various points the construction of the locomotive, each locomotive, with new tyres 1,630 mm. diameter, must work satisfactorily in parallel with another locomotive coupled to the same load and having its tyres worn down to a diameter of 1,575 mm.

GENERAL DETAILS.

The locomotive is shown in Fig. 1, and is of the 4-6-4 type. The weight of the mechanical part is 70 tons, the electrical part weighing about 42 tons. The load carried by each driving axle is 16.5 tons, the total adhesive weight being 49.5 tons. The locomotive is equipped with an automatic and adjustable Westinghouse compressed air brake, acting on all the axles. There are in all four brake cylinders, one to each bogie, and two for the drivers; there are two brake blocks to each axle, making a total of 14 for the locomotive. The two air reservoirs are disposed laterally under the body of the locomotive. The braking effort on the three driving axles, for a mean pressure of 3.5 kg./cm.² in the cylinder, reaches 60 per cent. of the adhesive weight, whilst on the bogie axles the braking effort is 35 per cent. of the weight on the bogies.

ELECTRICAL EQUIPMENT.

In order to obtain four running speeds, motors with wound rotors have been adopted, for working in parallel or in cascade. The stator and rotor windings are symmetrical, and, at a frequency of 16.7 the following combinations are possible:—

V. in km./hr.	Number of poles.	Connection of motors.	Synchronous speed R.P.M.
37.5	8	In cascade	125
50	6	In cascade.	167
75	8	In parallel	250
100	6	In parallel	333

In the cascade connection the rotors are connected electrically, two conductors being crossed to maintain the same direction of rotation for the two motors, and the starting resistance, in both cases connected solely to the terminals of the second motor. In the parallel connection of the motors, i.e., at 75 and at 100 km./hour, the resistances are connected to the rotor terminals, the same resistance serving for the two machines.

The change from one speed to the next is effected by modifying the stator and rotor connections by means of special switches. The winding of each phase is divided into six portions, each with two ends, making a total of 36 leads coming from the stator to a switch, the first position of which corresponds to the first and third speeds, and the second position to the two other speeds. For the rotor, a pneumatically-operated switch mounted concentrically on the shaft and rotating with the machine is employed. The construction of this pole-changing switch can be seen from Fig. 4 which gives a sectional view of the motor. Both stator and rotor slots are semi-closed, and the rotor slots are oblique in order to avoid the production of tooth ripples in the wave forms. With the exception of two openings for adjusting the brushes and the pole-changing device, the motors are totally enclosed and artificially ventilated.

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* Metric tons of 1,000 kg.—throughout.

† Excluding the weight of the locomotive.

The performance curves of the motors, showing their operation also as asynchronous generators, are given in Fig. 2

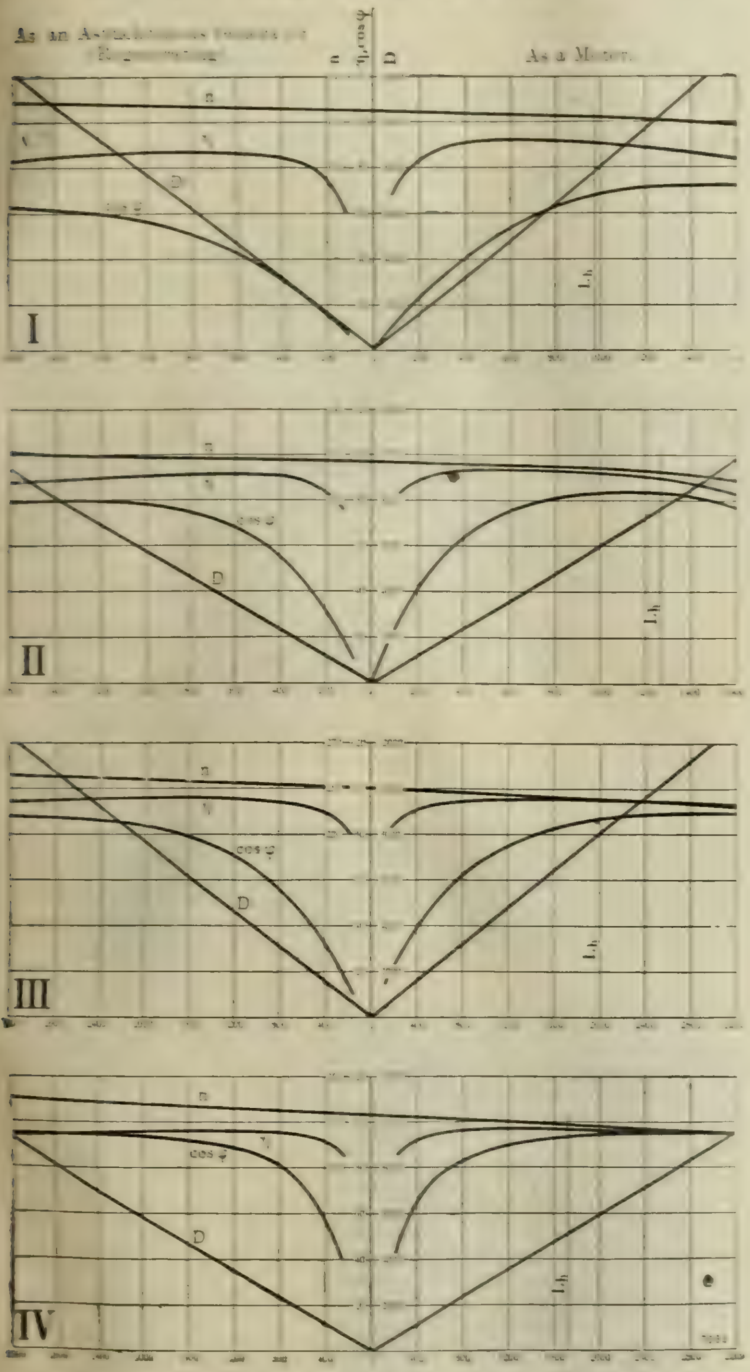

Fig. 2.—Characteristic Curves of Motors.

Kilowatts of the Two Motors, at the Shaft.

I. 8 pole connections 2 motors in cascade n = Revs. per min.
II 6 .. .. .. η = Efficiency per cent.
III 8 .. .. parallel cos φ = Power factor.
IV 6 .. .. .. D = Torque in kg.-m.
L_h = One hour rating of the two motors in kilowatts.

Main Circuit-Breaker.

The main double-pole, oil-immersed circuit-breaker is shown in Fig. 3; it is provided with no-voltage and overload releases, and is remote controlled by compressed air. The breaker can also be tripped by the motorman pressing a button and opening the circuit of the no-voltage relay.

The reverser for changing the direction of rotation of the motors, changes over the connections of two of the stator phases. A special switch, the cascade commutator, connects the starting resistances to the stator of the second motor, or to the two rotors, and makes the necessary connections for cascade or parallel working. In addition, there is a switch to connect the stator windings of the second motor in star or mesh, according to the method of connecting the motor to the resistances.

Starting Resistances.

The starting resistances are made of corrugated metallic strip and are cooled continuously by the fans ventilating the traction motors. For cascade working the resistances are connected in star, and for parallel working in mesh. Each group consists of eleven notches, the first six of which correspond to the cutting out of equal resistances in the three phases, covering a wide range of regulation; these notches are only used at starting. The remaining notches correspond to five resistance elements, short-circuited irregularly in the various phases. The subdivision necessary for the resistance elements is by this means reduced without the passage from one notch to the next being too abrupt. The very fine regulation obtained on these last notches permits of two locomotives being used in parallel on the same train, the slip of the motors of the more speedy locomotive being thus adjusted by working on one of these last five notches. Two locomotives having a difference of 55 mm. in the diameters of the driving wheels can thus be coupled so as to develop approximately the same power.

The construction of the various commutators or switches is on the lines of the ordinary controller with the exception of the starting commutator which is built up of contactors operated by means of cams. With the exception of the resistance combiner (for connecting the resistance in star or mesh), and the rotor switches for changing the number of poles of the rotor winding, all the various switching apparatus is oil-immersed, and pneumatically operated.

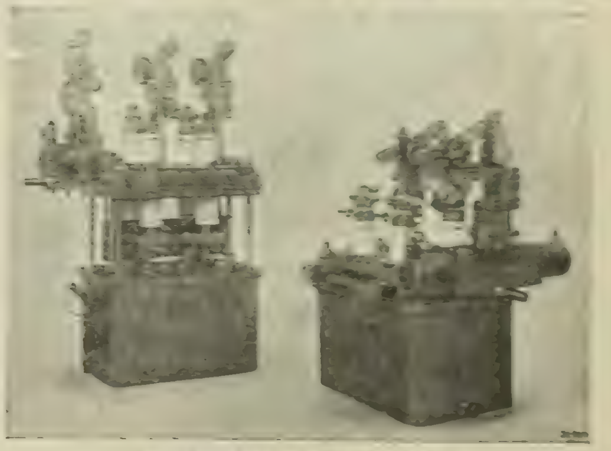

Fig. 3.—Main Circuit-breaker.

Control System

The chief characteristic of these locomotives is thus that all the apparatus, including the starting apparatus, for obtaining the various speeds, is operated by means of compressed air. The two master controllers also only contain pneumatic parts, and no electrical connections. The compressed air system has thus been applied on a greater scale than has been usual up to the present. The controller is shown in Fig. 5, and consists, in principle, of two systems of cams, one of which (the speed controller) establishes the four running speeds—that is to say, operates the pole-changing devices on the stators and rotors, the cascade commutator, the resistance combiner, and the star-delta switch of the second motor—whilst the other system (the starting controller), operates the starting switch or commutator. Each of these systems consists of a number of cams which, by means of levers, operate valves connecting the cylinders operating the various apparatus to the main compressed air cylinder, or to the outside air, as may be required.

The starting commutator is operated by means of three cylinders acting on a rotating shaft by means of three cranks at 120 deg. The starting controller, having 12 positions, including position 0, this shaft rotates four times when the controller handle is turned from position 0 to position 11, a chain drive being used to effect the necessary reduction. This shaft carries a cam operating the pneumatic valve of the main circuit-breaker, so that the latter is always open for the 0 position of the controller, and closed for all other positions, for which positions it can only be opened by the no-voltage or overload releases coming into action, or by the motorman tripping the breaker as before mentioned.

The Commutator Details.

At the centre of the case containing the commutator is the commutator itself, while to the left is the pneumatic operating motor, reactance coils and the main circuit-breaker; and to the right, the isolating links and the lightning arresters. It may be remarked that in passing from one speed to the next, it is not necessary to move the handle backwards, but it can be placed directly from the 11 to the 0 position, and thus a certain loss of time in changing the speed is avoided. Various mechanical and electrical interlocking arrangements are used to safeguard the apparatus, so that, for example, the speed controller can only be moved when the starting controller is in the 0 position, and the starting controller can only be moved when the speed controller is on one of the notches corresponding to 37, 50, 75 or 100 km./hour, and not when it is on the 0 position.

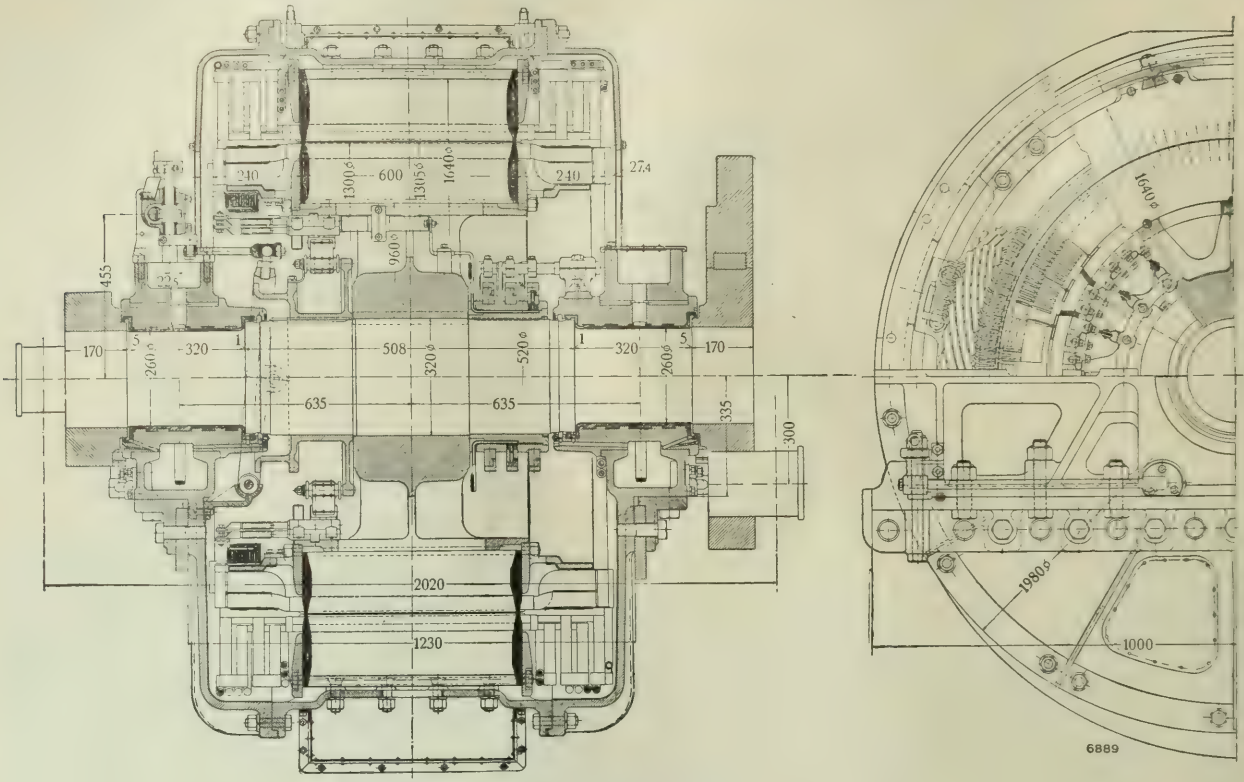

Fig. 4.—Cross-section of Traction Motor.

The auxiliary circuits are fed from two 20 k.v.a. 3,000/110, 16·7 frequency transformers. These two transformers supply the energy for the two ventilating units, the two compressors, as well as for lighting and heating, and for the electrical interlocking circuits.

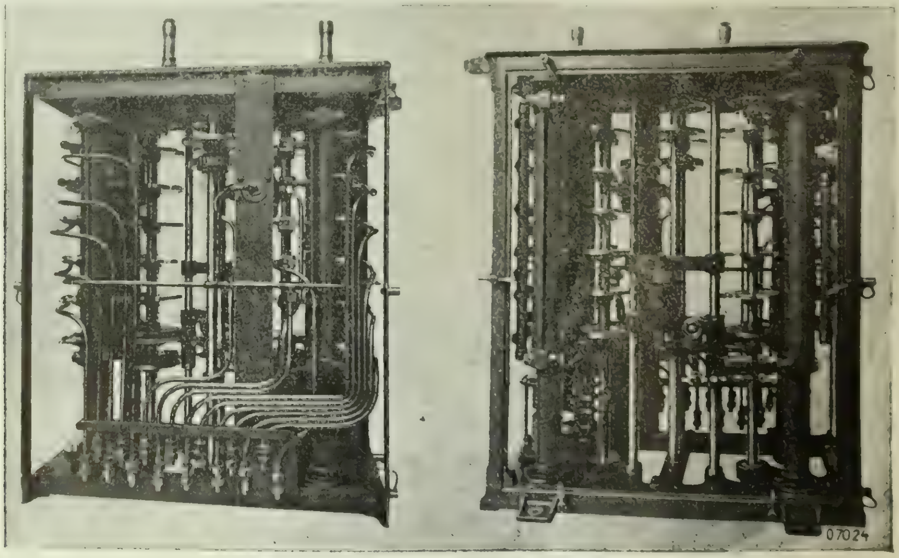

Fig. 5.—Controller with Cover Removed.

All the starting tests mentioned at the beginning of this article have been carried out after the delivery of the locomotives and have given good results, neither the motors nor the other apparatus having reached the temperature rise permitted by the specification. The metallic resistances, on account of their great sub-division, and of the two methods of grouping them, have enabled as smooth an acceleration to be obtained as in the case of the liquid resistances used on many of the locomotives of the Italian State Railways, and from the point of view of weight and constancy of ohmic resistance and of the facility of effecting starts at very short intervals, they are even more advantageous. So far as the length of the starting period is concerned, the metallic resistances have also given complete satisfaction, a 335+92=427 ton-train having been accelerated in 250 seconds, instead of the maximum value of 500 seconds allowed by the specification. Experiments with two locomotives in parallel on the same load have also given very satisfactory results, several tests for acceleration and continuous running having been carried out on a slope of 12 in 1,000 with passenger and goods trains weighing 374+184 tons and 600+184 tons respectively. The passenger trains operated at a maximum speed of 100, and the goods at 50 km./hour.

We have to thank Messrs. Brown, Boveri & Company for providing us with the information on which this article is based, and for the loan of the blocks illustrating it

Duplex Wireless Telephony.

Some Experiments on Its Application to Aircraft.*

By Captain P. P. ECKERSLEY.

This Paper deals with experiments on duplex wireless telephony for aircraft carried out at the Wireless Experimental Establishment of the Royal Air Force. With true duplex wireless telephony sets the operator should be able to send and receive simultaneously exactly as with the ordinary wired telephone. Interchange of thought between two participants in a telephone conversation is far more rapid if one conversant can at any moment interrupt the other. Otherwise a conversation loses coherence and the transmission of long messages may often entail irksome repeats. Duplex wireless telephony has, therefore, great practical value inasmuch as it obviates the necessity of using switches and enables unskilled communicants to be as readily put into touch with one another in wire telephony.

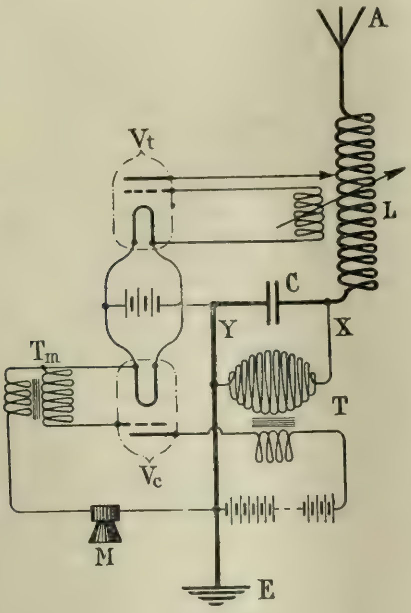

Fig. 1.

In order that waves shall carry over long distances, the amplitude of the aerial currents producing them must be large (possibly 10^6 times as great) compared with the currents which can be detected by the receivers. The problem is to protect the receiver, without detriment to its sensitivity, from these oscillations. A number of solutions have been suggested. For use on the ground two aerials, one for transmission and one for reception, may be employed placed at right angles and spaced more than one-quarter wave-length apart. Two different wave-lengths are then used. This is obviously not applicable to aircraft. Frames at right angles have been suggested, but it is doubtful whether this is practicable on aircraft. Balancing systems with two aerials, one receiving and the other transmitting, have had some success for ground work, but here again on aeroplanes such arrangements might not answer.

In another general method the earth path is split. All the transmitter currents pass to earth through one path and all the received currents through the other. The receiver can be coupled to the path, which is free from the transmitter oscillations and is only influenced by the received energy. This system presupposes two wave-lengths, the action depending upon the proper choice of the impedances of the two paths. One or two aerials may be used.

If perfect protection is afforded the receiver, simultaneous reception and transmission is possible. In order to overcome the criticality of the balancing system, a compromise is possible wherein the transmitter only oscillates when the operator is actually speaking, the receiver being meanwhile paralysed. One aerial and one wave-length is then theoretically possible. This constitutes no more than an automatic switching system; no "chipping-in" is possible, but the switch is dispensed with.

If such "quiescent aerial" transmitters are arranged with a small permanent oscillation flowing which is increased sympathetically with the voice, they are termed "augmented oscillation transmitters" and give, with very simple circuits, good speech. Thus such transmitters can be arranged with a receiver which is protected only from the small permanent oscillations necessary for good speech. "Chipping-in" is impossible except over short ranges, but the arrangement in the transmitter circuits are simple, and, as the receiver is given more and more protection, it becomes more and more a true duplex circuit.

Automatic Duplex Wireless Telephony Systems.

(a) *Quiescent Aerial Transmitters.*—In the first method embodied, the receiver was not specially protected but the powerful oscillations necessary for transmission were only created when actually speaking. This automatic has little superiority over switching systems, but its behaviour gives insight into methods of telephony control generally.

(b) *Voice Controlled High-tension Transmitter.*—This type of quiescent aerial transmitter is a direct outcome of the choke control system described by Major Prince. Instead of modulating, by the voice, the intensity of a continuous source of power supplied to the oscillator, as with choke control, power is only supplied to the oscillator when speaking, and is governed in intensity by the microphone. Thus, only when speaking are oscillations generated.

Fig. 1 shows the connections for producing oscillations in the aerial circuit *ALCE*. Only when a difference of potential is applied between the points *X* and *Y* will the system generate oscillations, proportional in amplitude to the voltage between these points.

In the latest arrangement, the voltage is amplified by the control valve V_c and the transformer *T*. If the microphone *M* is spoken into, the grid of the valve V_c varies in potential owing to the action of the transformer T_m, causing larger energy changes in the anode circuit, which results in amplified voltage variations across the secondary of *T*, and hence the appearance of proportional oscillations in the high-frequency circuits *ALCE*.

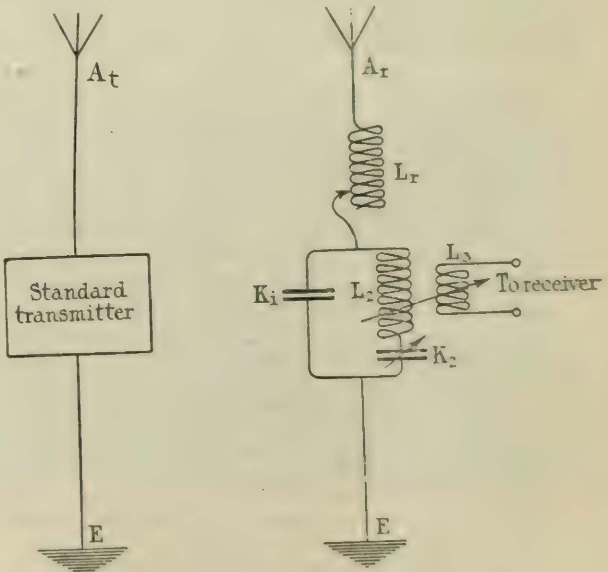

Fig. 2.

The potential variations across *T* constitute the sole source of voltage supply to the oscillator, and high-frequency currents therefore will only be created when speaking.

(c) *Theories to Explain Poor Speech-quality in the Quiescent Aerial Transmitter.*—The quality of the radiated speech was much worse than that given by transmitters using standard methods of control. It lacked mellow roundness, was sometimes broken and peaky, and was very variable. Even at its best it was never good enough for practical needs. The application of a small permanent voltage in series with the secondary of the transformer *T*, just enough to keep the system oscillating very feebly, at once completely changed the speech quality from bad to good.

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* Abstract of a Paper read before the Institution of Electrical Engineers.

Considerations of Power Input.—It has been suggested that quiescent aerial systems failed because the power input was not directly proportional to the voltage input. The relationship is represented by $P=KV^2$. But assuming the intensity of the received speech to be proportional to the transmitted power, a strict proportionality should be maintained and the received speech should faithfully represent the input voltage intensities, which in their turn are directly governed by the voice.

Time-lag Theory.—A time interval, amounting in extreme cases to 3/100ths of a second, elapses between the instant of application of the voltage to the high-tension terminals of a valve oscillation generator, and the time of appearance of oscillations in the high-frequency circuits. This interval is reduced the greater the intensity of the applied E.M.F. The oscillations persist an appreciable time after the withdrawal of the voltage pulse which created them.

Thus in the case of the voice-applied high-tension quiescent aerial system, the initial speech consonants, which produce relatively high-frequency and small-intensity voltage variations in the control circuits, may produce no corresponding high-frequency oscillations, since their time of endurance is small compared with the total time lag of the oscillatory circuits. Preceding consonants are the most important factors in determining good speech quality, and their loss alone is sufficient to make articulation imperfect. The application of the small extra voltage which maintains a small permanent oscillation in the high-frequency circuits may not only minimise the lag but make it constant for different intensities of applied voltage.

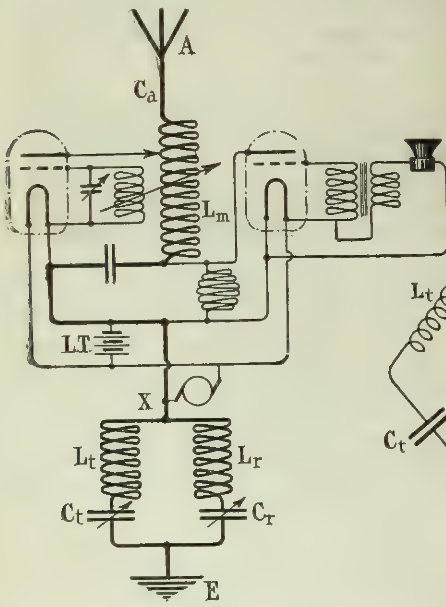


Fig. 3A.

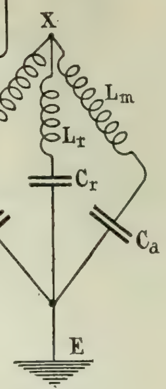


Fig. 3B.

(*d*) *Excited Grid Systems.*—After the declaration of the Armistice, the author experimented with a circuit which it was hoped would minimise the lag and open up the possibilities of quiescent aerial systems once more. The lag in the valve type of oscillation generator is probably due to the time taken for the energy to build up between the grid and the anode coils. Therefore, the grid voltage of the power valve was continuously varied in potential from an outside source at a period corresponding to the natural period of the aerial circuit.

Such a circuit gave good speech, but was found to be not a truly quiescent aerial transmitter, inasmuch as a continuous oscillation was set up in the aerial due to the capacity effect between the grid and anode of the power valve. When this effect was reduced to zero the speech quality became worse, although it was an improvement on any other tried system. Speech quality improved with brighter filaments.

Evidently the quiescent aerial system fails owing to the non-instantaneous response of the high-frequency system to the fleeting high-tension pulses applied to it; there is a persistence of oscillation after the high-tension pulses have ceased. This trouble may be overcome by maintaining a small permanent oscillation which is increased in intensity according to the intensity of the voice. Any circuits which are devised to make quiescent aerial transmitters must be arranged to overcome the lag effect. Even if circuits are so devised, they will not materially help the progress towards true duplex systems, since the question of protection of the receiver still remains.

True Duplex Wireless Telephony Systems.

(*a*) *Protected Receiver Circuits.*—In a protected receiver the transmitter, which may be of any known type based upon the steady continuous production of continuous waves is controlled in amplitude by the voice. The problem is to ensure that the receiver shall not suffer any great loss of sensitivity due to the persistent presence of the large alternating currents generated by the transmitter connected to an aerial very close to the receiving aerial or to a common aerial.

(*b*) *Rejector Circuit. Two Aerials Two Wave-lengths.*—The first suggested method embodied a standard type of telephone transmitter oscillating continuously and connected to an aerial separated by only a few feet from the receiving aerial. The received wave-length differs from the transmitted wave. All that is necessary is to make an extremely selective receiver, which will be influenced by disturbances of one single frequency and by no others.

Fig. 2 shows an aerial A_t connected to a standard type of transmitter earthed at E, and this constitutes the sending system wherein there are no departures from standard practice.

Let the wave-length emitted be λt.

The receiving system consists of a second aerial A_R, which, together with L_R, is tuned to a wave-length λR. A closed circuit $K_1L_2K_2$ is electrostatically coupled to the aerial system by the condenser K_1, and is also tuned by the adjustment of the condenser K_1 to λR. When, therefore, disturbances of a wave-length λR fall upon the aerial the closed circuit will be set in oscillation.

A safe value for K_1 is 0·003 mfd. Using an aerial of capacity 0·00025 mfd. K_2 can be made to vary between 0·0005 mfd. and 0·001 mfd., depending upon the range of wave-lengths desired, and L_2 is wound to suit the value of the received wave-length. Without the inductance L_R the arrangement exactly corresponds to the well-known "flywheel" circuit which may be used for the réception of long waves.

An attachment was made up for experimental form for demonstration and test purposes, and designed for wave-lengths between 400 and 500, or 650 and 750 metres. The circuit will work at a difference of 20 per cent. between the transmitted and received waves.

The transmitters used were the standard Air Force aircraft wireless telephones and on the average gave 0·4 ampere in the transmitting aerial. The aerials were carried on a common spreader 4 ft. across. The forced oscillations in the receiving aerial amounted to about 40 milli-amperes and nearly 1 milli-ampere flowed through the path K_2L_2 coupled to the receiver.

The receiver picked up very little radiated high-frequency speech variations from the nearby transmitter, but the interaction of the low-frequency circuits gave a comfortable intensity in the head receivers. The electrical overhearing of one's own speech in an aeroplane keeps an automatic check on speech quality, and approximates to conditions of ordinary conversation where one can hear one's own voice. Many successful ground demonstrations were given with these attachments, and all who used it were impressed with the possibilities of true duplex working.

(*c*) *Divided Earth Circuits. One Aerial and Two Wave-lengths.*—This circuit is simple in conception and lends itself very readily for application to aircraft, as it uses one common aerial for both sending and receiving.

The connections are shown in Figs. 3A and 3B. X in Fig. 3A is the earth terminal of a standard type of wireless telephone transmitter. Instead of connecting this point directly to earth the earth lead is split into two parallel paths, each containing capacity and inductance. The underlying idea of the circuit is to arrange for all the transmitter current to flow through one path while all the received current flows through the other. The receiver can then be coupled to L_r without being affected by the transmitter.

To achieve this end, the path L_t C_t is tuned to the transmitted wave-length and L_r C_r together with the common aerial circuit is tuned to a different received wave-length. The point X is furthermore arranged to be a node of potential as regards the voltage distribution of the transmitting system, so that there is no tendency for current to be forced into the path L_r C_r.

Let C_a be the capacity of the aerial and L the common aerial inductance. If we suppose the path L_r C_r to be disconnected, then the transmitter currents will flow through L_t C_t. If L_t C_t is made equal to L_m C_a the wave-length emitted will be the same as if X were directly connected to earth. Furthermore, the point X will be node of potential since the system as a whole forms an alternating-current bridge, which is balanced, making the points X and E of the same potential when $C_aL_m=C_tL_t$. A condition of balance is therefore obtained by adjusting the radiated wave-length with the path $L_t C_t$ added to be the same as when X is directly connected to earth. If now $L_r C_r$ is connected in parallel with $L_t C_t$ there is no insurance against the possibility of the balance being upset, as the whole circuit has two degrees of freedom and may oscillate with a period governed by L_t C_t or L_r C_r or a combination of both. It is, therefore, necessary to prevent the valve oscillation generator from producing oscillations other than those of a definite frequency governed by the values of C_a, L_m L_t and C_t and corresponding to the natural time period of the aerial in series with L_m, L_t and C_t.

This can be done by introducing a coupled circuit between L_m and the oscillation generator, or by tuning the reaction in the power valve circuits. Thus, by limiting the degrees of freedom of the oscillator to one, the connection of L_r C_r between two points X and E, of the same potential, cannot disturb the system and no current will be forced in the path L^r C^r.

Using ½ ampere in the aerial and tuned stoppers the two wavelengths could be brought within 10 per cent. of one another; without stoppers this had to be increased to 20 per cent.

The divided earth system has been successfully demonstrated to numbers of officers in the Air Force, but has not up to now been used in the air. It has the advantages of employing standard receivers and transmitters, using only an attachment to convert these from switching circuits to true duplex circuits.

PARTIAL DUPLEX.

(*a*) *Combination of Foregoing Circuits.*—A truly quiescent aerial transmitter with the addition of some arrangement to maintain a very small permanent oscillation will transmit good speech quality. In this case a very small oscillation is permanently flowing in the transmitter and the speech voltages are arranged to increase the intensity of these oscillations according to the intensity of the voice. This may be called an "augmented oscillation transmitter."

If such a transmitter is used in combination with a receiver, protected wholly from the small permanent oscillation, but with imperfect protection for greater amplitude, partial duplex is possible. It will be a very simple matter to protect the receiver against the effects of the small permanent oscillation, but the protection may not be so effective actually when speaking, so that quick chipping-in and true duplex could not be possible.

Systems such as this, however, would represent a considerable advance beyond present switch-operated arrangements besides being easy to handle and not very critical.

SUBSIDIARY PROBLEMS.

There exist other problems both from the point of view of the maintenance of communication between various stations and from a purely electrical point of view.

The adoption of two wave-lengths, one for transmission to and the other for reception from a remote station, has many practical disadvantages. For aircraft work it might be arranged for each air set to transmit on a wave-length λ_1 for which all ground stations should listen in, while the ground stations would transmit a wave-length λ_2 to which all aircraft receiving sets would be tuned. Practical problems may limit the use of the two wave-length system a certain amount, but there are great opportunities for aircraft and ship work awaiting its introduction.

Among electrical problems is the question of the type of receiver. In all the foregoing work, note amplifiers in conjunction with a reaction valve were used. They have several advantages for this type of work, but note amplification is not a sensitive method of reception.

The high-tension voltage for the transmitter is supplied in aeroplane work from some form of rotary direct-current generator. The low-frequency generator ripple is picked up by the receiver and, being of the order of frequency which the receiver is designed to amplify, is heard abnormally loud in the receiving phones.

If high-frequency amplifiers are used, the noise of the generator ripple is practically annulled, but any sparking at the commutator sets up high-frequency disturbances which drown the signal by appearing as a loud rustle in the telephones. Doubtless the best compromise between high- and low-frequency amplification must be arrived at by experiment.

The SOUTH AUSTRALIAN GOVERNMENT recently received a report of Mr. B. F. Rushton on a HYDRO-ELECTRIC POWER WORKS FOR ADELAIDE. Two schemes were presented. One was to harness the water power from the Square Waterhole, 37 miles from Adelaide, and the second to use the water of the Myponga River. By taking the water underground from the Square Waterhole and retaining it in a storage basin it is calculated 21,000 H.P. could be obtained all the year round. The other project is expected to provide 42,000 H.P., which would be sufficient to provide electricity for all the tramways, the suburban railways, the Islington workshops, and lighting and industrial purposes in the metropolitan area. Mr. Rushton estimates the cost of the two schemes at £1,000,000.

Electric Cooking at Debenhams.

In Mr. A. H. Seabrook's time the area comprised within the London Borough of St. Marylebone was the scene of a determined effort to make the public generally realise the advantages that might be obtained by employing electric cooking apparatus in their houses and flats. The wave of enthusiasm thus generated was sufficiently large to spray many of the shop owners, who also form a not unimportant part of the inhabitants of that borough, with a desire to test the economies of applying this method of cooking to their own work. In this connection electric cooking was first used for providing hot food in the staff dining rooms, but since shoppers must eat as well as shop, and since also it is desirable that they should eat where they shop most enterprising firms now provide a restaurant on the premises, which provides both refreshment and attraction in a way that is beneficial to both parties to the transaction.

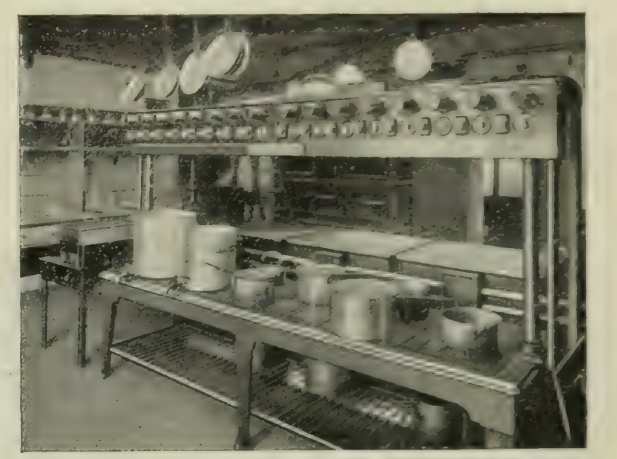


FIG. 1.—"CARRON" ELECTRIC BOILING TABLE.

Messrs. Debenhams, Ltd., have, however, gone a step further, and from first using electric cooking apparatus in their staff kitchen are now also employing it for providing food in their restaurant. Some of the equipment installed has been obtained from the Carron Company and some from the British Electric Transformer Company. We give details and illustrations below.

Fig. 1 shows a "Carron" electric boiling table, the dimensions of which are 8 ft. 9 in. by 2 ft. 4 in. wide. This appliance is built up of six standard-type boiling fillings, each measuring 16 in. wide by 22 in. deep. These are fitted into a cast-iron frame, with a polished moulding all round, ample provision being made in the frame for expansion and contraction of the fillings. Four of the fillings are fitted with two boiling sections, measuring 12 in. by 10 in. each, and loaded to approximately 2 kw., whilst the two fillings in the centre are fitted with four smaller boiling sections, each measuring 7 in. by 6 in., and loaded to approximately 1 kw. Provision is made so that each individual filling can be raised to an upright position in the frame, thus affording easy access to the heating elements and connections when necessary.

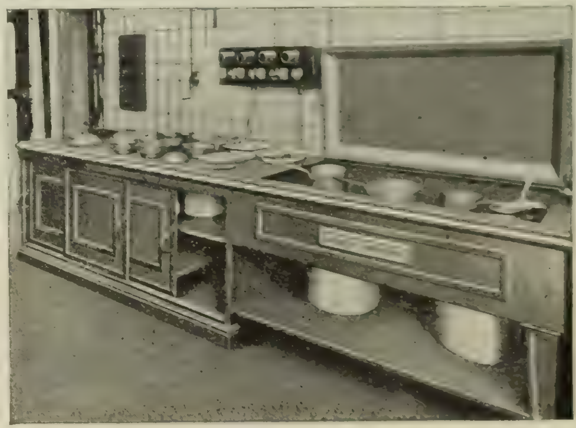


FIG. 2.—"CARRON" ELECTRIC HOT CUPBOARD AND BAIN MARIE.

A wrought iron pan rack is also provided, and the whole apparatus is supported on six strong cast-iron legs, and is stayed with heavy angle iron, which ensures a rigid surface to the boiling table. The switchboard is mounted at a convenient height over the apparatus, and each circuit is separately controlled by a rotary pattern indicating switch, fuse and pilot lamp.

Fig. 2 illustrates the "Carron" electric hot-cupboard and bain marie, which are also installed in Debenham's kitchen, the first-named apparatus being constructed of cast iron, with the following dimensions—6 ft. 6 in. long by 2 ft. 9 in. high by 2 ft. 6 in. deep. It is provided with a ground and polished top-plate, and moulding all round. The sliding doors are of wrought iron, with polished bands and handles, the back and end of the appliance being also panelled. A shelf is fitted inside the hot cupboard, the heating elements being arranged under a covering plate, and loaded to a maximum of 3·5 kw. with three heat regulation. The top-plate is independently heated with elements loaded to a maximum consumption of 1·5 kw. This is also arranged for three-heat regulation as in the case of the hot cupboard, both sets of heating elements being independently controlled by switches fitted to a separate ironclad switchboard on which are mounted the necessary fuses and pilot lamps for each circuit, together with the switches, fuses and pilot lights for controlling the bain marie.

The bain marie itself is constructed of heavy gauge copper, tinned inside with pure block tin, and polished outside, the dimensions of which are 4 ft. long by 2 ft. 8 in. deep. The heating elements are clamped to the underside, and are loaded to a maximum of 15 kw. on the three-heat regulation principle. This is sufficient to raise a 4 in. depth of water from 45°F. to boiling point in approximately 35 minutes. A removable cover is provided, which is shown in a raised position in the illustration.

Fig. 3 shows a "Carron" standard treble compartment electric grill, which is constructed of cast iron, the interior dimensions of each compartment being 24 in. wide by 18 in. deep, giving a total grilling area of approximately 9 sq. ft. The heating element in each compartment is loaded to a maximum of 6 kw., and is arranged for three-heat regulation, the "low" heat having a consumption of approximately 1·5 kw.

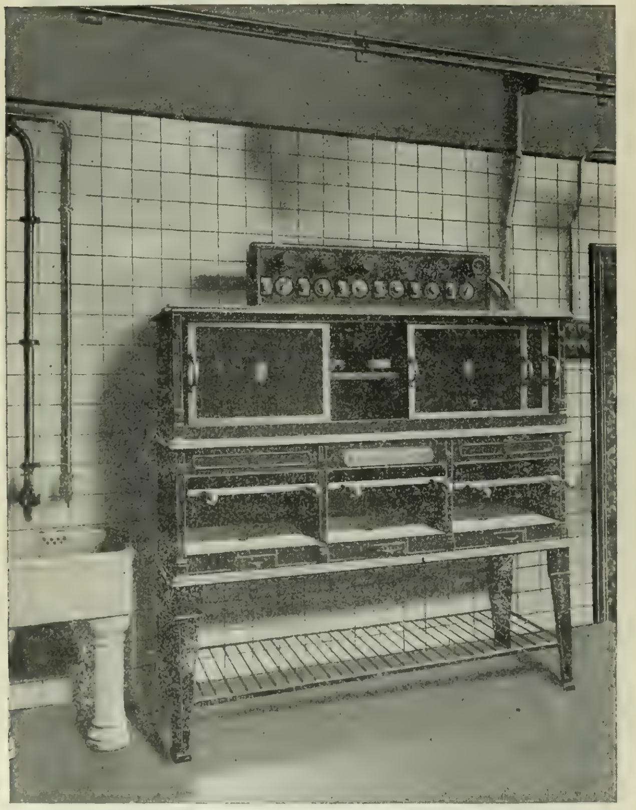


Fig. 3.—"Carron" Electric Grill.

Each section is provided with a polished wrought iron brander with cool grip handles, and the four pairs of runners fitted to each compartment are so spaced that the top one brings the bars of the brander close up to the heating element, but at the sane time to allow sufficient clearance for toasting bread. The bottom of each grilling compartment is white porcelain enamelled, with an outlet in the centre under which a removable gravy pan is fitted as will be seen in the illustration.

The hot-cupboard shown over the grilling compartments is the same width and depth as the grill, with a height of 18 in. A perforated centre shelf is provided, and the whole apparatus is mounted on substantial cast-iron legs to bring it to a convenient working level. The hot-cupboard is fitted with independent heating elements at the bottom. These are loaded to a maximum consumption of 1,500 watts. The wrought-iron sliding doors are provided with polished bands and centre panels. The switchboard is fitted on the top of the apparatus, and each circuit is arranged for separate control by a rotary indicating switch, fuse and pilot light.

In addition to the Carron apparatus just described, the British Electric Transformer Company have supplied Messrs. Debenhams with three ovens (Fig. 4) constructed of cast iron with sheet steel sides and back, lagged with slag wool, for use in their kitchen. The inside measurements of these ovens are 24 in. square. The maximum loading of each is 5 kw., with 2 kw. elements at the top and 3 kw. elements at the bottom. The elements are controlled by two three-heat switches. Three aluminium fish fryers, measuring 18 in. by 10 in. by 6 in. deep inside, having a maximum loading of 2½ kw. each, and are each controlled by three-heat switches.

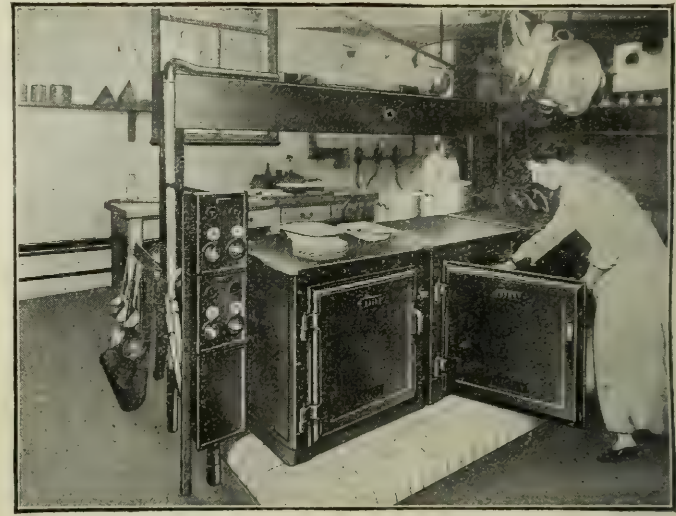


Fig. 4.—View of the British Electric Transformer Ovens.

A combined carving table, hot cupboard and bain marie (Fig. 5) is also installed. In this equipment the length of the hot cupboard is 6 ft. 6 in. over all, its height is 2 ft. 5 in., the height overall with the top shelf 3 ft. 5 in., the width of the top shelf is 12 in., and the width of the hot cupboard and carving table is 2 ft. The loadings are: Carving table top, including dishes, 1·5 kw., controlled by one three-point switch; the hot cupboard (which has doors on both sides) is 2·6 kw., and is controlled by one three-heat switch; the hot shelf is controlled by a three-point switch; the bain marie, of 4 kw. capacity, is controlled by one three-heat switch. Two switches and two fuses are mounted on each kartret panel, with a pilot lamp alongside each switch.

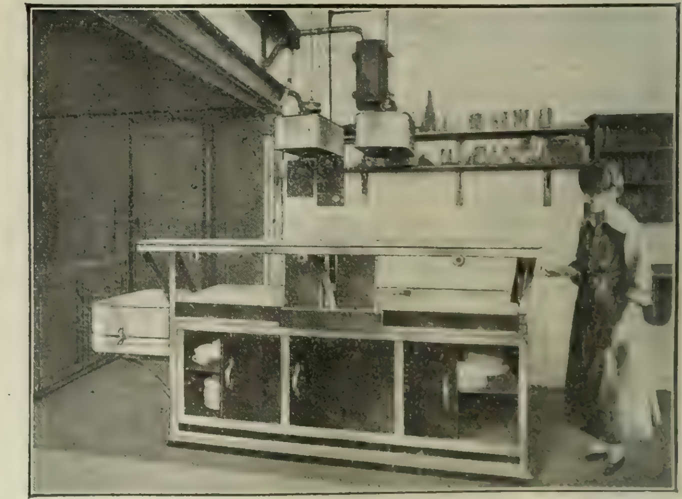


Fig. 5.—Combined Carving Table, Hot Cupboard and Bain Marie. (British Electric Transformer Company.)

According to the "Manchester Guardian Commercial" the lack of coal and the transport difficulties have compelled the German Government to adopt a big scheme of electric traction on the railways. It is proposed to utilise the water power available in Bavaria, Würtemberg and Baden and also the brown coal in the centre of the station. It is hoped to establish a railway network, starting in the Rheinpfalz and stretching through Baden, Würtemberg, Southern Bavaria, the Oberpfalz and Saxony, thence through Silesia, Brandenburg, Hanover and Essen, and finally uniting the Rhenish provinces, Westphalia, and the sea coast. A start will be made at Munich; Dresden, Leipsig and Berlin will next be connected; then Magdeburg and Saxony, Brandenburg and Berlin. Then a line will be made across to Freiburg to the higher Rhenish water powers. It is also proposed to connect Oppelin-Breslau with Upper Silesia. If these plans are carried through, the linking-up of other lines and districts will follow. Before the war an electric railway was planned from Cologne to Dortmund, via Düsseldorf and Essen, and this project will now be executed with all possible speed.

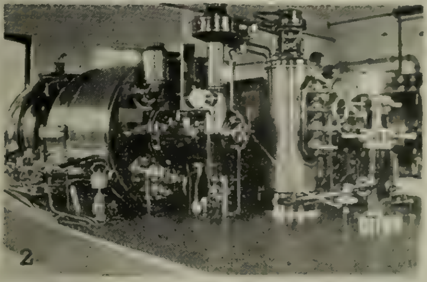
Summer Outing of the I. E. E. London Students' Section.

INTERESTING VISIT TO SCOTLAND.

A party representative of the London Students' Section of the Institution of Electrical Engineers, headed by their chairman, Mr. C. E. Webb, held their summer outing in Scotland during the last week in July, making their headquarters at the Grand Hotel, Glasgow.

A programme of visits to works and pleasure tours was arranged by the Committee of the Scottish Students' Section, the first item falling on *Monday, July 26th*, when the Londoners were the guests of the Scottish Centre at a social meeting in the Corn Exchange Restaurant, Glasgow. Mr. J. E. Sayers, chairman of the parent section of the Scottish Centre, apologised for the unavoidable absence of Mr. F. H. Whysall, chairman of the Scottish Students, and in a brief address welcomed the visitors.

The *following morning* the party visited the new super-power station of the Glasgow Corporation at Dalmarnock, and were greatly interested in the details of the immense boilers, turbo-alternators, switchgear and incidental auxiliaries. The turbo-alternators at present completed or under construction number four, and are each of 15,000 kw. capacity. Two others of similar capacity will be added. There are eight Babcock & Wilcox marine type boilers, each with a capacity of 50,000 lb. per hour, and designed for 275 lb. per square inch. The high-tension switchgear is of Messrs. Reyrolle & Company's substantial pillar type make. Coal storage accommodation, built of reinforced concrete, is capable of holding 75,000 tons of coal.



1. Part of Messrs. John Brown's Shipyard, Clydebank. (F. Housden.)
2. Turbo-Alternator at Dykehead Colliery, Larkhall. They go in for gardening on top of the alternators. (F. Housden.)
3. Three of the party on "Duchess of Argyll"; Mr. Smith-Rose, Chief Secretary, on right. (F. Housden.)
4. Control Room at Dalmarnock. (Note tell-tale automatic diagram at top.) (J. H. Reyner.)
5. The Chairman for 1920-21 in a facetious moment. (F. Housden.)
6. Turbo under erection at Dalmarnock. (J. H. Reyner.)

In the afternoon a visit was paid to the Dykehead Colliery (Larkhall), of Messrs. The Summerlee Iron Company. The party descended the mine and were guided along the underground workings for about a mile, right up to the coal face. On the surface, the power station, haulage plant, washing and screening plant, &c., were inspected. This colliery is quite a modern one, and the visitors were, therefore, able to observe the latest mechanical and electrical improvements in mining work.

A pleasure trip was arranged for *Wednesday*, the venue being Rothesay and Ettrick Bay. Rothesay is, we are told, the most attractive health resort on the Clyde, and is well known to thousands of Scotch and English visitors, while Ettrick Bay is equally well known as the terminus of an electric railway which runs through a countryside "replete" with beautiful scenery. Through the courtesy of Mr. Archd. Robertson, general manager of the Rothesay Tramways Company, a special car conveyed the members to Ettrick Bay. On its return the party visited the power station and depot of the tramways company by the invitation of the manager, and found much to elevate and interest them there. They returned to Glasgow in the evening.

On *Thursday* morning the works of Messrs. Mavor & Coulson, Ltd., Glasgow, were inspected, the various processes for manufacturing all classes of switchgear and electrical machinery being followed with much interest. After an excellent lunch provided by the firm, the party visited the Royal Technical College, where they were shown round the up-to-date and well-equipped engineering laboratories. A visit was thereafter paid to the University, where it was originally intended to inspect the engineering laboratories, but as these were in course of repair and alteration, the visit took the form of a general glance at the various places of interest in the University.

In the evening the party, by special invitation of the chief engineer, Mr. Ferguson, visited the Pinkerton power station of the Glasgow Corporation.

On *Friday*, the members were again on pleasure bent, the occasion being a sail to Arran on the luxurious turbine steamer "Duchess of Argyll." The weather was fine, and this enabled the rugged mountain scenery of Arran to be fully appreciated.

During the forenoon of *Saturday*, the last day of the visit, the works of Messrs. G. & J. Weir, Ltd., Cathcart, were inspected, and the manufacture of the firm's famous pumps, feed heaters, evaporators, &c., was followed with much interest. Members were greatly impressed with the modern and scientifically equipped laboratories and workshops, and also with the extensive use of Monel metal in the manufacture of many of Messrs. Weir's auxiliaries. For the benefit of the party, a special test was made on a specimen of rolled Monel metal which showed its tensile strength to be about 44 tons per square inch.

On Saturday afternoon the round of works visits concluded with a visit to the shipyard of Messrs. John Brown & Company, Clydebank. This is one of the largest shipyards on the Clyde, and is noted for having produced such ships as the "Lusitania," "Aquatania," and H.M.S. "Hood." The shipyard proper was inspected first, and much interest was manifested in the powerful punching, shearing and rolling machines, in the various types of cranes—hammer-head, goliath, tower, &c., and in the ships in course of construction. Other departments visited included the electric power station and sub-stations, the turbine shop, machine shop, boiler shop, &c. One of the most interesting departments was the one devoted to the making of ships' models, and members were able to inspect the ingenious and intricate machinery for fashioning the bees-wax counterpart of the ships built by the firm.

At the conclusion of the visit to Messrs. John Brown & Company, Mr. C. E. Webb, the London Students' chairman, took occasion to express the pleasure of the London party at the unqualified success of the week's visit, and to thank the Scottish Centre for arranging such a splendid programme for their benefit.

Correspondence.

PULVERISED COAL EXPLOSIONS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I feel that in view of the responsibility which I have undertaken in compiling the notes on pulverised coal systems, which have been issued in report form by the Department of Scientific and Industrial Research (Fuel Research Board) and also in consequence of the widespread interest now being taken in this subject that I must at once record a note of warning.

Pulverised coal naturally forms a highly explosive or inflammable "gas" when intimately mixed with air, and it is incumbent upon all and sundry who hold human lives under their care to adopt all means in their power, when installing pulverised coal plant, to see that adequate and common-sense safeguards are taken to prevent or eliminate the risk of explosion.

Pulverised coal can be handled, as a semi-solid or fluid with ease and safety, and has been so handled, conveyed and brought to the point for combustion without breakdown or accident for many years in numerous plants operating in America and elsewhere.

Pulverised coal is no more dangerous than finely-ground flour in a corn mill, and fuel in pulverised form is less dangerous than oil or gas, but recognised and established precautions against accident must not be ignored.

Some well-timed notes on this subject appeared in "The Times of India Engineering Supplement," for May 7th, one paragraph from which I will quote :—

> "Pulverised fuel preparing and burning equipment is now made which is as near as possible fool-proof, and free from any possible explosion danger; so that if worked with even reasonable care, no trouble or danger will be experienced in this direction."

I am informed that in America recently a series of mishaps have occurred, the result of these mishaps has been the reorganisation of the pulverised coal plant on more reliable and safe lines. This chapter of accidents and breakdown of the plant used culminated in a more serious occurrence in July at a sheet steel works, five men having succumbed to injuries through burns following upon an explosion in the pulverised coal system.

As I firmly believe in and foresee the extended application of pulverised coal systems, I consider it my duty to issue this advice and warning against installing pulverised coal plant which is not based upon acknowledged and safe practice. Not only will damage to plant, stoppage of fuel supply, cessation of works output result from an accident or explosion, but more serious consequences may follow upon the acceptance of avoidable and unnecessary risks. There is a wonderful future throughout the world for this system of applying solid fuel in almost analogous form to that of oil or gas, and it is to be hoped that every care will be exercised to see that this new art of immense value to industry is not given a setback on account of avoidable mistakes.—I am, &c.,

Malden, Surrey, L. C. Harvey.
August 13th.

PAYMENT FOR EXPERIENCE.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I noticed recent editorial remarks, also those of correspondents, as to the pay of the electrical engineers at Southampton and Wrexham.

This concerns the operating side, where the pay of engineers is in many cases public property, but it would be interesting to have an expression of opinion from yourselves and your readers as to the pay of important officials on the manufacturing side, which is, I believe, in many cases, also very poor under present conditions.

If £1,000 per annum is "not over generous" for Southampton, and £450 is "scandalous" for Wrexham, what would be fair pay for, say, the Chief of a Technical Department, aged not less than 40, with good and varied practical and designing experience in, say (1) a fairly leading company manufacturing switchgear, control gear, accessories, &c., (2) a leading company manufacturing also alternating-current and direct-current machines, &c.? I think it would be fairly generally agreed that (1) would have carried quite £300 and (2) £400 before the war, now equivalent respectively to about £750 and £1,000. How many such officials are getting such salaries?

Enquirer.

[We shall be very pleased to have the views of our readers on this subject.—Ed. *E.*]

Wild Barfield Electric Furnaces.

A firm which have been giving a good deal of attention to the design and construction of electric furnaces for commercial work are Automatic & Electric Furnaces, Ltd., who are now, as the result of numerous careful experiments, in a position to place on the market a series of designs of Wild-Barfield electric furnaces which include several points of interest. These furnaces consist essentially of a heating chamber over wound with a wire of a special alloy. This chamber is surrounded by another containing a device which enables an automatic indication to be given of the exact moment for removing the work from the furnace. This, of course, is of extreme importance, as it enables an element of precision to be introduced into this class of apparatus in a way which has not hitherto been possible. The question of standardisation has also been given a good deal of consideration in the manufacture of these furnaces, and we understand that the makers are prepared to guarantee them to give a certainty of temperature and a uniformity both of heating and of results. These are, of course, essential conditions for the successful heat treatment of carbon steel, and if this promise can be kept in practice (as no doubt it can be) a wide field for the use of these furnaces should be quickly opened up.

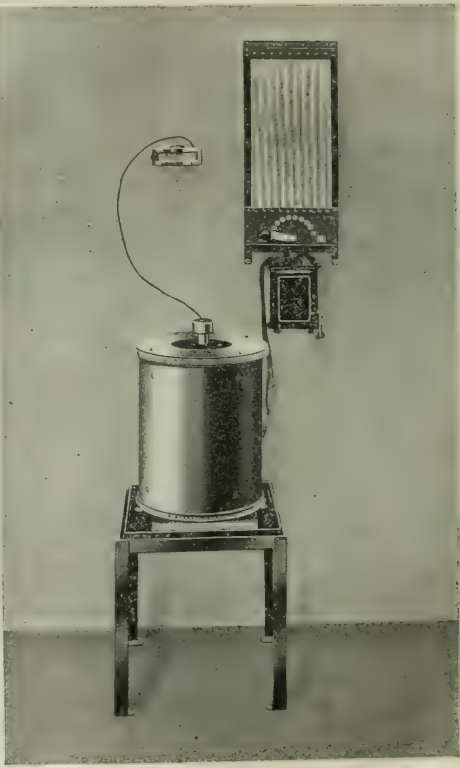


Fig. 1.—W. B. Radiator Furnace.

The device by which the automatic indication mentioned above is given is known as the Wild-Barfield pyroscopic detector. As is well known, it has been found that the right moment for withdrawing the work from the furnace is when the steel has just passed the decalescence point. The loss of magnetism which occurs at this point is made use of in operating the detector, the system of furnace and work making up what is really a magnetic circuit with the fine copper wire wound on the outer chamber as a detecting coil. This latter coil is connected to an indicating instrument in a position convenient to the furnace. It is obvious that with this arrangement when decalesence is reached a signal can be given which enables the operator either to withdraw the work from the furnace, to quench it or to cool it in air as may be required.

Fig. 1 shows a type of W.-B. radiation furnace equipment with an output of 30 lb. per hour. Started from cold this furnace only takes from 1 to 1½ hours to heat up to full temperature and may be provided with a time switch so that current can be switched on a definite time before the works open and the furnace thus made ready for immediate use on the arrival of the operator.

Fig. 2 shows an example of the W.-B. case-hardening furnace. This consists of a metal pot surrounded by cylindrical casing containing a heating element. The articles to be case-hardened are packed in this metal pot with any suitable casing compound. A metal lid is then luted on, the lid being provided with a hole through which the pyrometer is inserted so that there is no doubt that the essential temperature inside the pot is indicated on the pyrometer. An important point about the operation of this furnace is that the temperature rises evenly and the furnace therefore always takes the same time to reach the critical temperature, so that after the first trial the operator knows exactly on which stop of the regulating resistance to leave the handle and a minimum of attention is therefore necessary. The maximum capacity of the furnace is 100 lb. at one charge with a consumption of 9·5 units.

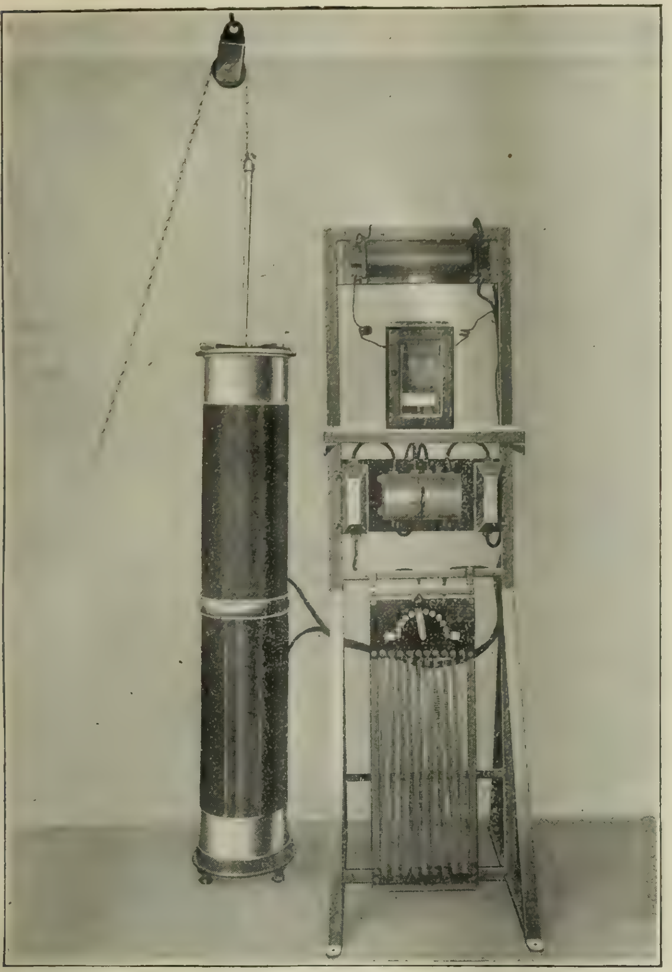


FIG. 2.—W.-B. CASE HARDENING FURNACE.

Fig. 3 shows a radiation furnace made by the Automatic & Electric Furnaces, Ltd., which is interesting from the fact that it is wired complete with Stannos wire, being the first electric furnace in this country to be so wired. This furnace operates on alternating current at 200 volts with a power consumption of 4500 watts and an output of hardened tools of 30 lb. per hour.

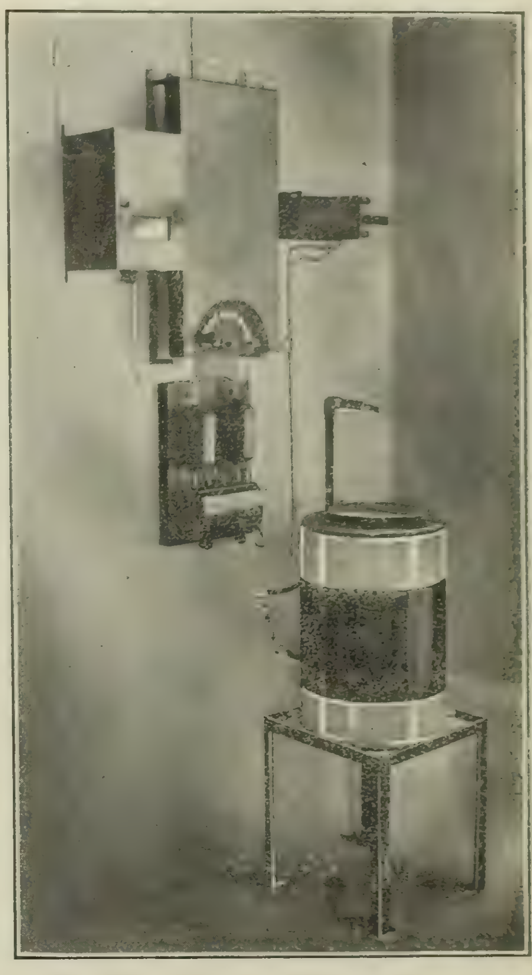


FIG. 3.—NO. 8 RADIATION FURNACE.

Parliamentary Intelligence.

Proposed Generating Station at Barking.

In the House of Commons last week, Mr. Kiley asked whether the Electricity Commissioners had received a proposal from the County of London Electric Supply Company for the construction of a generating station at Barking; whether it would be possible for the company, with the approval of the Commissioners, to connect the proposed station with the various areas of supply of authorised undertakers in the County of London; whether the Commissioners were prepared to give their consent to the application; and whether the London County Council, as the purchasing authority, and the other authorised undertakers had had an opportunity of making representations to the Commissioners?

In reply, Sir E. Geddes said the answer to the first and second parts of the question was in the affirmative. The Commissioners had the application under consideration at present, but they had not yet given their decision. They were in communication with the London County Council as the purchasing authority under the terms of the London Electric Supply Act, 1908, and the Council had been given an opportunity of making representations to the Commissioners, but they did not propose to consult other authorised undertakers unless a local inquiry was deemed necessary.

Tilbury Urban Council has been informed by the County of London Company that from the proposed station at Barking it will be able to supply the whole of the riverside area, including Tilbury.

Queensferry Power Plant.

In the House of Commons last week Sir Owen Phillips asked the Secretary for War whether the electrical power plant at the munitions factory at Queensferry had been lying idle for about 12 months' notwithstanding the fact that there was a shortage of electrical energy in the district and that industrial development was thereby retarded, and whether he could see his way to authorise, without further delay, the sale of the plant to the Corporation of Chester or any other would-be purchaser who would undertake to provide electrical power to works in the locality at a reasonable cost.

In reply, Sir A. Williamson said that the plant had not been idle for 12 months as power had been generated to a small extent to meet the requirements of the factory in connection with wagon repair work and the factory housing estate. The question of the future of the factory was under consideration, and it was hoped shortly to ensure the fullest development of the factory electrical energy. The offer to purchase the plant by the Chester Corporation was totally inadequate, and the Government would not be justified in coming to an arrangement which would involve a heavy loss on a valuable power plant.

On Monday last the ROYAL ASSENT was read to the following Acts of Parliament: Telegraph (Money), Post Office and Telegraph, Mining Industry, Cardiff Corporation, Huddersfield Corporation (General Powers), Salford Corporation, London Electric Metropolitan District, City & South London and Central London Railway Companies (Fares, &c.), and Bristol Corporation.

Commercial Topics.

Engineering in Czecho-Slovakia.

According to recent reports the engineering industries of Czecho-Slovakia are in a flourishing condition. A correspondent of the Federation of British Industries states that all the big works have enlarged their plant so that in spite of the recent reduction of hours their productive power is greater than in 1914. Engineering firms have orders sufficient to keep all the works in the country fully employed until well into 1921, and a number of the orders emanate from France, Jugo-Slavia, Roumania and Poland. Locomotive and rolling-stock works are working at full pressure, and the electrical industry is described as quite unable to cope with the home demand for motors, installations of generating plant, cables and wires, &c., and is, therefore, unable to export. The country has followed the German example by setting up an "Economic Association" for the whole of the iron and steel industry, governed by representatives of the manufacturers, employees and consumers. The "union" has nine departments, and acts as an advisory body to the Government Imports and Exports Commission. A Fair and Sample Exhibition of manufacturers and merchandise produced in Czecho-Slovakia will be held in Prague from Sept. 5 to 28.

* * * *

Factory Acts Administration.

An important scheme of re-organisation has been sanctioned for the Factory Department of the Home Office, and will be brought into operation as soon as the necessary arrangements can be made. The men's and women's sides of the Inspectorate, which have hitherto been separately organised and worked apart, will be amalgamated into a single organisation. Women inspectors will be regarded as eligible for all posts. While complete fusion, which is the ultimate aim, can only be brought about gradually, the immediate changes will be as follows:—

The post of Principal Lady Inspector will be abolished, and a woman Deputy Chief Inspector appointed, with special duties in regard to women inspectors. Women divisional and district inspectors will also be appointed. The independent organisation of the women inspectorate in the divisions will disappear. In divisions, under a man Superintending Inspector, a woman will be appointed as an additional Deputy Superintending Inspector (the post of Senior Lady Inspector being abolished), who will have special duties in regard to women's work in the division.

Owing to the increase in the number of factories and workshops and the great growth in the duties devolving on the Inspectorate, it has become necessary to reduce the areas of the divisions and districts into which the country is divided. The number of divisions will be increased from six to 10, and the number of districts from 62 to 88, while a corresponding reduction will be made in the number of junior inspectors.

The scientific and technical staff of the Department will be considerably strengthened in order to enable it to cope with new developments in regard to safety and health. The medical staff is to be increased from three to five, one of whom will be a woman. The special engineering staff which is more particularly concerned with problems of safety, ventilation, &c., arising in connection with the administration of the Factory Acts will be reconstituted and enlarged; and in view of the great growth in the use of electricity for industrial purposes, four additional electrical inspectors will be appointed to enforce the safety requirements of the electricity regulations.

We welcome the announcement that it is proposed to increase the electrical staff because there is evidence that many of the accidents arising out of the use of electricity in factories and workshops could have been avoided by adhering to the departmental regulations and for the sake of all parties it is necessary that these should be enforced more rigorously in future.

* * * *

Electrical Organisation in Australia.

Though electricity supply and the various industrial applications of electricity are making rapid progress in the Australian Commonwealth there has hitherto been a lack of co-operation between the technical societies and organisations which represent the various branches of the industry. In order to remedy this state of affairs steps are being taken by the Electrical Traders & Contractors Association of Victoria to re-organise the Association and to bring into closer co-operation all the electrical interests in the State. The present unsatisfactory position was recently dealt with in an able Paper by Mr. L. G. Hinwood on "Co-operation for Improvement of the Electrical Industry."

He stated that the electrical industry was probably the only one in Australia which was not making money. Before they could reach the maximum of success they must realise that those in the industry were all interdependent and that one firm or community of firms could not be affected for good or evil without the conditions being reflected in the rest of the industry. Mr. Hinwood advised the Victorian Association to adopt American methods. He estimated that there was an immediate demand in Victoria for 50,000 fan motors, 50,000 vacuum cleaners, 50,000 electric irons, 50,000 kettles, 50,000 radiators, 50,000 washing machines and 50,000 table standards, and that there were 135,000 dwellings waiting to be wired. He estimated that the value of the articles and work was over £5,000,000 and only organisation and industry would secure it. He said they, as a community, were doing nothing to convince those householders of the advantages of electricity. The membership of the Association consisted of 19 importers and 23 contractors out of 241 contractors, and it was the contractors outside the Association who were keeping prices so low. An interesting debate took place after the reading of the Paper and a standing committee was appointed to go fully into the question of re-organisation.

Electricity Supply.

Whitehaven Council has applied for sanction to a loan of £12,000 for a generating set.

The net surplus on the past year's working of the Winchester electricity undertaking (£2,686) has been transferred to reserve account.

Waterford Corporation has under consideration a scheme, prepared by Messrs. Keating & Gaule, for the erection of electricity supply works.

The official inauguration of the new plant, including a new 1,000 kw. steam turbine set, at the Aylesbury electricity works, took place on the 5th inst.

The Charing Cross, West End & City Electricity Supply Company has applied to the Minister of Transport for authority to increase the maximum price of current in the City of London to 8d. per unit.

Bexley Heath Urban Council have abandoned the proposal to obtain current in bulk from Woolwich Borough Council, on the ground that the outlay on converting plant would not be advantageous.

Truro Town Council has referred the offer of a firm to provide the necessary capital for establishing electricity supply under the Council's provisional order to a committee for consideration and report.

Doncaster Corporation has received sanction to a loan of £85,000 for the extension of the electricity undertaking, and sanction to the balance of the loan applied for (about £35,000) will be given as soon as figures of the actual cost are available.

Taunton Council has asked to be excluded from the Lower Severn Electricity District, on the ground that the cost of linking up would be out of all proportion to the possible benefit. The Council favours inclusion in the same area as Exeter.

For some considerable time there has been a dispute between the Dover electricity department and the Admiralty as to price to be paid by the latter for the electrical energy supplied during the war, but the Corporation has now received £9,000 on account of their claim.

The Industrial Court has made its award on the application of the National Association of Local Government Officers against Plymouth Corporation for the application of the Civil Service scale of war bonus to various officers, including the borough electrical engineer, Mr. E. G. Okell, fixed at £950.

Walsall electric supply department, having been asked by the Northern Command to give a supply of electricity to Whittington Barracks, Lichfield, inquiries are being made by a Lichfield Committee as to the probable demand for electric lighting and power. If there is evidence of a reasonable demand, Lichfield Council will probably take current in bulk from Walsall and lay distributing mains in the district.

At a recent conference of local authorities in the supply area of the Twickenham & Teddington Electric Supply Company it was decided to agree to an increase in the maximum charge for electric current from 10d. to 1s. per unit, provided the increase is limited to five years. The company has asked for a maximum of 1s. 2d. a unit, and a local inquiry will probably be held into the matter.

A subaqueous supply cable from King's Lynn to West Lynn has been laid, and the Lynn Shipbuilding Company are now taking a supply of current from the Corporation. It is proposed to supply the neighbouring districts, including Terrington and Clenchwarton, by an overhead line. The question of supplying current to an additional area in South Lynn has been deferred pending further particulars from the West Norfolk Farmers' Manure & Chemical Company.

Prior to the war Southwark Borough Council had let a contract for extensions of the generating plant to the General Electric Company, but only a portion of the order was completed. The Council has now entered into a fresh agreement with the company whereby the latter waive any claims in regard to the original contracts and to supply the remainder of the plant specified in the old contracts at the lowest price asked for by any one of three British manufacturers the Council may select.

The accounts of Brighton Electricity Department for the year ended March 31, which were adopted by the Council on 29th ult., show revenue £158,062 (compared with £130,557 in previous year), working expenses £105,755 (£86,476), and gross profit £52,307 (£44,081). Interest required £17,320 (£16,890), sinking fund £19,740 (£20,708), and net profit was £13,374 (£3,112). Costs were 2·29d. (2·05d.) per unit sold exclusive, or 3·11d. (3·02d.) inclusive of loan charges. The maximum load was 5,349 kw. (4,560 kw.), and load factor 23·5 (25·4) per cent. Units generated were 13,162,468 (11,862,963), and sold 11,002,835 (10,144,392). Coal consumed was 5 27 lb. (5·4 lb.) per unit, and the average cost of coal was 42/2¼ (38/5½) per ton.

The embargo on overtime by members of the engineering trade unions is causing serious trouble to Lancashire electricity undertakings. At Ashton-under-Lyne, where one of the turbines is undergoing its annual overhaul, a pinion driving the air-pump in connection with the condenser stripped on Sunday evening. The fitters were sent for to repair it, but they refused to come and the electrical engineer had to pull his coat off and, with the help of what assistance he could get, undertook the job himself in order to keep the station running. Ald. Coop, chairman of the Electricity Committee, has pointed how serious a state of things that was, but in addition one of the fitters who had had his holiday now refused to work during Wakes Week as previously arranged, although he had been paid for holidays. It had been arranged to overhaul the Belliss set during the Wakes holidays, but owing to the man's refusal to fulfil his obligations the work could not be done.

The accounts of Glasgow Electricity Department for the year ended May 31 show revenue £977,486 (compared with £865,039 in previous year), expenditure £713,450 (£567,258) and gross profit £264,035 (£297,780). Depreciation required £64,458 (£60,464), interest £151,089 (£116,809), repayment of principal £1,700 (£1,642) and sinking fund £101,401 (£86,101), and to meet the net deficit £54,614 was taken from reserve fund. Last year £32,761 was placed to reserve. Units generated were 176,866,781 (169,873,301) and sold 148,495,090 (144,930,164). Total maximum demand was 155,219 kw. (141,967 kw.). Generation, distribution and management costs amounted to 1·003d. (0·8407d.) per unit sold, and the total cost, including capital charges, rents, royalties, depreciation, &c., was 1·6681d. (1·3781d.). In the report of the Electricity Committee it is stated that there are 42,892 (37,130) consumers. Power and heating units sold were 119,543,209. Motors in use are 14,671 (13,730) = 123,421 (113,721) h.p. Two 1,500 kw. rotary converters are to be installed, one at Port Dundas station and the other at Pollokshaws-road station, and a 20,000-volt sub-station is being constructed at Partick. At Dalmarnock the first 18,750 kw. Metropolitan-Vickers turbo-alternator has been put into service, and two further sets of the same capacity are being erected. Work on the 20,000-volt transforming plant at Waterloo-street, Cathedral-street, Springburn, Osborne-street and Holmfauld will be completed during the current year.

The Stepney (London) Borough Council has approved an estimate amounting to £9,650 for laying a new feeder from the Whitechapel sub-station to Tower Hill. The Electricity Commissioners recently sanctioned the borrowing of £150,000 on account of the £239,950 required for extensions of the undertaking.

The Council has adopted a recommendation of the engineer and manager, Mr. W. C. P. Tapper, for a further increase of charges. Mr. Tapper pointed out that since the end of last year 6s. per week per man had been awarded to workmen and considerable increases to the technical and clerical staffs. A demand from the workmen was now being considered for a further increase of 24s. per week per man. Coal had risen 4s. 2d. per ton, and there was every probability of a further increase. In estimating this year's costs, he had allowed an average increase of 10s. per week per man in wages, and 10s. per ton for coal, and on that basis he estimated a loss of £4,385 at March 31 next, or including income tax about £8,000. An increase of ¼d. per unit in the present flat rate for power and for restricted supplies would yield £15,500 for a year, or about £8,000 if applied from the end of the September quarter. The penny rate for power and restricted supplies was now slightly below the average cost per unit and therefore should be increased, while the other rates showed a margin on the right side. The existing 50 per cent. increase, which was convenient for calculating purposes, need not be altered.

The Council has decided to appeal against the decision of Mr. Justice P. O. Lawrence granting an injunction (to operate from Nov. 12) against a nuisance at the Limehouse electricity works.

Catalogues, Price Lists, &c.

Recent trade literature of the Sterling Telephone & Electric Company, Ltd., include three revised lists of prices of the Sterling telephone pocket booklet No. 268 of the Sterling electric bell indicator and of the company's publication No. 276 respectively. The lists, which are numbered 280, 281 and 282, cancel previous prices.

The British Insulated & Helsby Cables, Ltd., of Prescot, Lancs., have French and Portuguese editions of their catalogue, in which illustrated particulars are given of the principal manufactures of the company, including cables for lighting and industrial power, telegraphy and telephony, junction boxes, switchgear, fuses, trolley wires and tramway accessories, meters, mine exploders, primary batteries, electric welding plant, pinions, insulators, transmission line poles, &c. Measurements are given in the metric system, and the catalogues, which are well illustrated, should give French, Portuguese and Brazilian engineers a good idea of the excellence of the company's products.

The Hughes-Johnston Stampings, Ltd., of Langley Green, near Birmingham, have issued their new catalogue and price list of drop forgings. The company have acquired a good reputation for the excellence of their manufactures, and they supply every description of drop forgings in iron, steel, aluminium, brass, nickel, tungsten and vanadium alloys with all forms of heat treatment. A few of the firm's standard specifications are given in the catalogue, but forgings are supplied to meet any special requirements. The forgings are produced from dies made accurately to customers' designs, and every precaution is taken in the course of production. Particulars and prices are given of a number of types of eyebolts, bow nuts, swivels, fly nuts, spanners, lathe carriers, shafts and rings, handles, hooks, links, &c.

A recent pamphlet issued by Messrs. Bruce Peebles & Company, East Hilton, Edinburgh, describes and illustrates the Peebles C type of continuous current dynamos and motors. This well-known firm has a lengthy and successful experience in the design and manufacture of electrical machinery, and the machines described leave nothing to be desired either as to mechanical or electrical design. Except a few of the smaller machines, especially those designed for the lower voltages, they are all fitted with commutating poles, and will run sparklessly at all loads within their capacity with fixed brush position. Details are given of the company's five standard types, but machines of special design can be supplied to meet special conditions. Tables of ratings of continuous rated machines (protected, semi-enclosed and pipe ventilated types) and motors (totally-enclosed and mining), with approximate dimensions and net weights, are given. The company's plant is used extensively for power and all industrial purposes, and the pamphlet which is nicely illustrated throughout, gives a picture of over 20 Peebles motors (aggregating over 200 b.h.p.) at an Edinburgh printing establishment.

Electric Traction.

Hammersmith (London) Borough Council has decided to equip, at a cost of £1,000, a garage for its six electric vehicles.

Blackpool Council has applied for permission to borrow £4,025 for doubling the tramway track on the new road.

Wolverhampton Tramways Committee recommends the purchase of eight single-deck tramcars, three double-deck tramcar bodies for existing trucks, and 16 motors, at a total cost of £14,784.

Plymouth Corporation has decided to promote a Bill to authorise extensions of the tramway system and to run motor omnibuses within 15 miles of the borough boundaries.

Burnley Tramways Committee has decided to act upon any agreement arrived at between employers and employed in the engineering trade in connection with the present application for a wage increase.

A revised scale of tramway fares has been adopted by Dundee Corporation. The new fares represent an increase of about 50 per cent. The maximum fare will be 3d., and workmen's fares have been abolished.

Owing to a goods engine and van running off the line at Barnes Junction the electric service on the Kingston and Hounslow loop lines of the London & South Western Railway was disorganised for some hours on Monday afternoon last.

The question of purchasing the local tramways is under consideration by Greenock Corporation at present. The local tramway company recently offered to sell the undertaking for £236,000, but the offer was declined, as the price was considered too high. It is proposed to appoint Mr. J. Dalrymple, of Glasgow, as arbitrator to determine the price to be paid by the Corporation for the undertaking.

A dispute over the dismissal of a conductor for not working on August Bank Holiday led to a lightning strike of Southampton Corporation tramwaymen on the 15th inst. On the following day the permanent way employees joined in the strike, making a total of 400 men out. The strike continues.

In an interim report on the effect of the higher fares, Mr. J. Dalrymple, general manager of the Glasgow Corporation tramways, states that the revenue for June and July amounted to £368,937, an increase of nearly £100,000 compared with the corresponding period of last year, but there was a decrease of about 9,000,000 passengers. Glasgow Tramways Committee has instructed the general manager to consider the question of extending the tramway from Netherlee to Clarkston.

A further revision of fares has been made by the Sunderland District Tramways, Ltd., and now the minimum is 1½d. a mile. The advance is due to the recent increase in the employees' wages, together with the heavy cost of keeping in repair the tramcars which are obsolete. Miners still pay ½d. a mile, but they are now restricted to certain hours, while shop assistants are to pay full fare, instead of travelling at the workmen's rate.

From a statement issued by the Ministry of Transport we learn that since 1878 the Length of Tramway Route open for traffic in the United Kingdom has increased from 269 miles to 2,728 in 1918-19. Local authorities own and work 1,713 route miles, and 146 miles owned by local authorities are worked by companies. The mileage worked by electric traction was 2,660, or 97·5 per cent. of the total. Compared with the last completed year before the war (1913-14), the total number of passengers carried has risen from 3,426,473,192 to 4,557,640,078 in 1918-19, an increase of 1,131,166,886, or 33 per cent. In the same period the number of car-miles run has decreased from 354,379,672 to 320,378,376, so that the average number of passengers per car-mile is now 14·2, compared with 9·7 in 1913-14. The number of journeys per head of the estimated civil population works out at 108, compared with 74 in 1913-14, while the number of passengers carried per mile of route open was 1,668,122, an increase of 400,387, or 31·6 per cent. on the pre-war figure.

Twenty-six local authorities have obtained powers to operate trackless trolley undertakings, but only seven actually carry passengers. Five companies have also obtained similar powers, of which only one was operated during 1918.

The work of rearranging and improving the lines of the London & N. Western Railway between Chalk Farm and Euston, which was begun in 1913, but stopped by the war, has recently been resumed. The principal object of the alterations is to provide a means whereby the electric trains from Broad-street (City) to Watford, via the Hampstead Junction line, should also be able to run via Chalk Farm, and also from Euston to Watford. When the works are completed it will be possible for passengers to travel between Watford and Euston and vice versa by an electrified line. An important part of the scheme involves the lowering at Euston of the up and down slow lines to allow of the up fast line crossing over them by means of a bridge, thus avoiding any crossing on the level. At Chalk Farm the railway is being widened on the north (up side), and the existing lines rearranged on the widened area, in order to provide for the additional lines which are to connect the present local lines from Euston and the North London lines from Broad-street with the new tunnels. These tunnels are constructed almost parallel with the present steam line tunnels between Chalk Farm and Loudoun-road, from which point onward there will be two additional lines reserved for the Watford electric services. There will be a new tunnel, by means of which empty coaches can be brought from the carriage sheds at Willesden to Chalk Farm over the existing up slow line, and can cross over underground to the departure platforms at Euston. It is not expected that the scheme will be completed before 1922.

Imperial and Foreign Notes.

Lilydale (Victoria) Shire Council propose to establish electricity supply works.

The Calcutta Electric Supply Company has undertaken to establish electricity works at Multan.

Beaufort (Victoria) Council is considering a report by an engineer on the subject of electricity supply.

It is announced that a Powerful Radiotelegraphic Station is to be erected at Shanghai which will be available for commercial and official purposes.

Gen. Sir John Monash has been appointed general manager of the Victorian Government undertaking for the generation of electricity from Morwell brown coal.

According to the "British and South African Export Gazette," an electric supply scheme is being prepared for the Thika, Ruiru, Kyambu and Machakos district of Kenya Colony. Water-power will be utilised, and it is estimated that at least 5,000 h.p. can be generated.

In a recent report on Hydro-electric Possibilities in Ceylon, Mr. J. W. Meares, electrical adviser to the Government of India, says Ceylon has far more water power than it can ever use, unless industries are specially started to utilise this natural wealth. Some 264,000 h.p. of water power is continuously available.

It has been decided to establish municipal electricity works at Pomancillo (Province of Catamarca), Argentina.

The Allgemeine Elektricitats Gesellschaft, of Berlin, proposes to increase its share capital by 250 million marks (£1,470,000 at present rate of exchange) by a preference share issue at 6 per cent.

The Netherland Railway Companies have sent a commission to report on the systems of electric traction employed in England, Switzerland and America. At present the electrification of the railway between the Hague, Amsterdam and Amersfoort is projected, and many of the steam tram services are contemplating a similar step, but it is probable that electric traction will ultimately be adopted on all the main lines.

The "Review of the River Plate" states that the Compania Alemana Transatlantica de Electricidad (the German company supplying electrical energy in Buenos Aires) recently placed before its shareholders a scheme for the transfer of the company's undertaking to a Spanish company, to be formed by Madrid, Bilbao and Barcelona banking firms.

H.M. Consul-General at Seoul (Korea) states that a large scheme is being prepared for utilising the waters of the River Hwangsu-won, a tributary of the Yalu, in South Hamkyeng (Kankyo) Province. The Oriental Development Company is supporting the scheme, which will cost 10,000,000 yen and take three years to complete. The province is rich in timber and minerals, and it is anticipated that there will be a large demand for electric power. The project has been approved by the authorities of the Government-General.

At the end of July the Cia Radio-telegrafica Argentina (S.A.) invited subscriptions in Buenos Aires for \$3,000,000 m/n in preference shares of \$100 m/n each. The company, which is a Germano-Argentine undertaking, is formed to establish a High Power Telefunken Station in Argentina to communicate direct to Nauen in Germany. It is said that the charge will be fixed at two-thirds of the present cable rates. Of the capital (\$10,000,000), a sum of \$4,500,000 in ordinary shares will be taken by the promoters, namely the two Telefunken Companies in Berlin, the Deutsche and the Dresdner Banks. The Argentine is asked for \$3,000,000, to be allotted against an issue of 7 per cent. preference shares, and the balance of the authorised capital is unissued. The President of the Provisional Board is an Argentine Senator, and an Argentine university professor also figures in the list of directors, but the remainder are Germans and represent the two German banks, the electrical and constructional interests and the Telefunken group. All the preference shares have been subscribed, and the company expects to be able to take ordinary commercial business by the spring of 1922.

Important developments are announced in connection with the Nela Research Laboratory (Nela Park, Cleveland) which was organised in 1908 under the directorship of Dr. Edward P. Hyde as the Physical Laboratory of the National Electric Lamp Association. The name was changed to the Nela Research Laboratory in 1913, when the National Electric Lamp Association became the National Lamp Works of the General Electric Company. For some years the laboratory was devoted to the development of those sciences on which the art of lighting has its foundation, but in 1914 its functions were extended by the addition of a small section of applied science, which had an immediate practical objective. This applied science section is now being largely extended as a separate laboratory of applied science under the direction of Mr. M. Luckiesh, who becomes director of applied science. A new building is being constructed to house this branch of the work, which will be carried on with a staff of several physicists, an engineer, an architect and a designer, together with the necessary technical and clerical assistants. Dr. Ernest F. Nichols, formerly President of Dartmouth College, and more recently professor of physics at Yale University, has accepted an invitation to assume the direction of the laboratory of pure science, under the title of director of pure science. The work of the laboratory will be somewhat further extended under the new organisation. The laboratories of pure and applied science will together constitute the Nela Research Laboratories, and will be co-ordinated under the general direction of Dr. Hyde, who becomes director of research.

Miscellaneous.

There will be an interesting Exhibition of Electrical Apparatus, Domestic Labour-saving Devices, etc., at the Town Hall, Greenock, from Oct. 11 to 16 next. The exhibition is being organised by Greenock Corporation electricity department.

The U.S.A. Naval Radio Communication Service commenced on Sunday, when commercial, private and Press messages were accepted for transmission to France, Belgium, the Netherlands, Italy, Switzerland, &c., via the new station at Lyons.

On Monday George Knight, chief electrical engineer of British Oil & Cake Mills, Ltd., Hull, was convicted of stealing two electric motors, 43 coils of cable and other electrical material, and he was sentenced to four months' imprisonment. For the prosecution, it was said that the value of the goods was about £1,100.

An Order has been made revoking the Defence of the Realm Regulation 37b, which related to Wireless Telegraphic Installations on British Ships, as the subject is now covered by the Merchant Shipping (Wireless Telegraphy) Act, 1919, and the new rules (given in our last issue) of the Board of Trade. These rules come into operation on Sept. 1.

The C.A.V. Athletic Association are holding a closed and open sports meeting to-morrow (Saturday) on their ground at Old Oak-road, Shepherd's Bush, in aid of the Acton Cottage Hospital. Such a worthy object should ensure a large number of visitors. The meeting comprises many open events, besides those confined to London Business Houses. A band will be in attendance, and after the sports there will be a concert and dancing. Admission 1s., including tax.

A useful guide to the changes made by the 1920 Budget in the incidence of Income tax and Super-tax has been issued by Messrs. Oliver & Boyd, of Edinburgh and London. Taxation is now so heavy that persons will be glad to have a work which shows at a glance the rates, exemptions and allowances, &c., The guide, which is published at 1s. net, and is now in its third edition, contains useful reminders and advice, over 30 typical cases of repayment claims, &c.

From the list of exhibitors at the Machine Tool and Engineering Exhibition we gather that 209 exhibitors will be represented, and they have between them booked about 15 per cent. more space than has ever previously been let for a machinery exhibition at Olympia. Exhibits of machine tools and small tools are confined to those firms who are members of the Machine Tool Trades' Association. No goods of German or Austrian manufacture may be shown by any of the exhibitors.

We regret to announce the death of Sir Joseph Norman Lockyer which occurred at Sidmouth on Monday. He was born at Rugby in May 1836, and was well known for his astronomical work and for research in solar and stellar physics, &c. In 1868 Lockyer and Jannsen independently discovered that the sun's chromosphere could be seen in broad daylight and in the same year, jointly with Frankland, he discovered helium in the sun's spectra. Subsequently the Government established the Solar Physical Laboratory at South Kensington with which he was connected for over 40 years and was its director from 1885 to 1913. He acted as secretary of the Duke of Devonshire's Royal Commission on Science in 1870 and later he was transferred to the Science and Art Department. He was the author of many books on astronomy, some of which have been translated into other languages, and he conducted or assisted in several eclipse expeditions. In 1869 Sir Norman Lockyer founded our well-known contemporary "Nature." He was President of the British Association in 1903-4, when he delivered a striking address on the national need of more universities. He was elected a Fellow of the Royal Society in 1869 and numerous honours and distinctions were conferred upon him by British and foreign societies.

Institution Notes.

The autumn meeting of the Institute of Metals is to be held at Barrow-in-Furness on Sept. 15 and 16. Various social arrangements have been made and a number of Papers will be read.

It is announced by the Association des Ingenieurs Electriciens sortis de l'Institut Electrotechnique Montefiore, of Liége, that the Montefiore prize for the best original work on the progress in the theory and technical applications of electricity will be awarded in 1921. The prize, which will be about 20,000 francs, is awarded triennially, and is open to foreigners. Works may be printed or type-written, and the award is made by a jury of 10 electrical engineers, of whom five will be Belgian. The last day for submitting an essay, which may be in either English or French, and of which there should be 12 copies, is April 30, 1921. Communications to M. le Secretaire-Archiviste de la Fondation George Montefiore, 31, rue Saint Gilles, Liége.

The British Engineering Standards Association has issued Report No. 122, dealing with British Standards for milling cutters and reamers and giving the results achieved in the standardisation of the nomenclature and definitions of these tools. The panels appointed to carry out the various sections of the work were thoroughly representative, and the tools considered were divided into four classes, namely: non-relieved cutters, end mills, form relieved cutters and reamers. The Report commences with definitions of the various classes of milling cutters and reamers, followed by definitions of various types of each class, each type being accompanied by a clear explanatory diagram. In part 2 there are 58 tables giving the standard dimensions and tolerances of the various tools, including tables of Brown & Sharpe and Morse tapers. Standard dimensions of arbors and keys and keyways are also given. The price of the Report is 1s. 3d. post free, and copies can be obtained from the Secretary, 28, Victoria-street, S.W. 1.

Personal and Appointments.

Dr. H. S. Hele-Shaw has been elected Emeritus Professor of Engineering in the University of Liverpool.

Mr. J. Govan, of Belfast, has been appointed teacher of engineering at the Portadown technical school.

Mr. W. T. Leech has been appointed Assistant Secretary to the Post Office, in place of Mr. A. H. Norway, C.B., who has retired.

Mr. Clement Johnson has been promoted to the position of rolling-stock superintendent of the Sheffield Corporation tramways.

Mr. H. E. Cordell has been appointed car works superintendent at the Hyde-road works of Manchester Corporation at £500 per annum, plus Civil Service bonus.

On his marriage to Miss Dorothy N. A. Holden, Mr. Thomas A. Kingham, A.M.I.E.E., borough engineer of Kingston-on-Thames, has been presented by the staff with a drawing-room clock.

Mr. F. W. Mills, chief electrical engineer of the South African railways, who has been on a visit to this country in connection with the forthcoming electrification of certain railway lines, is now in the United States.

Mr. S. Ronald Barclay, A.C.I.S., has resigned his position with the Buenos Ayres Great Southern Railway Company, upon his appointment as Secretary to the Automatic & Electric Furnaces, Ltd., 281-283, Gray's Inn-road, W.C.1.

Mr. Gilbert H. Flavel, chief officer of the P.O. cable ship "Alert," has been awarded the silver medal for Gallantry in Saving Life at Sea. In February last, whilst the "Alert" was engaged in repairing the Abbots Cliff–Grisnez No. 2 cable, a mine was brought up to the bows of the vessel entangled in the cable. Mr. Flavel had himself lowered in a boatswain's chair over the bows to the mine, and released it by cutting the wires with which it had been entangled. By his courageous action, Mr. Flavel probably averted a serious disaster.

At a smoking concert held at Hebburn on Monday, the staff and employees of Messrs. A. Reyrolle & Company, electrical engineers, bade farewell to Mr. William Lemmon, departmental manager, who is leaving for Australia, where he will be the firm's representative. Mr. Lemmon has been 19 years with the firm, and six years ago he became departmental manager. He is going to Melbourne to supervise the erection of switchgear which is being sent out by the firm, but later he will supervise the manufacture of switchgear for the firm at Sydney. The gathering was presided over by Mr. W. Harriman, works manager, and on behalf of the staff, foremen and workmen, Mr. A. E. Nicol, the oldest foreman, presented a silver tea service to Mr. and Mrs. Lemmon. On Friday last Mr. Lemmon was also presented with a silver cigarette holder and case on behalf of the outside staff of the company's northern section.

Bankruptcies and Liquidations.

The examination of Jardine M'Kerlie, electrical engineer and contractor, 195, Crow-road, Partick, Glasgow, will take place in the Summary Court, County-buildings, Glasgow, on Aug. 23.

E. Goossens, Pope & Company, Ltd., is winding up voluntarily, and Mr. P J. Payne, 36, Basinghall-street, London, E.C., has been appointed liquidator.

A meeting will be held at the office of Mr. E. C. Price, Finsbury-court, Finsbury-pavement, London, E.C., on Sept. 21, to receive an account of the winding up of the Tramways & General Works Company, Ltd.

Arthur Kershaw and Chas. Herbt. Wood, electrical engineers and merchants, 9, Bradford-road, Dewsbury, have been adjudicated bankrupt. The first meeting of creditors will take place to-day (Aug. 20) and the public examination on Oct. 7, both at the County Court House, Dewsbury.

Mr. Albert Gray, 9, Fountain-street, Halifax, has been appointed trustee in the bankruptcy of Johnson Jagger, electrical engineer and contractor, 28, Northgate, Halifax.

The "Z" Electric Lamp Mfg Company, Ltd., has gone into voluntary liquidation, with Mr. B. H. Binder as liquidator. A statutory meeting of creditors will be held on the 31st inst. at Orient House, New Broad-street, E.C. It is proposed that Messrs. W. Crawford and J. Scrivener, who have been associated with the company for many years, shall acquire certain assets of the company and continue the business as a going concern. Such an arrangement will ensure no interruption in the conduct of the business, and, furthermore, will provide for the payment in full of all creditors. A new company will be formed to operate from a London address, but in the meantime trade requirements are being promptly met from the company's works at Southfields, S.W.18.

Business Items, &c.

The new address of Messrs. E. G. Acheson, Ltd., is 40, Wood-street, Westminster, S.W.1. Telegrams: Oildag Vic London; telephone: Victoria 9848.

We are informed that the two new sizes of low wattage Royal Ediswan Gas-filled Lamps (100/130 volts, 40 watts; 200/240 volts, 60 watts), recently introduced, are making great headway on the market, owing to their particular suitability for private house lighting, or in fact for any situation where ordinary drawn wire lamps are in use. The high intrinsic brilliancy and concentrated light of the gas-filled lamp, coupled with its low current consumption, makes it the most efficient and economical lighting unit available. The Edison Swan Electric Company have made considerable extensions to their Ponders End works, especially for the manufacture of the lamps, and with improved methods of manufacture now in operation, large quantities of the Royal Ediswan gas-filled lamps are becoming available for quick delivery.

Tenders Invited and Accepted.

Warrington Corporation want tenders by Sept. 7 for surface condensing plant. Specification from Borough Electrical Engineer.

Southampton Corporation require tenders by Sept. 1 for an electric travelling crane to lift from 30 cwt. to 2 tons. Particulars from the Borough Engineer.

Arbroath Corporation require tenders by Aug. 24 for electrical installation work in 44 houses at Fishergate. Specifications from the Town Clerk.

West Ham Guardians require tenders by 10 a.m. Sept. 9 for six months' supply of electrical fittings, ironmongery, oils, &c. Forms of tender from the Clerk, Union-road, Leytonstone, London, E.11.

Nuneaton Corporation want tenders by Sept. 20 for h. and l.t. switchgear, connecting cables and accessories. Specifications from the Borough Electrical Engineer.

Edinburgh Corporation want tenders by Sept. 6 for converting plant for Portobello generating station and sub-stations (specification 26). Specification from the Engineer, Dewar-place, Edinburgh.

Manchester Electricity Committee require tenders by Aug. 24 for a steam turbine-driven boiler feed pump for Stuart-street station. Specification from Mr. F. E. Hughes, Town Hall, Manchester.

Portsmouth Corporation invite tenders for a 4,000 kw. turbo-alternator and two water-tube boilers. Specifications from the Acting Engineer and Manager, and tenders to the Town Clerk by Aug. 25.

Electric lighting plant is required for the city of Ponta Delegada, S. Michel, Azores. Tenders by Sept. 28. Specification (in Spanish) may be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

Renfrew Corporation want tenders for electrical installation work in 354 houses comprised in the Loanhead housing scheme. Contractors wishing to tender are requested to send their names to the Town Chamberlain by Aug. 25.

Croydon Corporation invite tenders for the supply and installation of a new feeder cable for the tramways department. Specifications from the Tramways Manager, and tenders to the town clerk (Mr. J. N. Newnham) by 11 a.m. Sept. 8.

The South African Railways & Harbours Department, Johannesburg, require tenders by Oct. 25 for metal filament lamps for train lighting. Specifications may be seen at the Department of Overseas Trade, 73, Basinghall-street, London, E.C.2.

Bradford Corporation invite tenders for the supply and erection of Boiler House Equipment, including Buildings, Water-tube Boilers, Economisers, Induced Draught Plant, Feed Pumps, Coal Handling Plant, and Piping Systems. Specifications, &c., from the city electrical engineer, Mr. Thomas Roles, and tenders to the town clerk, by Sept. 9.

Johannesburg Municipal Council require tenders by Sept. 6 for the supply of one or more light electric passenger vehicles and one or more light electric delivery vehicles. Specification from and tenders to the London agents, Messrs. E. W. Carling & Company, St. Dunstan's-buildings, St. Dunstan's-hill, London, E.C.

The Electricity Committee of Bolton Corporation invite tenders for the supply and erection of one 12,000 kw. turbo-alternator. Specifications and form of tender from the borough electrical engineer, Mr. W. J. H. Wood, and tenders to the town clerk, Mr. Samuel Parker, by noon, Sept. 16.

Walthamstow Council require tenders by 5 p.m., September 8, for (contract 43) two water-tube boilers and economisers; (44) 5,000 kw. turbo-alternator and condensing plant; (45) 1,500 kw. and 1,000 kw. rotary or motor converters; (46) natural draught cooling tower; (47) e.h.t. switchgear; (48) l.t. switchgear; (49) e.h.t. cables. Specifications, &c., from the Electrical Engineer, Priory-avenue, Walthamstow.

The Municipal Board of Agra (India) require tenders for four Diesel engines and h.t. alternators, h.t. and l.t. switchgear, transformers and sub-station equipment; 15 miles of underground h.t. cables, 28 miles of overhead l.t. mains, street lighting equipment, &c. Specifications from Messrs. Handcock & Dykes, 11, Victoria-street, Westminster, S.W. 1, to whom tenders by 10 a.m., Oct. 22

Liverpool City Council has placed an order with the British Electric Transformer Company for 12 months supply of transformers.

St. Pancras Borough Council has accepted the tender of Marshall, Fleming & Company for a 30-ton travelling crane, at £3,365.

Nuneaton Corporation has placed an order with the English Electric Company for the supply and erection of a 500 kw. rotary converter, transformer and accessories, at £3,989. There were seven tenders, ranging in amount from that of the accepted to £4,637.

Nuneaton Council has also accepted the tender of Escher, Wyss & Company for a 1,000 kw. d.c. geared turbo-generator at £11,328. (There were 11 tenders, varying in amount from that of the accepted to £17,7.0.) For the surface condensing plant, the tender of Cole, Marchent & Morley (at £4,348) was accepted.

British Electric Vehicles, Ltd., Churchtown Works, Southport, have received an order from the New Zealand Government for three of their locos to haul loads of 20 tons, complete with three motor generator sets, switchboards and all the necessary accessories. The locos are for use in conjunction with the hydro-electric schemes which are being carried out in New Zealand.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by MESSRS. MEWBURN, ELLIS & CO., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919 SPECIFICATIONS.

144,021 ROGERS. Electric vehicles. (7/10/19.)
144,024 WATSON & M. L. MAGNETO SYNDICATE. Dynamos. (9/4/19.)
144,073 PEARCE & METROPOLITAN VICKERS ELECTRICAL CO. Protective gear for alternating-current systems. (24/5/19.)
144,075 BRITISH THOMSON-HOUSTON CO. (General Electric Co.). Radial signalling systems. (26/5/19.)

Relates to a method of obtaining a desired value of feed resistance in an antenna having a plurality of grounding connections with tuning coils therein, and having means for introducing the energy through one of the ground connections which consists in neutralising a portion only of the distributed capacity of the antenna adjacent each ground connection by means of the tuning coils therein and neutralising the remainder of the distributed capacity of the antenna by means of the tuning coils in the connection through which the energy is introduced to the antenna.

144,108 BURRELL & SMITH. Electric switches. (20/6/19.)
144,122 AMBERTON. Electric circuit controllers. (8/7/19.)
144,152 WESTERN ELECTRIC CO. Combined telephone and telegraph systems comprising amplifying or repeating apparatus. (2/9/19.) (Addition to 143,949.)
144,175 CLIFFORD OF CHUDLEIGH (Clifford) Baron. Dynamo-electric machines. (17/10/19.)
144,182 AUDRAN. Electrical installations for controlling electric pianos and other apparatus. (18/7/19.)
144,183 SHARP & MARIN. Trolley-heads for electric tramcars. (3/11/19.)
144,191 BRITISH THOMSON-HOUSTON CO. (General Electric Co.). Bushings for electric conductors. (11/11/19.)
144,352 CRABTREE. Electric switches. (20/2/19.)
144,369 GILL. Electrically-operated engine-starters for self-propelled vehicles an other purposes. (6/3/19.)
144,371 WILSON, SHEPHERD & POWELL & HANMER. Means for controlling or regulating dynamo-electric machines. (6/3/19.)
144,376 ISHERWOOD. Earth connection for dissipating electric charges. (8/5/19.)

An earth connection which primarily makes contact with earth without inductive turns, and in which the metallic path in contact with the earth is in the form of a helix of gradually decreasing radius.

144,419 WYNNE. Electrical fuses. (1/4/19.)
144,438 CAMPBELL, GIFFORD, WAITE & TAYLOR. Control of power absorbed in an electric furnace. (25/4/19.)
144,446 BARR. Electrical water-heating apparatus. (7/5/19.)
144,447 HARRIS. Bearings for electricity motor meters. (7/5/19.)
144,456 MALLINS & BARKER. Trolley wheel fittings for the trolley poles of electrically-propelled vehicles. (19/5/19.)
144,503 B.T.-H. CO. & HASTINGS. Electric arc furnaces. (17/7/19.)
144,509 JEAL. Means for starting internal-combustion engines, adapted also to be used for generating electric current. (1/8/19.)
144,525 WRIGHTON & EDISON SWAN ELECTRIC CO. Electrical indicators and the like. (15/9/19.)
144,757 WILSON. Thermo-electric apparatus. (18/2/19. Cognate application, 18,612/19.)
144,761 RAHBEK & JOHNSEN. Apparatus especially useful as relay, oscillograph, telegraph, telephone, automatic-current or tension-regulator, and other arrangements sensitive to variations of electrical tensions. (6/3/19.)
144,767 BRITISH-THOMSON-HOUSTON CO. (General Electric Co.) Electric heating units, and methods of manufacturing the same. (12/3/19.)
144,777 FROST & CO. & WELCH. Pressure-operated electrical cut-outs. (13/3/19.)
144,778 FROST & CO. & WELCH. Electrical cut-outs. (13/3/19.)
144,782 ELECTROMOTORS, LTD., LONGBOTTOM & GREENHALGH. Electric driving and controlling gear for planing-machines. (14/3/19.)
144,800 ROHMAN. Brush rocking-gear and terminal mechanism for dynamo-electric machines. (17/3/19.)
144,802 MORGAN CRUCIBLE CO. & SPEIRS. Electrically-heated furnaces. (17/3/19.)
144,803 BRITISH THOMSON-HOUSTON CO. (General Electric Co.) Wireless signalling systems. (17/3/19.)

Comprises an antenna supplied with high-frequency current, an oscillation transformer or resonant circuit coupled with the antenna and connected to an electron discharge relay or pliotron, and signalling means, such as a telephone transmitter, connected with the relay for varying the amount of energy diverted from the antenna by the relay in accordance with the signals to be transmitted.

144,807 OLDHAM & OLDHAM. Galvanic batteries. (18/3/19.)
144,841 OLIER & ROUSSILLON. Manufacture of lead-covered electric cables. (30/4/19.)

APPLICATIONS FOR PATENTS.

NOTE.—*Names within parentheses are those of communicators of inventions.*

March 4.

6,587 THOMAS. Electrical clinometer.
6,591 AUTOMATIC TELEPHONE MFG. CO. & SAVIN. Telephone systems.
6,639 B. T.-H. CO. & SHUTTLEWORTH. Regulating dynamos, &c.
6,646 CLARK'S NEO-ELECTRIC DEVICES, LTD. Electric measuring instruments.
6,654 OLDHAM. Galvanic batteries.
6,656 BRITISH L. M. ERICSSON MFG. CO. & CROWE. Automatic or semi-automatic telephone systems.
6,658 CUSINS & FULLER & LEMON. Wireless telegraphy.
6,667 AKT. GES. R. BOSCH. Air cooling arrangement for electric generator set. (9/8/15, Germany.)
6,678 DINE, SMITH & STOCKS. Electric control of tipping gear on vehicles.

March 5.

6,693 CONNER. Metal contacts for electrical apparatus.
6,739 VERITZ. Electric radiator.
6,773 SEGAL. Electric condensers. (8/7/19, France.)
6,780 SUTTON. Electro-thermal absorber generator for separation processes.

March 6.

6,832 MECHANICAL SUPPLIES, LTD., & BAYNES. Electric signalling apparatus.
6,855 AUTOMATIC TELEPHONE MFG. CO. (Mercer & Carter). Automatic telephone systems.
6,900 ATKINSON. Reception of signals by wireless telegraphy.
6,901 SIEMENS-SCHUCKERTWERKE. Apparatus for electrically-driven submarine. (5/12/14, Germany.)
6,914 SEGAL. Electric condensers. (14/8/19, France.)

March 8.

6,739 MATHIEU. Electric valve or lamp relay and intervalve transformer.
6,974 THORNYCROFT. Wireless telegraphy and telephony.
6,977 SIEMENS & PETITHORY. Subscribers' instruments for telephone systems.
6,988 MEISSNER INVENTIONS CORPORATION. Telephone transmitters.
6,980 SULLIVAN. Electric heaters.
6,993 DUPREE. Safety switches for battery charge and discharge control, &c.
6,998 PORTER. Electric therapeutic plates.
7,020 BERNARD. Electric heater.
7,023 HOLLAND & PEARSON. Batteries. (5/9/19, U.S.)
7,024 HOLLAND & SKINNER. Batteries and separators for elements therefor. (17/5/19, U.S.)
7,038 HALL. Electric circuit breakers, &c.
7,046 FOCHL. Re-magnetising device. (20/3/18. U.S.)

Forty Years Ago.

(THE ELECTRICIAN, AUGUST 21, 1880.)

CHICAGO.—The City Council is considering the necessity of placing all telegraph and telephone wires in the ground. A committee has been formed to report on the subject.

CABLE COMPANY SHARES.—It will be noticed that last week the ordinary shares of the Eastern Telegraph & Eastern Extension were quoted at par, the first time this has occurred for several years.

THE SOCIETY OF TELEGRAPH ENGINEERS.—We would remind foreign members of this society that their opinion upon the proposed change of title should be posted so as to reach London by the end of October, the general meeting to decide the question being announced for November.

"NO NEWS IS GOOD NEWS."—We are spitefully reminded of this old saying in connection with the over hasty telegram which startled all London the other afternoon for several hours, announcing the loss of nearly a thousand lives at sea. Had there been no means of communication with Aden except the post, it would have informed us of the safe arrival of the deserted pilgrims at the same time that it brought us the by no means equally welcome intelligence that the captain and his party had taken particular care to save themselves. No news, however, is sometimes bad news, and we may charitably suggest that if the telegraph gave as full details as the post, the captain's conduct would not be thought so bad as it looks.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics,"—"The Air Ministry Tests"; "An Uncommon Dynamo"; and "Britain's Part in the Air."

"The Cabinet Maker."—"Barnstaple: The Work of the Local Art School"; "Practical Polishing"; and "Shuffle Board Tables."

"The Chemical Age."—"The Preparation of Catalysts," by A. A. Pollett, M.Sc.; and "Manufacture of Phosgene: Experiments at Gretna Factory."

"The Fruit-Grower."—"Increased Railway Charges"; "Fruit and Vegetable Exchange of Great Britain"; and "White Fly on Tomatoes."

"Gas World."—Sir Dugald Clerk on "Gas and Electric Efficiencies"; "Gas Engine Indications," by W. A. Tookey; and "Valuation of Scottish Gasworks on Transfer from Company to Local Authority."

"Hardware Trade Journal."—"The New Goods Rates"; "Putting up Belting"; and "The Brush and Broom Trade Board."

"Ways and Means."—"Effect of Change in Hours of Work on Output (I)," by Dr. H. M. Vernon; "Civil Aviation in British Dominions," by Major P. L. Holmes; and "Causes of High Prices," by John Johnston.

Prices of Metals, Chemicals, &c.

TUESDAY, Aug. 17.

		Price.	Inc.	Dec.
Copper—				
Best selected	per ton	£106 0 0	—	£3 0 0
Electro Wirebars...	,,	£116 0 0	—	£1 0 0
H.C. wire basis......	per lb.	1s. $4\frac{5}{16}$d.	—	$\frac{1}{8}$d.
Sheet	,,	1s. $5\frac{7}{8}$d.	—	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. $9\frac{5}{16}$d.	—	$\frac{1}{8}$d.
Brass 60/40—				
Rod, basis	,,	0s. $10\frac{3}{4}$d.	—	—
Sheet, basis	,,	1s. $4\frac{1}{2}$d.	$\frac{1}{4}$d.	—
Wire, basis	,,	1s. $3\frac{7}{8}$d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 10 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£38 0 0	—	£2 0 0
Foreign or Colonial	,,	35 7 6	—	£1 7 6
Tin—Ingot	,,	274 10 0	—	£5 10 0
Wire, basis	per lb.	0 3 $5\frac{1}{2}$	—	$1\frac{3}{4}$d.

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 8d.

Sodium Chlorate.—Per lb. $5\frac{1}{4}$d.

Rubber.—Para fine, 1s. $9\frac{3}{4}$d.: plantation 1st. latex, 1s. $10\frac{1}{2}$d. per lb.

Shellac.—T.N. Orange, 670s.–675s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and rubber prices by Messrs. W. T. Henley's Telegraph Works.

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Notes.

The Work of the Electricity Commissioners.

SOME idea of the policy of the Electricity Commissioners may be obtained from the Report issued by the Ministry of Transport and abstracted in another column. This is the first report of its kind, and it naturally covers a good deal of ground. It is pointed out that a preliminary survey of the present and prospective electrical requirements of the greater part of the country has now been made and some ten electricity districts have already been provisionally defined, though no local inquiries have been held, and, of course, no scheme for a Joint Electricity Authority has yet been approved. This is all useful preliminary work. It is, moreover, pretty clear from the reference to the recent Nottingham inquiry that care will be taken to prevent the erection of competing generating stations in a district, and that before sanctioning a scheme of extensions to an existing station the Commissioners will satisfy themselves it is not only technically sound but that there is no economical alternative source of supply available. We are glad to notice that the policy of allowing the use of overhead wires is being adopted to an increasing extent and that during the past year many consents were given to the use of overhead lines especially in rural districts. The method of dealing with the four applications for Provisional Orders transferred from the Board of Trade does not strike us as a model of despatch, but speed is not a usual characteristic of a Government department.

The Repayment of Loans.

THE question of the periods allowed for the repayment of loans raised by electricity supply undertakings appears to have been carefully considered, and some of the terms have been slightly extended. We have always contended that municipal electricity supply should be run on strictly business principles and the length of the period allowed for repaying borrowed money has an important bearing on the success of an undertaking. We note that the Commissioners say that the scale of maximum periods provisionally fixed by them is within the estimated life of the various assets forming part of an electricity undertaking, and in the majority of cases we have no doubt that this will prove to be the case. No exception can be taken to the periods usually allowed for mains and services (25 years), for buildings (30 years), or for plant, including rotary converters and transformers (20 years). The period of 40 years seems, however, too long for high-tension trunk cables, as does the 60 years granted for the purchase of sub-station sites and the 25 years for overhead lines. It is possible that time will justify these favourable terms, but in the absence of undoubted engineering experience we would prefer to see the error made on the right side, *i.e.*, to see the period fixed at too low rather than too high a figure. The seven years allowed for apparatus, fittings and appliances to be let on hire and the ten years for Diesel engines seems to err on the other side and are inadequate. Little objection can be taken to the periods for repayment of loans for the other items, except perhaps in the case of meters, fittings and furniture (ten years). It would be better to compel undertakers to provide for these out of current revenue. The report also deals with the question of increased charges which have been allowed in 41 cases, with the extension of the powers of distribution into other districts and with the permission that has been given to municipal undertakings to subscribe to certain Associations. There is sufficient indication that an enlightened policy is being followed in all these matters, and we hope this will long continue to be the case.

The British Association.

WE believe we are not misstating the objects of the British Association for the Advancement of Science when we say that it aims at bringing before the general public in an easily digestible form the latest discoveries and problems with which science is concerned at the moment, and equally at keeping the public informed of the advances that are being made in each branch of scientific knowledge. To fulfil that object the programme each year should, therefore, be an indication, not only of what is being done, but of the lines along which future progress will probably be made. Examining this year's programme from that point of view we are forced to the conclusion that we are making the greatest advances as far as the physical science is concerned in solar, atomical and mathematical physics, while something is also being done towards adding to our knowledge relativity, of spectroscopy and geology, But nothing, much is being done in electricity. In chemistry, industrial alcohol and lubrication, both highly important subjects, find high places, while in engineering questions relating to the testing of materials, internal-combustion engines and steam action in simple nozzles are among the subjects discussed. Right at the end of the programme comes one Paper by Prof. G. W. O. Howe on "The Efficiency of Transmitting Aerials and the Power required for Long Distance Radio-Telegraphy." It is indeed a long time since we remember so few papers on subjects relating to electrical science and engineering in either Sections A or G.

Electricity no Longer a Science?

It would be interesting to know the reason for this. Is it that the study of electricity has passed out of the realms of science into those of technology and has, therefore, ceased to be of interest to the British Association? Or is it that the curve of progress of our knowledge of electrical phenomena has reached a saturation point, and there is little or nothing to be gained by a further study of its details? It is obvious that neither of these is the true explanation and we are therefore led to suppose that there is either a lack of enterprise on the part of those who organise the literary side of the meeting or a reluctance on the part of those who are working in the fields covered by the objects of the Association to present the results of their researches before such a body It is not our duty to apportion blame for this neglect, we merely state the case. But we do so feel that at a time when electrical science is being more and more applied to the solution of industrial and domestic problems it is a pity that an opportunity such as the Annual Meeting of the British Association affords of placing what is being done in simple and, as far as possible, in non-technical language before the general public should have been so conspicuously missed. Such a gathering is a great chance for our leading scientists to come into contact with the public and also for our coming men to learn something of what is being done in other branches of knowledge than that in which they are themselves working; and full advantage should be taken of it.

The Presidential Addresses.

The field covered by the British Association is so large that it sometimes happens that the Presidential Address deals with a subject that is outside our purview. This year is a case in point, for the President, Prof. Wm. A. Herdman, C.B.E., F.R.S., dealt with advances that have been made recently in biological oceanography. Incidentally, however, he mentioned that it was at the Cardiff meeting in 1891 that Sir Oliver Lodge, in his address to Section A, put forward the idea of establishing a national institution for the promotion of physical research on a large scale. This idea was the germ of the National Physical Laboratory whose influence on the advance of physical and engineering knowledge, both in peace and war, cannot be over-estimated. Prof. A. S. Eddington, in his address to Section A, dealt with the internal constitution of the atom, while Prof. C. T. Haycock, in his address to Section B, dealt with the recent additions that have been made to our knowledge of the alloys. On the other hand, Prof. C. F. Jenkin, in his address to Section G, dealt with the important question of increasing our knowledge of the fundamental data on which engineering ideas of the strength of materials are based. We deal with the points raised in this address more fully in a Leading Article on another page of this issue, and we need only say here that many of the arguments advanced by Prof. Jenkin are not without their application to the problems of electrical measurement. On the whole, it may be said that the British Association is doing good work. But it must not be forgotten that to maintain its standard of usefulness it must move with the times. It is unfortunate that the success of the gathering should have been marred by a local tramway strike and other industrial disturbances.

The Telephone System.

It is, we believe, a well-known legal principle that when you have a weak case the best policy is to attack the other side. From this it naturally follows that the greater the stridency of an argument the more it is under the suspicion of having little behind it. A week or two ago we referred to the attack which had been made on the telephone service of this country and its administrators in a series of articles in "The Times"; and pointed out that though the management and operating side might both show considerable room for improvement the really good work that had been done on the engineering side had not received the recognition it deserved. In this issue we are able, in the course of an article which deals with the various activities of the Post Office Engineering Department, to expand this statement in a way that we hope will be of interest to our readers.

What Our Telephone Engineers Have Done.

It is peculiar that, as the writer points out, the telephone system is the one branch of the Post Office activities, since we may add the death of the late Sir J. Henniker Heaton, which is subjected to constant attack in spite of the fact that the system has always progressed and is at the present time advancing more rapidly than ever before. Can this be due to the fact that it is the only branch of Post Office work in which the public plays an active part? It would be distressing to think that this were the case. But it is an easy deduction to make, and one which is not so easily refuted. It is only fair to point out that along with the progress that is indicated by an ever-increasing number of subscribers has gone a large amount of reconstruction with a view to a modernisation of the plant, so as to provide a more efficient service for that much harassed individual, the subscriber. It must also be added that investigations have been made into such questions as the use of automatic apparatus, "wired wireless" and repeaters with the same end in view, and that this modern equipment has not only been tried but is actually in use. It is unfortunate perhaps that the Post Office do not keep the public more acquainted with what they are doing, but the latter would probably not be much interested if they did. For what is wanted on these occasions is sensationalism rather than truth, and a "good story" is better than a well-considered argument.

Still Room for Improvement.

We do not mean to imply that in our opinion the Post Office administration of the telephone system is above criticism. There is certainly room for great improvement, but the same might equally well be said of any other Government or municipal department and of any privately owned concern. Its very largeness is a check to efficiency. Moreover, its administration is entirely in the hands of bureaucrats who have passed almost from their swaddling clothes into the office chair and are quite without business training of the ordinary kind. The financial arrangements are weird and peculiar, and seem chiefly designed to prevent the true position of the undertaking being known. Indeed, taking everything into consideration, the wonder is not that the system is no better but that it is no worse. But the improvement of the administration of a Government Department is one before which the labours of Hercules are like child's play, and public pressure must be great and persistent if any change is to be made.

The Electric Lighting of Motor Cars.

In the days of horse traction nobody used the roads after dark unless they were obliged. For this and for other obvious reasons the oil or candle lamps provided on the carriages gave only sufficient light to illuminate a distance not more than a few feet in advance of the horse, and besides did little more than indicate that a moving vehicle was abroad. With the coming of the motor-car all this changed. Journeyings at night became a necessity and would also have been a pleasure had it not been necessary to depend upon messy acetylene appliances or unreliable electrical equipment. So obvious was it, however, that electric lighting was the best to use for this purpose that designers set to work to solve the various problems thus raised, with the result that there is now on the market equipment which is both efficient and reliable. Along with this has gone a decline in the use of acetylene apparatus and, as is well known, all modern pleasure motors cars are fitted with electric lighting. We have no doubt that the same statement will soon be true about commercial vehicles, whose use for the conveyance of goods is steadily increasing both for the sake of convenience and as the result of high railway rates.

Electrical Conditions.

In an article which we publish in another column of this issue Mr. C. H. Stephenson draws attention to certain difficulties which have had to be overcome. As he points out, the problems met with are by no means easy of solution and necessitate the use of compromises which would not be tolerated in other spheres of electrical work. The advantages of electric lighting are briefly that it avoids the mess and danger inseparable from the use of acetylene and that it gives a better light. The conditions under which a motor-car is used, however, impose certain difficulties on the designer, among them the provision of a dynamo which shall supply its full output at a speed somewhat below the legal limit, and whose output shall decrease as the car speed rises. Such a machine has never been constructed and the desired effect has therefore to be obtained by other means. But this is not all, as the provision of electric lighting carries with it the demand for automatic starting equipment. This apparatus must, as far as possible, be combined with that used for lighting, though naturally the conditions under which it has to work are very different.

The Starting Problem.

The particular problems connected with the use of starting apparatus are the provision of a heavy current from a battery whose capacity is limited by considerations of weight, suitable switchgear and gearing and a small and powerful motor. It follows that great care must be taken not only in the design and manufacture of the parts, but in ensuring that adequate arrangements are made for charging the battery and keeping it charged under the worst conditions of operation. But while much has been done, it is obvious that perfection has not been reached yet, and Mr. Stephenson gives some useful hints as to the lines along which future improvements may be made. In our opinion the essentials are simplicity, robustness and efficiency in the order named. It has to be remembered that few motorists have any great electrical knowledge, and that while the increasing use of such apparatus will surely assist the use of electricity for all purposes, if care is not taken to ensure its proper operation a move in the opposite direction will be correspondingly rapid.

The Coal Crisis.

The clear and very fair statement of the points at issue in the miners' latest claims which has been appearing in the Daily Press has had the result of driving Mr. Smillie into the open. The miners, he says, are determined upon nationalisation, but they would be prepared to drop their claims if these could be proved unfair or unjust. This should not be difficult in at least one respect. For it is so obvious as to be almost axiomatic that a coal strike at the present time will bring discomfort, unemployment and penury in varying degrees to everyone in the country and not least to the miners' fellow workers. Is it worth it ? This is a question to which only one answer can be given ; and it is an answer that is unaffected by reiterating the alleged rights and wrongs of the case. The miners have their grievances, no doubt, but they are not alone in that ; and we put it to them that it is best for them to remain at work, especially as their own leader believes that the strike has been planned in the interests of the mine owners. We are glad to see that the question is engaging the attention of the other Unions, and we hope that due note will be made of the protest of Mr. Frank Smith, secretary of the Engineering and Shipping Trades Federation, against this " policy of strike action which is affecting us all." No means should be left unexplored to prevent a strike, and though we are not optimistic as to the result of negotiations at this stage we hope for the best. Opportunity might be taken at the same time to avert the lock out of the Electrical Trades Union members, an action which is likely to be more than local in its effects.

A National Electrical Settlement.

Owing apparently to some hitch in the postal arrangements we did not receive a copy of the agreement which has been entered into between the National Federated Electrical Association and the Electrical Trades Union in time to comment upon it in last week's issue. Although, therefore, the subject is news no longer we may perhaps point out that under this agreement the country is divided into four districts in which payment will be made at certain scheduled rates. The highest paid district is London, where 2s. 6d. per hour is to be paid, followed by a number of industrial districts such as those comprised in the Manchester, South Wales, Mersey, Sheffield, Birmingham and Tyneside areas. In the third class are the smaller industrial towns such as Southampton, Devonport and Chatham and a number of country districts mainly in the south, while the fourth class comprises the rest of England and Wales. The agreement is interesting from the fact that it admits the principle of differentiation between town and country districts for which we have always contended. But what concerns us at the present time is how long it will be kept and whether it will or will not be broken within the next few weeks for some more or less adequate reason. For our part, we sincerely hope it will be kept, for the electrical industry no less than the E.T.U. cannot at the present time afford to play fast and loose with its prospects.

Electricity Supply Charges.

Orders authorising an increase in the statutory maximum charge for electrical energy continue to be made in increasing numbers. In fact, during the past week five or six have been issued. This is the natural sequel to the high price of coal and other materials and to the various awards of higher wages and salaries to the employees. For some small undertakings the maximum charge has been increased to a shilling or 1s. 2d. per unit, and owing to the present upward trend of things this may not be sufficient. We hope, however, that it will, for when the maximum reaches a shilling, although it may only apply to a few consumers, it is difficult to see how any supply authority can make progress with such high charges. From the latest Orders we learn that the maximum at Clacton has been fixed at 11d. per unit, and at Dublin 45/- for the first 60 units and 8d. per unit thereafter, and in both Orders it is laid down that " the price to be charged shall not be more than sufficient so far as can be estimated by the Council before the commencement of the period for which the charge is made to enable the said undertaking to be carried on without loss." At Killarney the maximum is 10d. and the company is authorised "to pay a dividend on the ordinary stock or shares at a rate of not more than three-quarters of the pre-war rate of dividend," a concession which will not enable the shareholders to indulge in riotous living, for as far as our recollection goes the Company has never paid a dividend.

Bureaucratic Ignorance.

We are astonished, however, to find that the Ministry of Transport has inserted a clause in the three Orders referred to providing that a rebate shall be made to consumers of electricity for domestic or household purposes "in accordance with the Prescription by the Controller of Coal Mines to Electricity Undertakings, dated the 30th December, 1919, in respect of the deduction of 10s. per ton on the price of coal used for the generation of electricity, &c." Evidently the gentleman who drafted the Orders is unaware of the decontrol of coal for domestic purposes and that the Household Fuel & Lighting Order was suspended on June 7 last. Coal mining is now under the control of the Board of Trade, and as electricity supply no longer interests that Department it is too much to expect that one Government Department should make itself acquainted with the acts of another. We were, however, given to understand that the Ministry of Transport was at all events businesslike, but apparently a few brief months of existence has been enough to cause it to fall into the traditional official method of doing things.

The Goldenberg Generating Station in Germany.

In a recent issue of the "Elektrotechnische Zeitschrift," some particulars are given of the progress of the vast Goldenberg works of the Rheinisch-Westfalische Elektricitätswerke during the period 1913-1919, to which we referred briefly some months ago. During the war the output rose from 290 to 772 million units, chiefly owing to the large metallurgical and electro-chemical demands. But it is significant that subsequently the high-water mark of 1917-18 was not attained, the output falling to 688 million units, and this despite the fact that the demand for electricity for lighting increased by 30 per cent. owing to the withdrawal of war restrictions. The plant installed includes six turbo-generators each of 15,000 kw., and two of 50,000 kw., but of the latter only one is actually ready for work. This is considered to be the biggest steam-driven plant in Europe. The existing boilers have a heating area of 330,000 square metres, and the Rhine is spanned by 100 kw. conductors in five places, the greatest span being 505 metres, and the towers 106 metres high. It is, in fact, a real super-station.

Modern Research.

In calling attention last week to the incorporation of the Electrical Research Association we divided the work that is being undertaken by that Institution, to increase our knowledge of electrical phenomena, into two classes according as to whether it was more immediately concerned with fundamental principles or with investigations leading to the improvement of materials and apparatus already employed. This division, however, is more apparent than real. It is evident that advances in our second class can only be effected by increasing our knowledge of the basic physical principles with which our first class has to do, and thus determining the why and the wherefore of the varying behaviour that occurs in the materials we are employing. There is a great deal to be done in this direction, for at the present the successful use of much material depends more on rule-of-thumb experience than upon real knowledge. This is, it will be admitted, a somewhat sandy foundation, and a sounder basis is needed.

The War and Research Work.

This subject is one of the greatest interest and importance, not only to engineers, but to the public generally; and we are, therefore, glad that Prof. C. F. Jenkin made it the theme of the presidential address to Section G of the British Association which he delivered at Cardiff on Tuesday last. Like many other engineers, Prof. Jenkin during the war was engaged on research work for the Government, his particular branch of the services being the Royal Air Force, where he was mainly concerned with problems connected with materials of construction. As a result he reached the conclusion that the time has come when the fundamental data on which the engineering theories of the strength and suitability of materials are based require thorough overhauling and revision, especially as he discovered that in aeroplane engineering the problems to be solved raised fundamental questions in the fields of the strength and properties of materials which have never been adequately solved.

The Factor of Ignorance.

It has long been the proud boast of English engineers that their work is pre-eminent not only in design, but in solidity, and that in building for strength they are erecting lasting monuments to their knowledge and enterprise. To members of this school of thought Prof. Jenkin's arguments will come as a rude shock. Like Jeffrey, who, according to Sydney Smith, spoke disrespectfully of the equator, Prof. Jenkin has equal disregard for the factor of safety. And what he says on this question is worth attention. An engineer wants to know the strength of steel. As a means of discovering this he has the choice of a number of tests from which he may determine the ultimate strength: The yield point, the elastic limit, the elongation, the reduction of area, and the Brinell and Izod figures. But which of these tests give him what he requires, with anything like scientific certainty? None of them, says Prof. Jenkin. To use the ultimate strength requires the introduction of an arbitrary factor of safety. The yield point is equally illusory, and depends more often than not on the taste and fancy of the tester, while the other tests have similar drawbacks. It therefore seems that we must realise that there is no connection between test results and the stress we can safely call on the steel to bear, except that the two are linked by "that cloak of our ignorance—the factor of safety." This is a searching indictment, but there seems no reason to doubt its truth, and it is therefore obvious that the sooner we substitute real knowledge for the present empiricism the better it will be. It is in this direction that the work of our theoretical engineers must move.

A Scheme of Reconstruction.

Prof. Jenkin does not, however, demolish without suggesting schemes for reconstruction. He thinks that the fatigue limit and proof load should be accepted as the only sound basis for strength calculation for engine parts, and that extensive researches should be made into this question upon which our available data is most meagre; and that in this connection improved methods of testing are needed. Subsidiary questions are the investigation of the internal mechanism of fatigue failure and the determination of better methods of testing in torsion. The important point to notice, however, is that the time has gone by when failures can be avoided by making parts "stronger"—*i.e.*, heavier, and that such failures must be counteracted by finding answers to the questions, "What stress caused the fracture?" "What property of the metal was absent which would have enabled it to withstand the stress?" and "What other materials possess suitable properties to withstand the stresses better?"

The Discovery of Fundamentals.

The fundamental physical properties affecting these questions are probably very few, but Prof. Jenkin thinks that they may be discovered by researches of a general nature, in which the results depend upon one factor only at a time, so that general laws may be established which will be applicable to all special problems, as what is most needed is a real knowledge of the fundamental properties of materials. A consideration of these questions gives us a chance to realise the advances that the War has allowed us to make in our engineering knowledge. For to discard obsolete methods is in itself an advance. The necessity of producing efficient apparatus forced the cost factor into the background, and permitted a lavishness in many directions of a character which had never been seen before, and which, we hope, will never be seen again. But bad as this policy was from the financial point of view, it allowed great advances in engineering knowledge to be made in a shorter time than would otherwise have been possible. It not only added to our information, but it disclosed our ignorance. It not only cleared our minds of the old shibboleths, but suggested new methods of attack. It not only eradicated much conservatism, but introduced the cool blast of fresh ideas. It is to be hoped full advantage will be taken of the clearance and refurbishing which has thus been made possible.

The Position of Electro-Culture.

Electrical engineering is a subject whose ramifications are so wide that it is not surprising to find on its borders phenomena whose nature is not yet thoroughly understood. The reason may be either that no theory has been formulated with the help of which, like scaffolding, a structure may be built, even if it is found better subsequently to demolish the scaffolding when its usefulness has ceased; or it may be due to the part which electricity plays in the particular reaction under consideration being imperfectly understood, with the result that it is made responsible for certain factors which are really due to something else.

An Important Border-Line Subject.

The stimulation of plant growth by electrical means may usefully be taken as an example of one of these border-line subjects. It is a subject of which a great deal has been heard in the past and of which we may expect to hear still more in the future. But curiously enough at the moment it seems to have relapsed into a semi-moribund state, one of the results of which is a good deal of scepticism as to its future possibilities. The real reason for this appears to us to reside in the difficulty of drawing any definite conclusions from the results of the work, much of it very useful, that has been done by numerous detached experimenters.

Stimulation and Increased Production.

The pioneer work of Lodge, Newman and Lemstrom showed us that some plant and vegetable growths at least responded so far to electric stimulation as to show a definite if slight increase in production when exposed to its influence. The difficulty arose, however, that in any particular field or with any particular crop there was no guarantee as to the effect electrification would have. That is an electrified field might one year produce a crop distinctly above the average and the next year one as decidedly below the average, although as far as could be seen the conditions were the same.

Electro-Culture and Potatoes.

This difficulty is very strikingly illustrated in some results obtained by Mr. S. E. Britton, city electrical engineer of Chester, which we published in The Electrician about two years ago. Experiments were made as to the effect of applying electro-culture to three varieties of potato. In the first year one crop showed an increase of 23·5 per cent., another an increase of 15·3 per cent., and a third a decrease of 7·5 per cent. In the second year all the crops showed a decrease. At this time there was a general interest in this question owing to the food shortage, but Mr. Britton quite rightly reported that though the system had great possibilities its general application was unwarranted. The fact is that we do not know enough about the causes and the effect of the phenomena at work to make a definite pronouncement one way or the other as to the good or ill results likely to arise from the use of such methods of stimulation. Such varying factors as the class of crops, soil, manure, air conductivity, leakage, general meteorological conditions, effectiveness of discharge and other physical and chemical conditions come into play in a way we do not yet understand, but which we must learn to understand if anything is to be effected by this method of using electricity. It is obviously worth going into.

The Wolfryn Process.

The same contradictory results seem to be obtained when the electrification of seeds is considered. A report on this subject, recently made by Mr. Martin Sutton on some experiments undertaken by the Wolfryn process, indicate this clearly. The inquiry was designed to show whether the process was sufficiently beneficial to justify the expense, whether the process was equally satisfactory when electricity is not as when it is used as part of the immersion process. In these tests experiments were made first with the seeds placed in wet sand, carrot, swede, cabbage and mangold being used; and the results obtained were inconclusive. In the field tests with the same crops Mr. Sutton reports that the results were no more conclusive than were the tests for germination, the returns from the electrified seed showing no advantage over the other sections except to a small extent in the case of the mangold.

Some French Experiments.

On the other hand, some experiments made by Heim in the Conservatoire des Arts et Metiers at Boulogne-sur-Seine on electro-culture by brush discharge gave distinctly better results. In these experiments a Gaiffe transformer was used, the working pressure being 20,000 volts. The negative pole, which consisted of an iron plate 1 in. square, was buried 1·5 m. in the soil, and suspended thin wires 0·5 mm. in diameter 2 m. above the soil about 0·8 m. apart from bell insulators of varnished glass were employed as the positive. It was found that with electrodes of such different sizes the current only flows in one direction without the use of rectifiers being necessary. The treatment was applied morning and evening for about two hours, though on hot days the morning treatment was omitted. All the plants were fairly advanced when the treatment began, and it was found that the tobacco plants electrified grew to a greater height than those not electrified and flowered, while those not electrified did not flower at all. Cabbages, potatoes, sugar beetroot, all improved under the treatment. These are the most definite and encouraging results that have yet been obtained, and it would be interesting to know what effect the climate had on them and what the other conditions were.

We hope that these experiments will be continued, and the important point in carrying them out should be realised that what we require is not so much results as a knowledge of the phenomena underlying the action and interaction of the processes and the mechanism by which they operate.

The Lighting and Starting of Motor Cars by Electricity.

By C. H. STEPHENSON, B.A., A.M.I.E.E., F.C.S.

The following article is an outline of the methods at present adopted for the lighting and starting of motor cars by electricity. The problems presented are by no means easy of solution, and necessitate the use of compromises which in other spheres of electrical work would not be tolerated.

The adoption of electricity for lighting and starting has been a gradual process. The earlier equipments were confined to providing current for lighting purposes, and only at a later period was a starter added. In many cases a lighting set would form part of the standard equipment of a car, whilst a starter was supplied as an extra. At the present time, however, it is only the smallest and cheapest vehicles which are not fitted as standard with a complete lighting and starting set. The universal use of electric starters probably owes its origin to the great convenience of electric lighting. There can be no question but that it is the only really satisfactory form of illumination when every factor is taken into account. Acetylene, which has been entirely replaced on pleasure cars, is always troublesome, and even when it is carried in cylinders—absorbed in acetone under slight pressure—there is the uncertainty of obtaining spare cylinders apart from any question of expense. Again, the illumination obtained by means of electricity is much better and steadier and more comfortable to drive by.

Starting a Corollary to Lighting.

As a result of electricity becoming firmly established for lighting purposes it was only natural that its use for starting should follow, the more so as only one serious addition to the equipment—viz., a motor—was necessary. It is the writer's opinion that electrical methods of engine starting would never have become general, but for the obvious advantages of electricity for lighting purposes.

The Energy Required.

It is proposed to treat the matter primarily from the point of view of the electrical energy required for the performance of the various functions of an equipment. This method of treatment lends itself to an article of a general nature, whereas any attempt to describe in detail the mechanism adopted in even the better known examples of starting and lighting equipments would require an unreasonable amount of space. Apart from this consideration, a proper appreciation of the problems to be solved is of more general interest than a mass of data of real value only to the specialist. The requirements may then be stated as follows :—

1. The provision of energy for starting the engine.
2. The provision of energy for lighting lamps, operating an electric horn, &c.

Of the above, by far the more difficult to meet is the first, and it may be of interest to examine the matter somewhat closely.

The Starting Problem.

As everyone knows, a petrol engine is not self-starting, and, as many owners of motor cars are painfully aware, frequently requires the expenditure of a considerable amount of energy to induce it to start up. If we neglect such faults as poor ignition, bad carburettion and other defective adjustments, the principal causes of difficulty in starting are : (*a*) The compression of the gas in the cylinders, and (*b*) the viscosity of the oil film between the pistons and cylinder walls. Of these two factors the former is always present, but the latter is of importance only when the engine is cold. The resistance due to viscosity is felt practically throughout a complete revolution, whereas the compression factor only occurs twice during each revolution in the case of a four-cylinder four-stroke engine. The effect of congealed oil may become so great in winter time that it is impossible to start an engine by hand (unless petrol be injected to free the pistons), which when warm can be turned over quite easily. It is of course, in circumstances of this description that a starter is most needed.

The starter, then, must be powerful enough under the worst conditions to overcome the viscosity effect plus the compression and other factors, such as friction, &c., and to rotate the crankshaft at not less than about 150 revs. per min.

The voltage at present almost universal in this country is 12, so it is evident that very heavy currents will be drawn from the accumulator to provide the necessary power for starting. As a matter of fact the current required frequently exceeds 100 amperes. It may be noted that the starting current is very variable ; it depends, among other things, on the bore and stroke of the engine, the speed of rotation, the compression pressure, the value of the viscosity factor, and is not constant throughout one revolution. As the usual practice is to close the circuit through the starter without inserting any resistance, the initial current is exceedingly heavy, being in the nature of a dead short-circuit across the accumulator.

It will, perhaps, be of interest to quote an actual case which refers to a small four-cylinder engine of 65 mm. by 120 mm. bore and stroke. In the winter time, when the car was left all night under cover, but not in a closed or heated garage, the starting current would rise to 75 amperes when rotation commenced, dropping to about 35 amperes at 165 revs. per min. of the engine. The voltage across the starter being 10·6. The instantaneous initial current would, of course, be very much higher than 75 amperes, but was not readable on a Weston moving coil instrument.

It will be seen, then, that a very considerable demand is made on the accumulator, and it is only of recent years that a satisfactory construction has been evolved. In the case quoted above, a battery of 56 ampere-hours' capacity was used with a normal charging rate of 7 amperes.

Accumulator Capacity.

The capacity of the accumulator really governs the satisfactory working of a well-designed equipment. If, for example, an accumulator four times the normal size could be used, and a suitable charging dynamo fitted, then the performance of the equipment from the point of view of starting would be very greatly enhanced. In practice the capacity of the accumulator is limited by considerations of weight ; indeed, the whole question of weight is one which is receiving more and more attention from motor-car designers. It is, of course, an important point in that it intimately affects the performance and running cost of a car. The weight of the ideal car would be principally that of the passengers. The actual weight of an accumulator which is used at present, is about 65 lb., including electrolyte.

As a result of the very great demand made on the battery when the starter is in operation it will be clear that provision must be made to replace the energy, otherwise failure will soon take place. We meet a difficulty here, which is again really bound up with the question of accumulator capacity.

The Charging Problem.

It is evident that the amount of energy supplied to the accumulator should, on the average, exceed that withdrawn. Now it may happen that the car is used for very short runs, with frequent use of the starter. The case of a doctor using his car for professional purposes is a good example. If the accumulator is to be kept well charged the actual charging rate must be high as the duration of charging is short between consecutive "starts." The case is even worse in winter time, when it is necessary to leave at least 3 lamps burning all the time the car is in use during the hours of darkness. Now, there is not very much objection to a high charging current (say, 12 amperes for a 56 ampere-hour accumulator whose normal charging rate is 7 amperes), provided that it is not continued, uninterrupted, for lengthy periods. Such a charging rate is required for a doctor's car, but would lead to rapid disintegration of the plates in the case of a car used for touring. One way out of the difficulty is to have at least two charging rates, which may be brought into operation either automatically or by the driver. This complication would be avoided if a larger accumulator could be used, which would then be capable of standing the higher charging rate continuously.

The writer is of the opinion that the size of accumulator at present used is much too small, and there is no doubt that this fact is responsible for a large part of the trouble experienced with starters.

Lighting.

We may now turn our attention to (2) the provision of electrical energy for lighting lamps, &c.

This falls partly on the dynamo and partly on the accumulator. The former must be capable of supplying enough energy to keep the accumulator charged, and the latter, in addition to providing current for the starter, has to take the lamp load when the car is stationary. This latter load is not as a rule serious, and, when side and tail lamps only are kept alight, need not amount to more than 1·5 amperes at 12 volts. Nevertheless it must be taken into consideration, as a car is sometimes left standing in the road for several hours at night time. The practice of leaving a car about has, however, recently become rather unwise, unless it is decidedly antiquated and very heavily insured!

As regards the dynamo, it should, in general, be capable of supplying at least rather more energy than is required by the lamps when they are all alight, and this energy must be available at a reasonably low road speed—say, 20 miles per hour. It is obvious that if the dynamo output is less than the lamp load, the accumulator is called upon to make up the difference and, if much night driving is done, the risk of failure is considerable. We may take 70-100 watts as a rough estimate of the average lamp load so that the dynamo should give not less than 120 watts at 20 miles per hour. We have, however, seen that a charging rate of about 12 amperes is desirable for town use, and if we take 15 volts as the pressure required to charge a 12-volt accumulator we arrive at a maximum output of about 180 watts for the dynamo.

Generator Design.

The design of a satisfactory generator presents but little difficulty, except as regards the control of output. It will be quite obvious that, since the dynamo is driven either from the engine or some part of the car mechanism, its speed is subject to very great variation. Briefly, we require a machine giving its maximum output at less than a car speed of 20 miles per hour, and the output should commence to fall above about 20 miles per hour, reaching not more than half its maximum value at 30 miles per hour and over. As far as the writer is aware no machine of this description has ever been constructed. An approximately similar result may be attained by using a thermally controlled shunt resistance, but it is very doubtful whether complications of this description are desirable.

The usual method of control employed is that which makes use of a third brush, to which one end of the shunt field winding is connected. The distortion of the field which occurs as the speed and output of the machine increases, results in a diminution of the excitation current. This arrangement gives a machine which reaches its full output at a reasonably low speed, and any further increase in speed either slightly augments or reduces the output.

It is quite evident, however, that the resultant output is not at all in accordance with the demands of the installation as a whole. If the dynamo output is sufficient for town use then it is inevitably excessive for touring. The simplest solution seems to be to arrange the dynamo control switch to give two charging rates, and to make it clear to the user that one is intended for town work and the other for touring. This arrangement is by no means ideal, but has the merit of requiring no complicated automatic devices, and at least makes it possible for the driver to adjust the dynamo output approximately in accordance with the varying needs of the accumulator in a very simple manner.

The Necessity of Suitable Switchgear.

There is but little of a special nature in this portion of the equipment. It is essential that the switchboard have a neat appearance, and unfortunately some designs, excellent from this point of view, are very defective as regards the arrangement of terminals to which the various wires have to be connected. The wiring of a motor-car is not an easy matter to carry out neatly at the best of times, and inaccessible terminals are an additional source of trouble. The switchboard illustrated in Fig. 1 gives a good idea of how accessibility may be attained.

The usual practice is to fit an ampere meter showing the charging current, and, as the question of selling price demands the use of a cheap type of instrument, its actual utility is doubtful, except in so far as it gives a mere indication that charging is taking place. The majority of instruments of low price are so very badly damped that any attempt to obtain a definite reading on the road is not often successful. The American practice of using a simple indicating device seems to have much in its favour. The buying public, however, likes an instrument with a needle and scale.

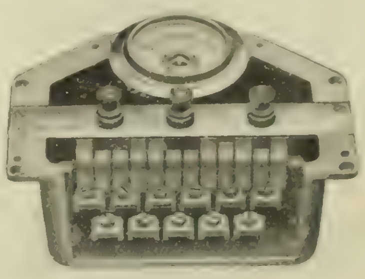

Fig. 1.—An Accessible Switchboard.

The Fuse Question.

The question of fuses is one which is open to argument. That fuses in the main charging circuit and the dynamo shunt are desirable cannot very well be doubted. The former breaks the circuit in the event of the cut-out failing to come "out," and the latter prevents damage to the dynamo field coil if the car is used with the accumulator disconnected and the charge switch "on." It also protects the cut out shunt coil. As regards lamp circuit fuses the writer is of the opinion that it is safer not to fit them, at any rate for the head-lamps. If a head-lamp fuse blows, the sudden extinction of the lamps is very disconcerting at high speeds, and may easily result in a serious accident. The effect of a short on any of the leads, if no fuse is fitted, will be only to dim the lamp whose circuit is affected, leaving sufficient light to steer a course, until the car can be pulled up. It is, of course, improbable, that a short will occur on both head lamp leads at the same time, and, therefore, if fuses are fitted each lead should have a separate fuse. This arrangement is excellent when the price question will permit of its use.

Mention has been made of the cut-out, and it will be obvious that some automatic means of making and breaking the charging circuit is necessary, owing to the rate of rotation of the dynamo at very low speeds falling below that at which charging can be effected. The device needs no description, as it is designed along standard lines. It is the one part of the equipment which has, in the past, given a good deal of trouble, but modern examples work quite well. At least one manufacturer has avoided the use of a cut-out by fitting the dynamo driving pulley on a free wheel. This allows the dynamo to "motor" freely when its voltage falls below that of the accumulator. The device had much in its favour in the days when cut-outs were unreliable, but the noise made by the free wheel whenever the car speed drops to that at which "motoring" commences is most irritating. A silent free wheel is no use as the noise is necessary to call attention to the fact that the dynamo should be switched off.

A New Design of Cut-out.

A modern cut-out is illustrated diagrammatically in Fig. 2. There is one point of special interest in this design. It will be seen that a resistance is connected in series with the shunt winding and is short circuited when the cut-out is out. The short circuiting contacts are opened as soon as the cut-out closes the main circuit. In this way the shunt ampere turns are reduced, so that the reverse current required to open the main cut-out circuit is brought down to a minimum. An additional advantage is that less heat is generated in the shunt coil of the cut-out, which is always subjected to the full charging voltage, owing to the increased resistance. The main contacts are of silver, and are protected from pitting due to sparking by a subsidiary pair of carbon sparking contacts. These latter are not shown in the diagram.

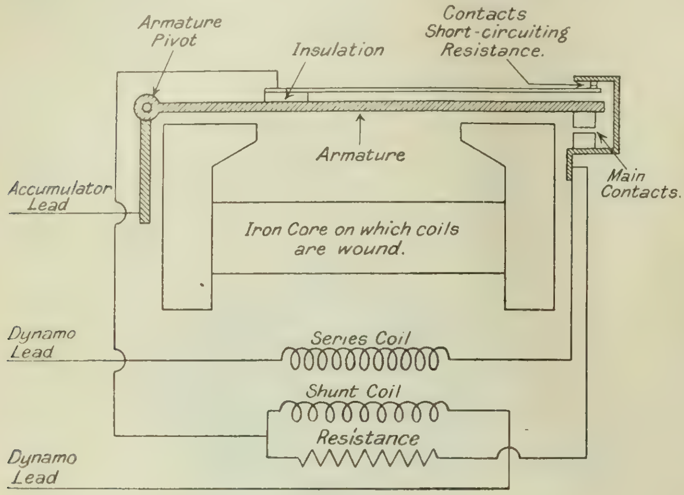

Fig. 2.

The Starting Motor.

The starting motor is almost always a simple series wound machine, and may be very much overloaded with safety as it is never in continuous use for more than a few moments. The difficulty in applying an electric motor for engine starting is more of a mechanical than electrical nature. The motor must be small and powerful, therefore it must run at a high speed. The torque will then be too low to start the engine unless the speed is very considerably reduced (about 10 to 1 is usual ratio). Hence gears and difficulties.

The usual arrangement is to cut teeth on the engine flywheel and to bring a small gear wheel, mounted on the motor spindle, into mesh when required. The actual meshing is done automatically. The small gear wheel can move longitudinally on the motor spindle along a quick thread. When the motor is started up the small gear is drawn into mesh, and when properly engaged comes against a stop on the motor shaft, which prevents it moving further along. When the engine starts up the direction of drive is reversed and the small gear wheel is thrown out of engagement. The most popular arrangement is known as the Bendix drive.

The whole arrangement is obviously crude; in practice whilst working fairly well it is almost always noisy and not infrequently fails either to engage or disengage. In the latter case the motor is liable to be damaged as it may easily reach a speed of 10,000 r.p.m. That the device works as well as it does is surprising, as it is nearly always located in a position which is accessible only to road grit and dirty oil. There is no real reason why the whole of the moving parts should not be enclosed. The car manufacturers are to blame for failure to do this. They cling tenaciously to the methods of fitting, which were unavoidable in the days when starters were "extras."

The Motor Dynamo.

So far no mention has been made of the motor dynamo because it seemed best to deal with the dynamo and motor as two separate units first. It is obvious that since a generator may be used as a motor, there is a *prima facie* possibility of combining the functions of the dynamo and starting motor in one machine. This has, in fact, been done for some years and with great success. A machine of this type is illustrated in Fig. 3. The vertical commutator and design of brush gear are points of special interest. The armature is wound with stranded conductors which enable the maximum amount of copper to be laid in the slots. This feature, which is one of considerable importance, is covered by British and foreign patents. The arrangement is shown in Fig. 4. The application of this type of starter is at present limited to small cars on account of certain complications which are necessary when dealing with large engines. The type of machine used is generally compound wound and relies for limiting its cut-out on some third brush arrangement or on the demagnetising effect of the series coils only. As regards weight of the whole equipment there is little to choose between a single or a two-unit system. The motor-dynamo is, of course, larger than a dynamo only. The machine is usually driven by "silent" chain from the engine, and at about twice the engine speed. All difficulty of gear meshing is done away with and starting is perfectly silent. The arrangement also possesses the advantage that there is only one machine requiring attention, and this may be easily fitted in an accessible and clean position alongside the engine.

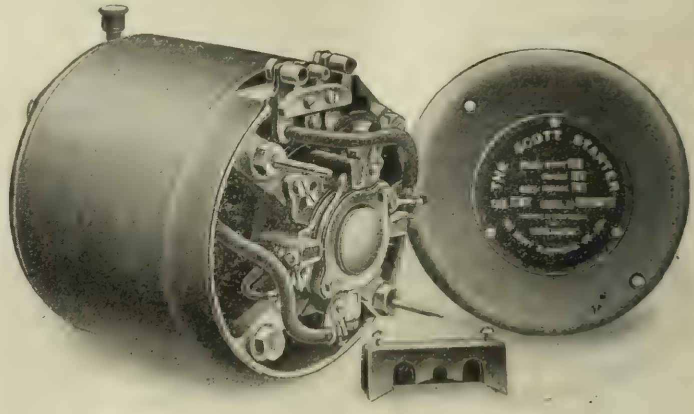

Fig. 3.—Combined Dynamo and Starting Motor.

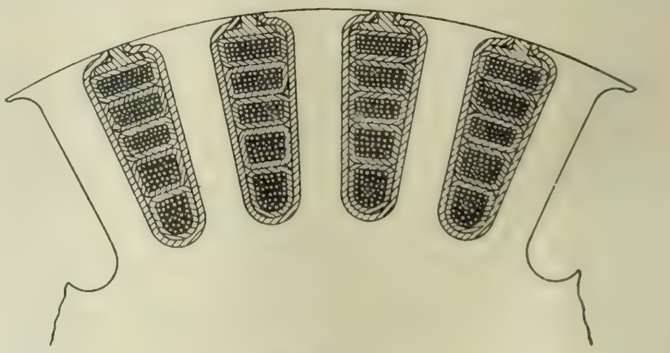

Fig. 4.

Conclusion.

In conclusion the writer would like to draw attention to a few points which, in his opinion, should receive more attention from starting apparatus manufacturers and motor car manufacturers.

(1) The question of designing the equipment so that the accumulator is kept charged under the worst conditions is of primary importance. It is obvious that a more or less fixed charging rate cannot possibly secure this. The charging current must be closely related to the need of the accumulator at any moment. There is at present a considerable amount of dissatisfaction on the part of the general public regarding the performance of starters, and in the majority of cases, failure is due to the inability of the dynamo to keep the accumulator charged.

(2) The method of bringing the starter into engagement with the flywheel is crude, and there is a very great opening for a more satisfactory device.

(3) Car manufacturers should be more liberal in weight allowance. It is better in the long run to carry a few extra pounds weight on the car and so to secure reliability of the electrical system than to cut down the weight with the consequent risk of failure.

There is a marked tendency to regard the merits of a starting and lighting equipment almost entirely from the point of view of its cost—the cheapest being the best. This is certainly a very short-sighted policy, as it tends towards the cutting down of the equipment below that point at which prolonged and reliable performance can be guaranteed. In addition to this, the failure of electrical equipment reacts on the reputation of the car which is another point in favour of manufacturers adopting an equipment which can be relied upon to give satisfaction under all circumstances.

(4) Whilst simplicity is very desirable in the design of starting and lighting apparatus there comes a point beyond which it is impossible to go. The writer feels that more attention should be given to the provision of a good instruction book. The type of booklet generally provided consists of a miscellaneous collection of bald statements of the order "do this" "don't do that."

The trouble is that blind instructions are almost useless. The man who uses an instruction book should be given such information as will enable him to appreciate why certain things should be done.

Parrot-like learning is no good when dealing with electrical apparatus. The difficulties in the production of a satisfactory booklet are great, and it may be urged that nine out of ten car owners would never take the trouble to read one. This is largely a matter of "style," and if the information were interestingly written, it is more than probable that it would be welcomed.

Finally, the writer realises that the whole subject of starting and lighting equipments has been dealt with in a very cursory manner. The field is so great that a whole volume would not afford space in which to treat adequately of all the items. It is hoped, however, that attention has been drawn to the principal problems which, in the writer's opinion, are yet unsolved.

A Portable Direct-Reading Anemometer for the Measurement of Ventilation of Coal Mines.[*]

By J. T. MACGREGOR-MORRIS, M.I.E.E.

At the Dundee meeting of the British Association in 1912 the author read a Paper, entitled "The Electrical Measurement of Wind Velocity,"[†] and showed certain experiments illustrating the application of the principles involved. Subsequently, in order to obtain correct measurements of the velocity of air at various atmospheric temperatures, it became necessary to introduce a modification of the method first described.

The Principle of the Apparatus.

The principle utilised in the apparatus which is the subject of this Paper may best be illustrated in the following manner.

When a length of thin wire in air is heated by the passage of an electric current of constant strength, the wire attains a steady temperature in a second or two. Heat is then being taken away from the wire by the motion of the air passing it at practically the same rate as that at which it is receiving heat from the electric current, and the rise in temperature will be the smaller the higher the velocity of the air. This fact can be utilised to determine the rate at which the air is passing.

Generally speaking, when a wire changes in temperature its length changes, as does also its electrical resistance. Either of these two effects can be used. In many ways the change of length would be simpler to use, but owing to the minuteness of the change it is probably better to use the change in electrical resistance. To obtain the same magnitude of effect mechanically a wire would require to double in length when raised to a temperature of 400°F. or 500°F.

However, as the principle of the instrument about to be described may be more easily grasped by some mechanically, the following crude mechanical model is put forward.

Four thin wires, a, b, c, and d (Fig. 1), each of the same length, are arranged as shown, and a constant electric current is maintained, flowing through the two paths in parallel, ab and cd, entering at X and leaving at Y. b and c are enclosed in, but not touching, two thin walled metal tubes, which shield these two wires from the cooling effect of the moving air. The other two wires, a and d, are fully exposed to the air. If the material of the wires is such (say, for example, iron) that an appreciable change of length takes place with change of temperature, then the greater the velocity of the wind blowing upon the apparatus, the shorter the wires a and d will become, whilst wires b and c remain practically unaltered in temperature, and consequently in length also. A pointer, made of insulating material, connecting the junction of a and b with the junction of c and d, will move over to the right, as the velocity of the wind increases. Such apparatus as this of necessity gives for low velocities a more open scale than for higher velocities. Consider, for instance the case of a wire for which the temperature elevation above the atmospheric temperature is reduced to half by a wind velocity of 3 miles per hour, then any further increase of velocity no matter how great, can do no more than reduce the temperature down to that of the atmosphere. Such an instrument would, therefore, have the 3 miles per hour mark half-way across the scale, whilst a hundred miles per hour or more would only double the reading.

This shows that the apparatus in this form is mainly suited for the measurement of low velocities, say, up to 10 or, perhaps, 20 miles per hour.

Change of Resistance with Temperature.

We now turn from the method of using the change of length with temperature, to that of utilising the change of resistance with temperature, and then the only alteration which we have to make is that of replacing the insulating pointer connecting the junction of a and b to that of c and d with a sensitive voltmeter or galvanometer. This arrangement then constitutes the well-known Wheatstone Bridge.

In both the mechanical and the electrical model, it is obviously essential that the current through (or the voltage applied to) the bridge be maintained constant, as variations in these quantities seriously affect the indications of the pointer in the mechanical model and the voltmeter in the electrical arrangement.

Former Work.

It will be clear that apparatus operating on the above lines has many fields of action, and many investigators have worked at the subject of the electrical measurement of wind velocity. This is not the occasion to attempt to outline their work, but one cannot pass over in silence Kennelly's pioneer experimental work, L. V. King's classical Royal Society Paper of 1914, and, more recently, J. S. G. Thomas's excellent work published before the Physical Society of London and elsewhere.

A Practical Form of Instrument.

In the present Paper it is proposed to confine attention to the development of a practical form of portable anemometer for use in coal mines.

A consideration of the materials available suggests the use of platinum, nickel or tungsten. Platinum, though in many respects suitable, is hardly robust enough to stand the kind of treatment it is likely to receive. Nickel is good, if extreme care is taken in its selection. Similarly, excellent results have been obtained with tungsten.

There are many points which call for considerable experience, in the choice and the handling of these wires, in the soldering and the adjustment of tension, and in other matters, including the eliminating of errors due to thermo-electricity.

In the apparatus about to be described a very special nickel wire has been used, having an electrical resistivity temperature coefficient of 0·474 per cent. per degree centigrade, reckoned on 20°C.

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[*] A Paper before the British Association (Section G), Cardiff, 1920.

[†] The Electrician, Vol. XIX., p. 1056, Oct. 4th, 1912.

The whole apparatus is entirely contained in a box measuring 10 in. by 6½ in. by 7 in. deep, and weighs 13½ lbs. complete. It is illustrated in the accompanying figure (Fig. 2). The pair of exposed sensitive heated wires, the enclosing tubes for the other pair of wires, and the thermometer which together form the anemometer head, are carried by the ebonite handle, and are shown on the right in front. The protecting cage (which has been removed only for the purpose of showing the details) will be seen at the back. The recess in the box underneath the indicating instrument holds the anemometer head and the connecting length of flexible when the instrument is not in use. The 2-volt accumulator will be seen on the left' and behind it the switch for connecting the battery by a turn of the key. In the centre the indicating instrument is seen with its pointer deflected half-way across the scale, and this is illuminated, if need be, by means of a small shielded electric lamp carried in an overhanging holder.

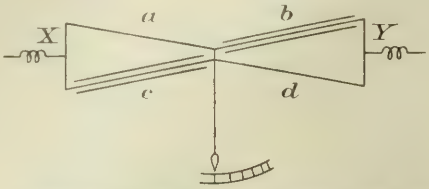

Fig. 1.—Diagram of Mechanical Model of Apparatus.

There are two switch handles on the right, the one in front being a rheostat handle for adjusting the voltage applied to the bridge to the correct value for the particular air temperature, this adjustment being made when using the indicating instrument as a sensitive voltmeter, the switch handle at the back being placed on the right hand stud marked "Standardise." After this adjustment, which takes only a few seconds, has been made, the switch handle is thrown over to the left-hand stud marked "Anemometer," when the pointer of the measuring instrument swings to a reading giving the velocity of the air passing the anemometer head in miles per hour.

There is a simple but effective device, which only allows of the box being closed if the needle of the indicator has been clamped, and should the battery by accident be left on, it is automatically switched off by the action of closing the box.

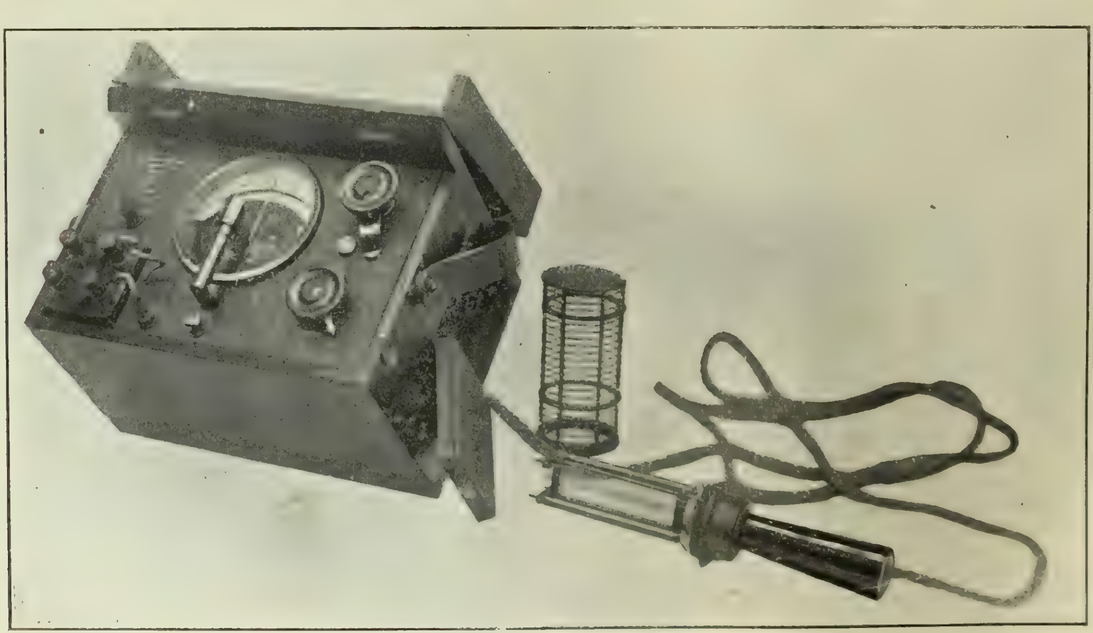

Fig. 2.—General View of Portable Anemometer.

Operating Details.

To obtain the best results, the anemometer head should be held at arm's length with one of the two little brass screws at the top of the ebonite handle facing in the direction of the wind, and the checking of the standardisation at the right temperature should naturally be looked to at intervals.

If one is in doubt as to the correctness of the instrument, it is a simple matter to check approximately the reading, by walking round a table on which is placed the anemometer box, carrying the anemometer head in one's hand at a known radius (using the flexible for this purpose), and taking the time of one complete turn round the table, and so getting a measure of the velocity. Naturally a certain allowance has to be made for the "swirl" created in the air by the person moving through it.

As the instrument has such an open scale near its zero it is very exceptional to find it indicating zero velocity, as it easily gives an indication for a velocity of one-twentieth of a mile per hour, and probably even a fifth of this would give a measurable indication. In its present form, however, its best range is from ½ mile per hour up to, say, 5 miles per hour. Movements of air, which it is quite impossible for us to feel, are indicated by it.

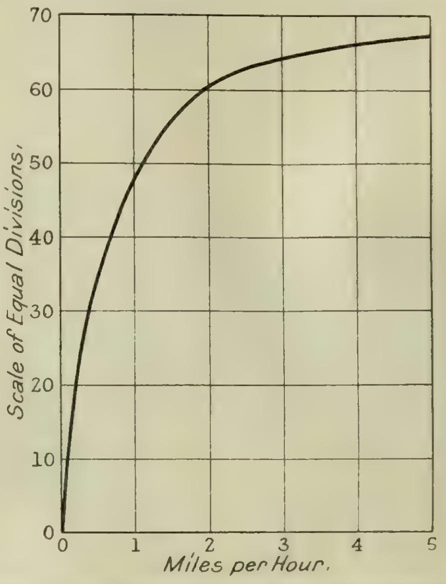

Fig. 3.—Calibration Curve of Instrument.

The calibration curve of one of these instruments is given below :—

Miles per hour	5	4	3	2½	2	1½	1	¾	½
Indication	67·5	66·0	64·0	62·7	60·5	55·7	48·5	43·0	35·5

and is shown graphically in Fig. 3.

As the indication of this class of instrument is dependent on mass flow, and therefore on the temperature of the air stream, an error comes in if the temperature alters, but for practical purposes this can be automatically compensated for by an adjustment of the voltage on the bridge. Hence there are certain temperature index marks on the scale, which show the proper position for the indicator for these temperatures of the air stream when standardising. (The maximum temperature reached in practically all English mines is not more than 85°F., though in exceptional cases it may reach 95°F.) It is important that the standardising adjustment should be done with care, as the indications are dependent on the cube (or more nearly 2·8 power) of the voltage applied to the bridge.

The effect of water vapour in the air on the indications of such instruments might be expected to be very considerable, but the experiments of Kennelly, and later those of J. S. G. Thomas have conclusively shown that such effect is negligible, Thomas having shown that saturating air with water vapour does not affect the indications by 1 per cent.

Advantages over the "Windmill" Type.

As far as the author is aware, the only apparatus at present used in coal mines is the Windmill type of anemometer. This instrument has simplicity on its side. In order, however, to use the instrument it is necessary to have a stop watch and a miner's lamp, to read the little dials before and after a minute's run, to take their difference, and to add a constant number of revolutions to allow for friction. Thus the velocity in feet per minute is obtained.

The present apparatus has the following points:—

1. It is portable and contained in one box.

2. It gives a reading directly in miles per hour, and the variations can be easily followed.

3. It is quick acting.

4. The precision attainable with ordinary use is higher than with existing apparatus.

5. It is a simple matter to check approximately the indications of the instrument.

The author is indebted to the Cambridge & Paul Instrument Company, Ltd., for many minor points in the design of the portable instrument, which materially contribute towards rendering it a practical portable instrument. He desires especially to thank Sir Horace Darwin and Mr. R. S. Whipple for their share in the work, and Dr. Thornton for useful information in connection with its application to work in mines.

Some Engineering Necessities.*

Strength of Materials and Research.

As a result of my work in the Air Service on problems connected with materials of construction I have come to the conclusion that the fundamental data on which the engineering theories of the strength and suitability of materials are based require thorough overhauling and revision. It has been very remarkable how again and again in aeroplane engineering the problems to be solved have raised fundamental questions in the strength and properties of materials which had never been adequately solved.

The Strength of Wooden Members.

Let us consider first one of the oldest materials of construction—timber. Timber was of prime importance in aircraft construction. The first peculiarity of this material which strikes us is that it is anisotropic. Its grain may be used to locate three principal axes—along the grain, radially across the grain, and tangentially across the grain. It is curious that there do not appear to be generally recognised terms for these three fundamental directions. A very few tests are sufficient to show that its strength is enormously greater along the grain than across it. How, then, is an engineer to calculate the strength of a wooden member? There is no theory, in a form available for the engineer, by which the strength of members made of an anisotropic material can be calculated.

Suppose a wooden tie or strut is cut from the tree obliquely so that the grain does not lie parallel to its length. In practice it is never possible to ensure that the grain is accurately parallel to the length of the member, and often the deviation is considerable. How much is the member weakened? This comparatively simple problem has been of immense importance in aeroplane construction, and, thanks to the researches made during the war, can be answered. The solution has thrown a flood of light on many failures which before were obscure. If the tensile strengths of a piece of timber are, say, 18,000 lb./sq. in. along the grain and 800 lb./sq. in. across it (radially or tangentially) and the shear strength is 900 lb./sq. in. along the grain—these figures correspond roughly with the strengths of silver spruce—then if a tensile stress be applied at any angle to the grain the components of that stress in the principal directions must not exceed the above strengths, or failure will occur. Thus we can draw curves limiting the stress at any angle to the grain, and similar curves may be drawn for compression stresses. These theoretical curves have been checked experimentally, and the results of the tests confirm them closely, except in one particular. The strengths at small inclination to the grain fall even faster than the theoretical curves would lead us to expect. The very rapid drop in strength for quite small deviations is most striking.

Similar curves have been prepared for tensile and compressive stresses inclined in each of the three principal planes for spruce, ash, walnut, and mahogany, so that the strengths of these timbers to resist forces in any direction can now be estimated reasonably accurately.

Timber Tests Wrong.

Many of the tests applied to timber are wrong in theory and consequently misleading. For example, the common method of determining Young's modulus for timber is to measure the elastic deflection of a beam loaded in the middle and to calculate the modulus by the ordinary theory, neglecting the deflection due to shear, which is legitimate in isotropic materials; but in timber the shear modulus is very small—for example, in spruce it is only about one-sixtieth of Young's modulus—and consequently the shear deflection becomes quite appreciable, and the results obtained on test pieces of the common proportions lead to errors in the calculated Young's modulus of about 10 per cent.

The Testing of Steel.

Steel is not strictly isotropic—but we may consider it to be so to-day. The first obvious question the engineer has to answer is, "What is its strength?" The usual tests give the ultimate strength yield point, elastic limit, the elongation, the reduction of area, and perhaps the Brinell and Izod figures. On which of these figures is the dimension of an engine part, which is being designed, to be based? If we choose the ultimate strength we must divide it by a large factor of safety—a factor of ignorance. If we choose the yield point we must remember that none of the higher-grade steels have any yield point, and the nominal yield point depends on the fancy of the tester. This entirely imaginary point cannot be used for accurate calculation except in a very few special cases. Can we base our calculation on the elongation—the reduction of area—the Izod test? If we face the question honestly we realise that there is no known connection between the test results and the stress we can safely call on the steel to bear. The only connecting link is that cloak for our ignorance—the factor of safety.

I feel confident that the only reliable property on which to base the strength of any engine part is the suitable *fatigue limit*. We have not yet reached the position of being able to specify this figure, but a considerable number of tests show that in a wide range of steels (though there are some unexplained exceptions) the fatigue limit for equal ± stresses is a little under half the ultimate strength, and is independent of the elastic limit and nominal yield point, so that the ultimate strength may be replaced as the most reliable guide to true strength, with a factor—no longer of ignorance, but to give the fatigue limit—of a little over 2.

Extensive Researches Necessary.

If the fatigue limit is accepted as the only sound basis for strength calculation for engine parts, then it is obvious that there is urgent need for extensive researches in fatigue, for the available data are most meagre. The work is laborious, for there is not one fatigue limit, but a continuous series, as the signs and magnitudes of the stresses change. Many problems in connection with fatigue are of great importance and need much fuller investigation than they have so far received—*e.g.*, the effect of speed of testing; the effect of rest and heat treatment in restoring fatigued material; the effect of previous testing at higher or lower stresses on the apparent fatigue limit of a test piece. Some observers have found indications that the material may possibly be strengthened by subjecting it to an alternating stress below its fatigue limit, so that the results of fatigue tests may depend on whether the limit is approached by increasing the stress or by decreasing it.

Improved methods of testing are also needed—particularly methods which will give the results quickly. Better methods of testing in torsion are also urgently needed, none of those at present used being free from serious defects. Finally, there is a fascinating field for physical research in investigating the internal mechanism of fatigue failure. Some most suggestive results have already been obtained, which extend the results obtained by Ewing.

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* Abstract of the Presidential Address of Prof. C. F. Jenkin, C.B.E., to Section G (Engineering) of the British Association.

For members of structures which are only subjected to steady loads I suggest that the safe stress might be defined by limiting the corresponding permanent set to a small amount—perhaps ½ per cent. or ¼ per cent. This principle has been tentatively adopted in some of the aircraft material specifications by specifying a proof load which must be sustained without a permanent extension of more than ½ per cent. Whether this principle is suitable for all materials and how it will answer in practice remains to be proved by experience. It is at any rate a possible rational basis for determining the useful strength of a material under steady loads.

Important Fundamental Questions.

There are more fundamental questions still which must be tackled before the simplest questions of all which meet the engineer can be answered scientifically. The two most urgent and most important questions which I met with during the war in connection with aircraft were always the same—Why did some part break? and, What is the best material to use for that part? It was most disconcerting to find how inadequate one's knowledge was to answer these two simple questions. The common answers are: To the first: "It broke because it was too weak, make it stronger," and to the second: "General practice indicates such a material as the best—better not try any other or you may have trouble." In aircraft weight is paramount, and to make a part stronger—*i.e.*, heavier—had to be the last resort, and when used was almost a confession of failure. "General practice" was no guide in aeroplane engines, which are built of the strangest materials. The origins of fractures were traced to many causes, often lying far away from the site of the breakage; but with these I am not concerned to-day. I wish to confine our consideration to the actual fracture and to ask, "What stress caused the fracture?" and "What property of the metal was absent which would have enabled it to withstand that stress?" And again, "What other material possesses suitable properties to withstand the stresses better?" These fundamental questions urgently need answers.

The Nature of the Researches Required.

The suitability of different materials presumably depends on their fundamental physical properties. These may be many, but some physicists think that they are probably really very few, and that, knowing these few, it may be possible to deduce all the complex properties required by the engineer and to state with certainty how materials will behave under any conditions of service. This is the most fundamental problem which needs solution to enable the knowledge of the strength of materials to be put on a sound foundation. It will need the co-operation of able physicists, metallurgists, and engineers to solve it.

While urging the importance of research in the fundamental theories of stress and fundamental properties of materials I wish to lay special stress on the nature of the researches required. Engineers are intensely practical men, and their practice has generally been ahead of their theory. The difficulties they have met have been dealt with, often with the greatest ingenuity and skill, as special problems. They have seldom had time or opportunity to solve the general problems, and as a result they are used to making their experiments and trials as close a copy—usually on a smaller scale—of the real thing as possible. The results obtained in this way, while they are applicable to the particular problem, are of little general use. They depend on many factors. The researches I am now advocating must be of a diametrically opposite description. They must be absolutely general, and the results must depend on one factor only at a time, so that general laws may be established which will be applicable to all special problems.

There are many other similar gaps in our knowledge to which I have not time to refer to to-day. I have tried to show that we need most of all a real knowledge of the fundamental properties of materials, from which we shall be able to deduce their behaviour in any condition of service, so that we may be able to compare the relative merits of diverse materials for any particular purpose. Secondly, that we need a practical method of calculating the stresses in parts of any form, so that concentrations of stress may be avoided or that their magnitudes may be known and allowed for. Thirdly, that we need a rational connecting link between the tests made on materials and the stresses they will bear in service, to replace the factor of safety. Fourthly, that we need a mathematical theory for the strength of anistropic materials, of which timber is an extreme and important example.

Renovation of Leclanché Porous Pots.*

By W. J. THORROWGOOD.

The Leclanché cell is so extensively used for telegraph, telephone and signal circuits on railways that the opportunity is open to effect economy by renovating porous pots. The author describes a process which he has introduced on the London and South Western Railway, that has given satisfactory results.

In view of the increased cost of new porous pots and dry cells since 1914, it seemed to the author that it might be economical to treat the old porous pots which had been put out of service by washing, either:—(1) As they were, or (2) by unsealing the top and washing the porous pots and the contents separately, and then reassembling. Neither method gave very satisfactory results, and the second was costly owing to the labour charges.

Analysis of the contents of the porous pots supplied to the Railway's standard specification before the war (that had been in use and had failed, owing to increased resistance or other causes, to give the ordinary working current) showed that the volume of carbon and pyrolusite (50 per cent. of each) remained the same, and the quantity of pyrolusite (85 to 90 per cent. of manganese) was practically unaltered, but the damp mixture had an alkaline reaction.

Several porous pots that had been in use for various periods and had been discarded were treated with solutions of hydrochloric acid of different strengths to see if the discarded porous pots could be made reusable. After several trials a solution of one part hydrochloric acid and five parts of water was adopted as most suitable, although a weaker solution could be used and gave satisfactory results. Six discarded porous pots, taken at random, were then treated according to the following instructions:—

1. A solution of commercial hydrochloric acid one part and water five parts to be made up and sufficient to be placed in each of six Leclanché glass jars so that when a porous pot stands in the jar the solution comes nearly up to the black rim at top of pot.
2. The porous pot to remain in the acid solution in glass cell for 24 hours.
3. Then the porous pot to be washed and soaked in clean water in Leclanché glass jar for 48 hours, the water being changed after 24 hours immersion.
4. The cell will then be ready for use in the ordinary way.
5. The acid solution described in (1) can be used three or four times, as described in (2), but new acid solution should be added after each porous pot has been treated to make up for waste solution.

Each of the six chemically treated cells were then joined up to three way repeaters, having 300 ohms resistance, and tested against a new cell of standard quality for seven weeks.

The six chemically treated cells and the new cells were then left standing for five and a half months. The six chemically treated cells were then joined in series with two new porous pots of standard quality to form a battery of eight cells, which was put in service on April 25, 1917, on an electric fouling bar circuit. The battery remained in service until October 30, 1917, when the current given by the battery in the electric circuit was 400 m.a., the minimum current allowed for lifting the lock. The battery was then put out of service. The voltage of the two new cells that were used for comparison had fallen to 1·3 volts. One of the treated cells on testing gave 1·3 volts, but the voltage of the other five treated cells had fallen to from 0·9 to 1 volt.

It was noticed that the zinc rods used in the cells containing the chemically treated porous pots remained freer from crystallised salts and were generally cleaner than the zincs in the new cells. This method has been extended, and up to March, 1919, 3,653 porous pots were treated, and 2,650 had been put into service, so far with satisfactory results.

Another economy can be effected with Leclanché cells by using the interiors of spent dry cells as porous pots, and very successful results have been so obtained.

Circuits on which Leclanché cells are used may be divided into important and unimportant circuits, and the treated porous pots can generally be used on the less important circuits. Approximately 95 per cent. of the spent dry cells can be made useful. Loose lead terminals and broken carbon plates account for the remaining 5 per cent.

The question of costs naturally arises. It is found that one quart of hydrochloric acid is sufficient to treat 36 porous pots. The average total cost of material and labour (including war wage) of treating one porous pot is twopence.

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* Abstract of a Paper read before the Institution of Railway Signal Engineers.

Inland Intercommunication.

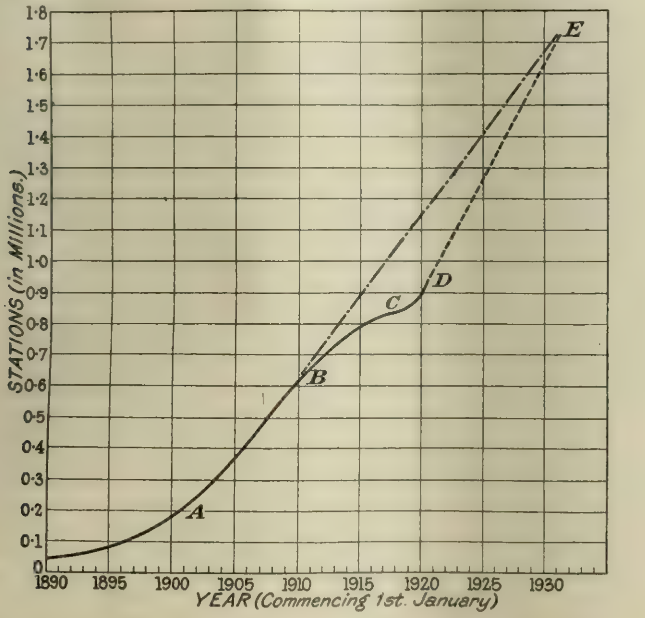
The Activities of the P.O. Engineering Department.

[COMMUNICATED.]

It has become a habit for the daily press to attack the British Post Office on account of the telephone service. The Post Office employs over 250,000 persons, and runs a number of intricate and extensive businesses with practical immunity from attack in respect of all except the telephone service. It is interesting, therefore, to inquire as to the reason for the present telephone situation, and in particular as to the qualifications possessed by the Post Office for carrying on a technical business.

The Growth of the System.

We give herewith a curve which shows the growth of the telephone system of the country, and it will be seen that the highest development over a prolonged period occurred between the points *A* and *B* at a time when the Post Office was in active competition in London with the National Telephone Company. At about the point *B*—*i.e.*, in the year 1910—the effect on development of the impending transfer of the National Telephone Company's business to the State began to be felt. The transfer took place in January, 1912, and the situation had not readjusted itself before war broke out in 1914. The effect of the war continued as far as the point *C*. *CD* shows the actual progress being made now. It will be seen that the telephone development is more rapid at the present moment than it has ever been, and it is estimated that *DE* represents on a conservative basis the probable growth of the system during the next 10 years, at the end of which period the retarded development *BC* will have been corrected. It is possible that the development may be even more rapid; but, in estimating telephone progress, attention must be paid to the fact that one third of the system is still operated from obsolete magneto plant taken over from the National Telephone Company, and that several installations of central battery plant now in use are old, and will shortly fall due for renewal. It is clear, therefore, that a large volume of work, over and above that of pure development, will have to be carried out by the Engineering Department of the Post Office and by telephone equipment manufacturers in the course of the next few years.



Telephone Development in the United Kingdom, 1890-1930.

Here and in America.

Those who are acquainted with the telephone situation in America will no doubt expect a much steeper development curve than is shown by *CE*, and there is something to be said, within certain limits, for anticipating a curve that shows a geometric increase; but it is necessary to sound a warning note against the drawing of too close a parallel between American and British conditions. This country, with its older civilisation and more settled conditions, contains a considerable proportion of comparatively poor people, who cannot be expected to rent a telephone any more than they can be expected to own an automobile, and, as long as that condition exists, there will be a great disparity between the telephones per cent. of population in the two countries. The comparison between telephones and automobiles is instructive. In California there are 20 automobiles per 100 of population, and there are in the United States a few cities in which the telephone development reaches as high a figure as 20 per 100 of population. These figures are extreme, however, and the average telephone development in America is 10 telephones per 100 persons. It is probable that the natural telephone development for this country in its present economic state is about half that figure (*i.e.*, 5 per cent. of the population). The average number of automobiles in the United Kingdom, including motor cycles, per 100 persons is, even at the present time, as low as 1·6, whereas the telephone development stands at 2·1; and it is well known that the automobile industry has been stimulated by the war, whilst the telephone industry has been retarded. One reason for anticipating a much lower natural development of telephones and automobiles in the United Kingdom is the fact that the distances between the important cities are in this country very much shorter than they are in America, and consequently the postal, telegraph and railway services satisfy the average needs here to a much greater extent. Further, the number of people who cannot afford telephones and motor cars is in this country a preponderating proportion of the total population.

The Qualifications of the Post Office.

Having indicated the nature of the telephone situation, it is necessary to examine the qualifications of the Post Office for directing such a technical business as the telephone service. There is plenty of evidence to show that the Post Office has hitherto furnished ample capital for the provision of new and additional plant, and an additional capital sum of £10,000,000 was recently authorised. The Engineering Department of the Post Office is responsible for the construction and maintenance of the telegraph and telephone systems of the country. In addition to employing 26,000 persons, the Post Office Engineering Department provides a great volume of work for firms engaged in the manufacture of telephone and telegraph apparatus, wire, cables, conduits, &c. During the past financial year material of the value shown below passed through the hands of the examining officers of the Post Office, and 90 per cent. were deliveries in respect of purchases from manufacturers.

Cable	£984,000
Wire	253,000
Apparatus	1,149,000
Woodwork, ironwork and miscellaneous stores	606,000
Total	£2,992,000

During the past year contracts were placed as under for supplying material in position ready for use:—

Laying conduits	£306,000
Providing, drawing-in and jointing main cables	690,000
Laying conduits and providing, drawing-in and jointing local area cables	838,000
Providing and installing telephone exchange apparatus	380,000
Providing lifts, heating plant, lighting plant, power plant and pneumatic plant	48,000
Miscellaneous contracts (including wireless plant, cable ship repairs, &c.)	114,000
Total	£2,376,000

The single-wire mileage of the conductors, mostly copper, used in the telegraph and telephone systems was, on March 31st last, nearly 3¾ million miles, made up as follows:—

	Miles.
Aerial wires	1,036,500
Underground	2,683,200
Submarine	19,800
Total	3,739,500

These figures will be sufficient to indicate the magnitude of the operations of the Post Office Engineering Department, and perhaps also, in conjunction with what follows, will show, to the satisfaction of electrical engineers, that the telephone business is being thoroughly developed.

Technical Personnel.

As regards technical personnel, The Electrician said recently: "The Post Office has great resources at its command; its engineers are second to none in technical ability, and improvements in telephone work, as we shall shortly hope to show, are going on satisfactorily." During recent years representatives of the British Post Office Engineering Department have periodically visited the United States, and that Department is fully aware of all the technical developments that are taking place, together with what is perhaps equally important—the policy, financial and otherwise, which underlies the operation of the "Bell" and "Independent" telephone organisations of that country.

Telegraph Engineering.

It is, of course, recognised that telegraph engineering is the oldest branch of applied electricity, and the present Institution of Electrical Engineers was founded, as we are all aware, in 1871, under the title of the "Society of Telegraph Engineers." In the science and art of telegraphy, the premier position of the British Post Office has long been a universally admitted fact, and it may not be out of place to quote a recent interesting pronouncement on the part of Dr. Drysdale in an address on "Post War Electro-Technics" in 1917. He says: "Telegraphy, which is the oldest of the electro-technical applications, is to-day the youngest and most progressive of them. Thanks probably to our insular position and great commerce, this is a field in which we may legitimately be proud of our record." There has been much public comment of a similarly appreciative nature by competent authorities.

High-Speed Systems.

The Wheatstone high-speed automatic telegraph with automatic repeaters, a distinctive Post Office system, was in a fully developed operation on a great scale throughout this country for almost a generation before other countries had begun to make practical progress beyond the earlier hand-worked telegraphs. The Hughes printing system was duplexed by the Post Office, and in this form has been utilised by a number of foreign administrations. Systems of central battery telegraphs, both simplex and duplex, were invented by Post Office engineers during recent years, and the use of these systems has spread all over the world. One instance of the application of central battery telegraph working—namely, that in London—involved the design of a large intercommunication switchboard, which is itself a unique piece of telegraph equipment, and has no rival elsewhere. By its introduction the work of writing down and re-transmitting about 27,000 telegrams per day was saved, together with the delay which would have arisen in the internal circulation of the message forms. In multiplex telegraphy the British Post Office was the pioneer, and it has continued to set the fashion in ways which have been copied by America and many Continental administrations. The famous French Baudot multiplex printing telegraph system was originally adopted by the Post Office in the form of providing four simplex channels in one wire. The Post Office succeeded in duplexing the system, and thus successively obtained increased channels on one wire up to a maximum of 12. These developments proved thoroughly successful, and the results obtained were so far in advance of other systems then on the market that inventors were impelled to turn their attention to further improvements, resulting in the production of the Murray duplex multiplex and the Western Electric duplex multiplex, both of which use the five unit code of the Baudot system, together with developments of the duplexing methods evolved by the Post Office.

The P.O. and the Thermionic Valve.

In connection with the general subject of machine printing telegraphs, the Post Office has carried out more trials of new systems, and has done more development work than any other administration. Thermionic valves for telegraph purposes have been devised by Post Office engineers, and their use will effect appreciable economies in the working of land lines and cables. The recent application of this device to the British–Russian cable, the capital value of which is over £400,000, increased the speed, and therefore the ordinary capacity of the cable, by 60 per cent. In the early days the Post Office took the leading part in the application of secondary cells to telegraphy, and designed switching and distribution plant which has been widely copied. Its officers have also from time to time greatly improved the design of primary batteries.

Wireless Telegraphy.

In the field of wireless telegraphy the Post Office was among the earliest pioneers, and was also the first to take up and assist in developing the system of Marconi. It acquired the wireless telegraph coast stations in 1910, and re-modelled and re-built them in 1914. It has made considerable contributions to the art of wireless telegraphy, among which may be mentioned a low-power calling device of simple construction and easy to maintain (this has worked satisfactorily since 1915); an improved short range set; a high-frequency instrument for simultaneous measurements of resistance, capacity and inductance; a wireless direction finder not involving balanced, untuned aerials, and cabling signals to be read while operating; a means for recording wireless signals on ordinary telegraph instruments; a special relay with a new form of contact for repeating wireless signals over land lines. This relay works at 100 words per minute, with currents of wireless magnitude. A relay of this type was installed at the Post Office wireless station, Stonehaven, and has repeated wireless signals from Amsterdam over land lines to London without manual transmission. During the war, officers loaned by the Post Office to the Army have produced improved developments in wireless telegraphy as applied to military affairs.

Recently the Post Office has been entrusted with the provision of the wireless stations for Imperial communications and the engineering work for the British and Egyptian stations is well in hand.

Aerial and Underground Lines.

The aerial and underground lines constructed by the engineers of the British Post Office are second to none in efficiency and economy of construction and are frequently referred to as models of sound and scientific design. Although for some years it has been the policy of the Post Office to extend its underground system and to reduce the amount of aerial plant, it is nevertheless still necessary to erect a certain number of aerial wires to provide short lengths, for leading-in to subscribers' premises, for extension of the telegraph and telephone to small towns and villages, and in certain cases to provide high grade transmission trunk lines where the required transmission qualities cannot be obtained otherwise. During the year, work of this character accounted for the erection of about 13,000 poles and 9,000 miles of wire. The extension of the underground system was being pushed forward with great energy prior to the outbreak of war. On January 1, 1912, the Post Office took over from the National Telephone Company about 3,400 miles of underground conduit and itself possessed about 2,500 miles. In July 1914 the conduit mileage had been increased to 7,500 miles, and in the same short period the mileage of underground wire was increased from about $1\frac{1}{4}$ to $1\frac{3}{4}$ million miles. If these figures are compared with the particulars already given of the underground wire now in use it will be seen that the further increase since the end of the war has been of a substantial character. The provision of long underground trunk circuits, both telegraph and telephone, has progressed further in this country than in any other. The British system of underground telegraph cables connecting up the main cities of the country is quite without a parallel.

It may be of interest to quote an extract from the Berlin "Tageblatt," published after a severe snow-storm which had swept over Central Europe in January 1918, destroying a very large proportion of the overhead plant. "Owing to the recent almost complete breakdown of the national telephone system on account of storms, the German General Post Office is considering a scheme to place the entire system underground after the war. Engineers say that the day of overhead telephone wires is past." That is to say, that in 1918-19 the highly scientific and efficient German Administration was proposing to introduce a system which had been proved, adopted and extensively carried out by the British Post Office many years before.

Trunk Telephones.

As regards trunk telephones, London already has underground communication with Birmingham, Liverpool, Brighton, Dover, Reading, Aldershot, Canterbury, Chatham, Aylesbury, Chelmsford, Colchester, Farnham, Gravesend, Guildford, Luton, St. Albans, Sevenoaks, Sheerness, Slough, Sittingbourne, Uxbridge, Watford, Walton, Woking and Weybridge. In the provinces the following schemes are completed:—Liverpool to Ormskirk, Prescot, Preston, St. Helens, Southport, Warrington and Wigan; Manchester to Ashton-under-Lyme, Bolton, Blackburn, Burnley, Bury, Halifax, Leeds, Liverpool, Oldham, Preston, Rochdale, Stockport, Wigan and Warrington; Glasgow to Edinburgh, Kilmarnock and Paisley; Birmingham to Chesterfield, Coventry, Derby, Dudley, Sheffield, Walsall, Wednesbury, Worcester, and Wolverhampton; Leeds to Barnsley, Bradford, Castleford, Dewsbury, Halifax, Huddersfield, Hull, Sheffield and Wakefield; Newcastle-on-Tyne to Durham, Middlesborough, North Shields, South Shields, Stockton-on-Tees and Sunderland; Cardiff to Newport, Pontypridd and Swansea; Sheffield to Chesterfield and Doncaster; Swansea to Briton Ferry, Llanelly, Neath and Port Talbot.

TELEPHONE BALANCE.

Post Office engineers have recently carried out an exhaustive investigation into the question of the electrical balance of circuits in telephone cables with a view to ensuring immunity from cross talk and inductive interference, and they have devised methods of balancing which have had a far-reaching effect upon the efficiency and utility of telephone cables for long-distance work.

As will be gathered from the figures already given, the extension of the underground system is actively and continuously proceeding and the work at the moment is only limited by the inability of contractors to deliver the necessary material with sufficient rapidity.

LOADING AND REPEATERS.

The theory of the loading of telephone cables is well known to readers of THE ELECTRICIAN. Loading was taken up by the Post Office in the earliest stages of knowledge on the subject, and studies and experiments have been systematically pursued with the result that the British telephone system enjoys the full improvements of transmission efficiency that this important discovery renders possible. Over 8,000 miles of telephone circuits have been loaded. In the loading of deep-sea submarine cables the Post Office is well known to have been the pioneer authority and its advice on the subject is in general request.

Another development of modern telephony well known to readers of THE ELECTRICIAN is the use of thermionic discharge tubes as telephone repeaters. It is known that the Post Office was one of the earliest authorities, if not the earliest, to experiment with thermionic tubes for this purpose. Its staff has from the first recognised the immense possibilities of these devices in extending the possible range of communication and reducing the necessity for heavy and costly line conductors, and it has eagerly participated in their development.

The actual use of thermionic repeaters in commercial telephony is now very far advanced, both in this country and in the United States, and one instance illustrating the economy of line construction made possible by the use of telephone repeaters is afforded by the case of a new trunk telephone cable from London to the Midlands and thence to the North of England, which is now being manufactured, and has line conductors of one-fifth the weight of copper contained in those required in the first long distance trunk cable introduced in 1913, and less than one-tenth the weight of the aerial conductors erected for long distance conversations in 1900. What this saving in material has meant to the country during the war is shown by the following example. At a critical period of the war in 1918 it was urgently necessary to provide additional telephone lines between London and the British Armies in France. The demand for copper, lead and other materials required for telephone lines was enormous at that time, but by the use of the telephone repeater it was possible to provide the additional lines with less than one tenth of the copper previously necessary for Anglo-French conversations.

Telephone repeater stations in which the thermionic discharge tube is exclusively used are now established at nine centres in Great Britain and plans are in course of preparation for a large station at Leicester to permit of telephone conversations on an underground route between London and Manchester. Plans are also in hand for the installation of three other large repeater stations.

AUTOMATIC TELEPHONY.

In connection with the use of automatic telephone switching plant, it should be stated that there is no telephone administration in the world which has studied this subject so widely and so enterprisingly as the British Post Office. It has sent its expert officers abroad to every quarter where information and demonstration could be obtained. It alone has adopted the policy of equipping in actual service a series of comparatively large telephone exchanges which constitute trial installations of every automatic system so far invented, which could be shown to be capable of meeting the essential conditions obtaining in this country. It does not confine its energies to the setting up of these trial installations; on the contrary, it holds first place in the actual development of automatic telephony, that is to say the proportion of its subscribers who are already served by automatic systems is greater than that of any other large telephone administration in the world.

It will be clear to all who give a moment's thought to the matter that the problem of automatic telephone intercommunication in a large city like London is very different from the problem of installing switching mechanism in a small town. In the former case the public interest involved is great, the capital at stake represents many millions of pounds and wrong steps once taken are very costly and difficult to retrace. Those who light-heartedly attack the Post Office for not having already provided London with an automatic telephone system can have little idea of what is involved. The design of such a system is not, as is so often supposed, a mere multiplication of uniform parts. There is no machine or set of electrical mechanism existing to-day in any branch of science or industry which can compare in its mass of co-ordinated complexity with the machine switching system which must be produced in order to provide the London area with automatic telephones; nevertheless, the Post Office considers such a programme to be practicable and the first experimental exchange designed to meet these telephone conditions will be installed in the City of London within the course of the next few months.

MANUAL SYSTEM NOT OBSOLETE.

While the Post Office has been among the earliest telephone authorities to recognise the possibilities of mechanical switching it is necessary to state that modern *manual* systems of telephony are not in any sense obsolete. The design and equipment of manual switchboards has reached a high state of perfection, and telephone engineers are quite satisfied that the needs of large commercial communities can be efficiently met by the manual system for many years to come. There can be no question, however, that the human element involved in manual operating affords a service that is not so good as that given by the automatic system, and that as the telephone system increases the manual service may be expected progressively to deteriorate whilst the same will not occur with a mechanical system; to say nothing of the economy that is likely to accrue from the elimination of human operators.

A recent development of some scientific interest that is being pursued both in this country and in America is that known as "wired wireless" multiplex telegraphy. The Post Office has a long distance circuit operating on this system and the result of the experimental trial, which permits several conversations to be held on the same wire, may be of far reaching importance.

Turbine Steels: A Research into their Mechanical Properties.*

By W. H. HATFIELD, D.Sc., and H.M. DUNTON, B.Sc.

At the British Electrical and Allied Manufacturers' Association meeting at Sheffield in May, 1918, it was thought desirable that investigations should be conducted to determine what auxiliary tests might usefully be added to the specification on turbine steel, with a view to supplementing the information obtainable. A sub-committee, consisting of Mr. A. D. C. Parsons and the authors, was therefore appointed to carry out investigations into the response which commercial forgings made to the different forms of mechanical testing now in vogue, and into the mechanical property of turbine parts which had given satisfactory and unsatisfactory service, with a view to eliciting reliable information concerning the relative importance of the different values to be obtained from the different forms of mechanical tests.

After giving brief details of the mechanical tests employed during the investigations, which included the tensile test, torsion test, bend test, Charpy test, Fremont test, Izod test, Arnold alternating test, Stanton test, Sankey test, Brinell test and the scleroscope hardness test, the authors state that they exhaustively examined the composition, microstructures and mechanical properties of two turbine discs and two shafts. Three separate large producers were responsible for these forgings, and the results may, therefore, in some measure be taken as indicative of the quality of commercial forgings at present produced. In all four cases the discs and shafts ultimately went into service, and the time will arrive when their exact performance will be known.

A detailed account of the results of the analyses and mechanical tests are given in the Paper. In the case of one particular shaft, interesting differences of value were noticed between the longitudinal, transverse and radial tests. A study of turbine steels under laboratory conditions was also made, the results of which are included in a table in the Paper giving a complete analysis of the mechanical tests made on the different samples.

A second course of tests was conducted with the object of determining how far the metal under examination was affected by unfair treatment. Perhaps the most important portion of the programme included the examination of forgings which had been successful and unsuccessful in service. Unfortunately, the authors were not well supported as regards materials for these investigations, and had to content themselves with reporting upon one turbine disc that failed, one shaft end which successfully served for 11 years, and a rotor shaft which failed after three years. Very comprehensive tests were carried out on these parts, and full details are given in the Paper.

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* Abstract of a Paper read before the North-East Coast Institution of Engineers and Shipbuilders.

The authors are now particularly desirous of obtaining material from important parts of turbines which have served well after having been thoroughly stressed in service. This is especially desirable because the successful shaft end mentioned above proved upon examination to have only been submitted to the lightest stresses, and had never been called upon to meet conditions which would really test the reliability of the material. The failure of the turbine disc was explained by the axial tests, and the rotary shaft certainly failed owing to the fact that the steel was unduly contaminated by slag inclusions, and hence obtained only low results in ductility in the tangential and radial directions.

The general conclusions arrived at as a result of the investigations indicate that the commercial forgings have displayed their properties clearly in the various mechanical tests performed. A relatively small selection from the tests available is generally sufficient to indicate the quality of the material, but the effect of varying amounts of forging on the properties is not yet sufficiently defined. A difficulty in making the tangential and radial tests is that the position of the test piece—that is, its distance from the axis of the forging—may seriously affect the result. The tests generally indicate that commercial forgings are of moderately good quality steel, but that the qualities which can be induced in small masses are not obtained, nor are they to be expected in large masses. Turbine parts which have given satisfactory service as compared with those which had not suggest that design may be a factor of greater importance than the quality of the steel. A shaft which served successfully for 11 years, compared with another which failed after three years, was superior in ductility. Since, however, the former shaft was only lightly stressed in use, this cannot be considered as leading to any definite conclusion. As regards the indications of the various mechanical tests on the forgings and turbine parts investigated, it can safely be said that the tensile test gives a good indication of the quality of the material, though perhaps not sufficient for absolute reliance. The difference between ductility longitudinally and transversely is generally shown up in the value for elongation or reduction of area, while the maximum stress reached indicates the condition of hardness or stiffness. While neither of these figures is directly useful in design, they constitute definite guides as to the condition of the material. The quantities which are of more importance for purposes of design, such as true elastic limit, modulus of elasticity, &c., associated with a given maximum stress and elongation, can be found by independent tests for the various materials used; but are not necessary for routine tests, which have for their object to discover whether the material is up to the standard of quality desired. The Izod test is of little advantage in large turbine forgings on account of its lack of sensitiveness. It may be usefully retained in some cases of nickel-chrome steel forgings as a check on heat treatment. As regards auxiliary tests, one form of test might be introduced to check the conclusions drawn from the tensile test as to reliability, and might be selected from the torsion, Stanton, Arnold or Sankey tests. These are of more direct utility than any of the notched bar tests, such as Izod, Charpy or Frémont. All these tests indicate clearly if the material is really brittle, and are sufficiently sensitive to bring out the differences between longitudinal and transverse directions in forging. The Stanton test probably approaches the nearest stress likely to be obtained in practice where design or accident introduces undesirable features, such as sudden changes of cross-section, sharp right angle corners and the effect of a blow. Experimental work enables the authors to recommend the Sankey test for much more attention from engineers.

Woolwich Borough Council has decided upon a policy of extending its electricity works so as to increase the capacity of the generating plant from 10,000 to 20,000 or 25,000 kw. The Electricity Commissioners are anxious that the Council should develop the undertaking and offer to grant maximum periods for the repayment of loans, and to permit the capitalisation of interest for three years, which ought to cover the time taken to complete the proposed extensions; the Electricity Committee is of opinion that the success of the undertaking depends on extended output in order to keep the price of supply reasonable owing to rising costs caused by increased wages and salaries and the higher price of coal. It thinks it a matter for congratulation that the Woolwich station had been selected by the Commissioners for extension to meet the needs of Woolwich and adjacent areas. Therefore the Committee recommend that extensions be carried out at an approximate cost of £200,000, that mains extensions necessary to meet the further demand required be carried out at a cost not exceeding £30,000, that vacant land on the south side of New-street be acquired to complete the extensions.

Reviews.

Modern Illuminants and Illuminating Engineering. By L. Gaster and J. S. Dow. 2nd Edition. (London: Sir Isaac Pitman & Sons.) Pp. xv.+490. 21s. net.

That it has been so soon found desirable to issue a second edition of Gaster & Dow's excellent book is evidence of the rapid growth of interest in the science and the art of artificial lighting. As pointed out by the authors, the only marked change made in the new edition is the addition of two chapters, titled "Lighting in War Time," and "Searchlights and other Appliances for the Projection of Light."

In order to avoid making the book too bulky, the scope of the text is restricted to main principles, and highly technical and controversial subjects whilst adequately dealt with are not developed in detail. But while thus arranged to provide for the general reader, the book has been made of value to the expert, not only by the addition of an extensive bibliography (Appendix), but also by giving numerous references throughout the text to original Papers, periodicals and to other books.

Illustrations and diagrams are plentiful, and often serve to give information without having recourse to a long description in the text. In view of this it is unfortunate that in one or two cases the descriptive printing on the diagrams is in such small type that it is difficult to read. This defect was emphasised in our review copy by poor reproduction, some letters being entirely missing.

The authors have a note on page 206 pointing out that the term "candle-power" is frequently wrongly used instead of the more correct "candles." They also point out that for convenience the wrong term is retained in some chapters in the book. It is thought that the continual use of the term "watts per candle-power" cannot, however, be defended on the ground of convenience. "Candle-power" is the name of a quality that is associated with any source of light, viz., its intensity; and "candles" is the name of the unit in which this quality is measured. Thus we say a room has a "length" (quality) of 12 ft. (unit), and similarly a light has a "candle-power" of 30 candles.

Only one printing error has been noticed, viz.: the word "ten" instead of "two" in the first line of page 223.

B. F. Dudding.

Précis d'Electricité Theorique. By Leon Bloch. (Paris: Gauthier-Villars et Cie.) Pp. vi.+476. 30 fr.

In the book under notice it has apparently been the aim of Prof. Bloch to present a theoretical treatment of electricity in as succinct a form as possible. The work, therefore, gives a logical chain of facts, definitions and principles, rather than a description of experimental applications.

Titles often convey little real idea of the type of treatment employed in a book, and it is well, perhaps, to state at once that a really good mathematical knowledge is essential to the reading of the present volume. There are in all 15 chapters, and, starting from a consideration of the laws of electrostatics, magnetism and electromagnetism in the early chapters, the author takes us through the mathematical theory of the propagation of waves, and the electromagnetic theory of light, to the electrodynamics of bodies in motion, and the optics of bodies in motion, in the last chapters. In presenting the equations of the electrodynamics of bodies in motion, the author thus takes the reader right up to the threshold of the most recent speculations on the physics of the electron and of gravitation, and also gives an introduction to the study of relativity. The reader is referred to the various classical treatises for a detailed analysis of the laws of electromagnetism and their consequences, the author having aimed simply at establishing these laws in an order conforming with modern physics. On the score of brevity the author has, from the earliest chapters, extensively used vector notation and formulæ and some further idea of the nature of the treatment emloyed can be gathered from the fact that there are only 18 diagrams in the whole 469 pages.

This book is undoubtedly of value to the honours physics student and to the mathematical physicist generally, forming as it does a complete, yet concise, mathematical treatment of modern electrical theory. In common with many Continental publications, the book as issued is provided with paper covers; otherwise the printing and "get-up" of the book are admirable.

A. E. C.

Shorter Notices.

A Plain Guide to Investment and Finance. By T. E. Young, B.A. (London: Macdonald & Evans.) Pp. xii.+324. 7s. 6d. net.

This book has now run into its third edition and is revised and enlarged, so it has evidently proved useful to investors in the past. It has been brought up-to-date with a chapter on the effect of the war on British finance and commerce. To the small investor, and, indeed to anyone who wants to have an intelligent idea of the theory of investment in general, the book can be heartily recommended. The advice is plain and practical. The most practical chapters are those of Part I. which covers "Hints to Investors," the "How," "When" and "What" to select. Part II. is "An Exposition of Finance," and although necessarily more theoretical in treatment, is indispensable to anyone who wants to find his way intelligently through the intricacies and technicalities of the money market and financing generally. We notice one bit of sage advice which may come in appositely in the near future for those whose investing activities turn in the direction of the electric supply industry. It runs, "Never, whether dealing with bodies of men (governments, boards or corporations), or individuals, forget that character is as essential as financial position." The advice sounds trite enough, perhaps, but if electric supply investments are going to secure a reputation for trustworthiness it will only be by investors rigidly applying such rules and so eliminating the "unfit" at the start.

Electric Lighting in the Home. By L. Gaster and J. S. Dow. (London: Sir Isaac Pitman & Sons.) Pp. 31. 6d. net.

This booklet is written by the well-known authors of the more comprehensive treatise "Modern Illuminants and Illuminating Engineering." They describe in a few pages how the worst features of bad lighting may be avoided without sacrificing individuality of taste and without involving high cost. It will be of particular value to non-technical persons, and will enable them to estimate the yearly cost of any proposed installation.

In connection with cost it is thought that a word of warning should be given that in some localities the cost per unit may be very considerably higher than that stated. The authors indicate sixpence per unit as the likely cost, whereas some suburban companies have already intimated that the price in the future will be tenpence.

Correspondence.

A METHOD OF AMPLIFYING ELECTRICAL VARIATIONS OF LOW FREQUENCY.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In your issue of the 13th instant, Dr. Eccles and Mr. Jordan describe a method of amplifying electrical low-frequency variations by the use of a subsidiary high-frequency oscillation. As we have recently been carrying out some experiments of a different character, which also emphasise the utility of this method, it is perhaps worth while to communicate one of our preliminary results. A self-excited triode high-frequency *generator* can be used as a very efficient low-frequency amplifier, the low-frequency voltage amplification factor under such conditions being quite different from the natural factor of the tube. Thus it has been possible to produce a voltage amplification of 40 with a tube possessing a natural factor of 10. The circuits we used are different from those described by the above-mentioned authors, but have one principle in common—the use of a subsidiary high-frequency oscillation.—We are &c.,

Cavendish Laboratory, E. V. Appleton.
Cambridge, Aug. 20. Mary Taylor.

PAYMENT FOR EXPERIENCE.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: As a believer in Trade Unions, I am much interested in the letter under the above heading, signed by "Enquirer," and in answer to your request for your readers' views I have much pleasure in informing you that chiefs of technical departments should assimilate the knowledge between themselves as to the correct rate of wages that they should expect for their position.

I am pleased to say that the directors of my company are sufficiently up to date to pay a reasonable remuneration for work done, and that my salary, which pre-war was £300, plus 10 per cent. of the profits, is to-day between the figure that your correspondent gives, plus 10 per cent. of the profits. You will notice that our manufacturers come under item 1 of your correspondent's schedule, that is, switchgear, meters, &c., and I should be only too pleased if this letter should assist those who are in a similar position as a lever to better their salaries should they be below these figures. At the same time, I should always be pleased to give them privately a proof of the above if it would assist them in any way. I am, &c.,

J. Delebecque.

Walsall, Aug. 20, 1920.

P.S.—I do not think there is any need for you to put this letter under a nom de plume, unless you think it advisable.

[Neither do we—Ed. *E.*]

The Industrial League and Council.

The most difficult and trying period of the year for an organisation such as the Industrial League and Council, which is seeking to improve the relationship between employers and employed, is, without doubt, the three mid-summer months when the attentions of all are focussed on holidays. Then preparations are being made in every home for a visit to the favourite seaside or inland resort, and, for the time being, the ordinary everyday troubles of life are almost entirely, if not altogether forgotten. Yet, withal, the Industrial League has not abated its excellent propaganda work. It is ever alive to grasp opportunities afforded it to procreate the ideals for which it stands, and eloquent indication of the progress made is apparent in this month's publication of the Industrial League and Council Journal. Week-end conferences have been a feature of the organisation's activities. At Cloughton, near Scarborough, the Yorkshire centre of the League organised and held quite a formidable gathering, while similar functions promoted by the Head Office have been held at the residence of Mr. E. J. P. Benn, C.B.E. (of Messrs. Benn Bros.), at Oxted, and the residence of Sir Samuel Waring at Footscray Place, Kent. Each of these functions, while, socially providing a thoroughly enjoyable week-end to all the participants, were productive of earnest and searching inquiry into, and debate of industrial problems of the day. The conferences were attended by employers, employees and trade union representatives, each of whom voiced their opinions without restraint. The general outcome has been that all have obtained a deeper knowledge of the motives which actuate "the other side." Incidentially, the employers and trade unionists alike have come to appreciate the real educative value of these conferences, and the Industrial League has gained a wider sphere of influence and usefulness accordingly. Reports of two of the recent conferences are given in this issue of the Journal.

It is announced that as the outcome of the recent conference between representatives of the National Alliance of Employers and Employed and the Industrial League and Council it has been agreed to recommend the amalgamation of both bodies. The Joint Executives will meet shortly to consider the report and to work out the details. There will then be created, it is claimed, the most influential body of employers and employed that has ever existed in any country. The main object to be pursued will be the bringing together of Capital and Labour with a view to the avoidance of labour troubles, the joint consideration of matters appertaining to their industries and general industrial welfare.

Legal Intelligence.

Workmen's Compensation.

At the Rugby County Court last week, Mrs. Edith May Chamberlain sought to recover £300 from the British Thomson-Houston Company as compensation for her husband's death in the course of his work. It appeared that Chamberlain fell from a crane upon which he was engaged at the company's works in June last, and died three days later from the effects of the injuries.

For the company, it was argued that as the man fell in stepping from one crane to another by means of a girder, instead of using the ladders provided for the purpose, the claim could not succeed. The practice was one that was quite contrary to the intention of the company.

For Mrs. Chamberlain, attention was directed to the absence of any definite instruction by the company in regard to the matter, and evidence was called to show that the practice was commonly indulged in by crane drivers.

After hearing the evidence, the Judge gave judgment in Mrs. Chamberlain's favour for the full amount, with costs.

Electricity Commissioners' Work.

The first annual Report of the Ministry of Transport respecting the applications to and proceedings of the Ministry under the Electricity (Supply) Acts, 1882 to 1919, has been issued. The introduction deals with matters which are now ancient history to our readers, such as the enactment of the Electricity (Supply) Act of 1919, the appointment of the Electricity Commissioners, &c.

We learn that the four applications for provisional orders (for Abersychan, Havant, Panteg and Saint Mellons) which were made subsequent to the date of the last report have been transferred to the Electricity Commissioners for consideration; that for Havant has been refused and the others are still under consideration. Between the date of the last report and the transfer of the powers and duties under the Electric Lighting Acts to the Ministry consent was given to the erection of generating stations at Portrush and Stroud; 25 "fringe" orders were issued, and an extension of time was granted in regard to 12 Acts and Orders, while 73 Orders were made modifying the charges under special Acts and Provisional Orders. In 22 cases consents have been given to the placing of electric lines above ground; the transfer of the Warminster Order of 1914 to the Warminster Electric Supply Company, Ltd., was approved; and notices under sec. 4 of the Electric Lighting Act, 1888, were served on seven owners of non-statutory undertakings

Work of the Commissioners.

Dealing with the work of the Electricity Commissioners, it is pointed out that a preliminary survey of the present and prospective electrical requirements of the greater part of the country has been made, and at the date of the Report six districts had been provisionally determined, while in four other cases the districts will be determined very shortly. A number of applications for consent to establish new or to extend existing stations were received. The Commissioners found that in the majority of the applications a good case had been made out. Before giving formal or provisional consent, the Commissioners satisfied themselves that the need was urgent, that the proposals were technically sound and that there was no economical alternative source of supply at the moment or in the immediate future. Special reference is made to the applications of Manchester Corporation to construct a station at Barton having an initial capacity of 50,000 kw., with the possibility of ultimate extension to 150,000 kw.; of Leicester Corporation to construct a station of 10,000 kw., with the possibility of extension to 50,000 kw.; of Nottingham Corporation to construct a station of 40,000 kw., with the possibility of extension to 240,000 kw., and of the Derbyshire and Nottinghamshire Electric Power Company to construct at Colwick a station of 30,000 kw., with the possibility of extension to 120,000 kw. The Commissioners have sanctioned the applications of Manchester and Leicester Corporations, and an inquiry has been made into the others. Three other undertakers have applied for consent to the establishment of new generating stations, and the applications are still under consideration. In one case the proposed initial capacity is 66,000 kw., with the possibility of extension to 200,000 kw.; in another case it is 45,000 kw. and in the third case the capacity has not yet been decided upon.

With regard to extensions of existing generating stations, the policy of the Commissioners in dealing with the applications, which for the most part relate to plant only and not buildings, has been governed by the following considerations: (*a*) The necessity of facilitating the development of the electrical industry in any district; (*b*) the effect of any given extension upon the ultimate development of electricity supply in the district; and (*c*) the undesirability of extending a badly placed station in one district when a better situated station in an adjacent district could be exteneded and thus enabled to assist the first-named station.

The Commissioners have in a few cases had submitted to them proposals in regard to the establishment of new private generating stations. In accordance with the powers vested in them by sec. 11 of the Electricity (Supply) Act, 1919, the Commissioners have in certain cases prescribed regulations as to the type of current, frequency and pressure to be used with a view to the standardisation of electricity supply in the districts concerned. The Commissioners have approved arrangements for mutual assistance being entered into between Bristol Corporation and the Keynsham Electric Light & Power Company, and between the Corporations of Nelson and Colne.

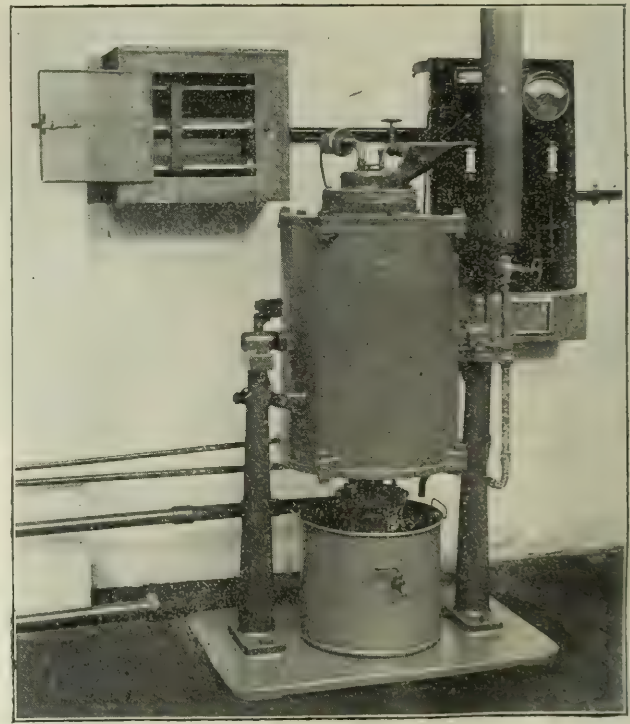
Loan Applications.

Under sec. 20 of the Act of 1919 it devolves upon the Commissioners to sanction borrowing by local authorities for the supply of electricity. The Act requires the Commissioners in exercising the powers placed upon them to act in consultation with the former sanctioning authorities, and a provisional arrangement has been entered into whereby consultation is limited to cases in which the undertaking involves a charge on the local rate, or where the proposed expenditure is likely to involve such a charge, and in the Administrative County of London in certain other special cases. The Commissioners have given careful consideration to the periods which should be allowed for the repayment of loans raised, and they have provisionally fixed a scale of maximum periods which, in their opinion, are within the estimated life of the various assets forming part of an electricity undertaking. During the period ending June 26 the Commissioners had had under consideration 227 applications for sanction to borrowing by local authorities, and a list of formal sanctions to 57 authorities is given. The total of the loans is £2,127,235, including £1,863.405 for England and £263,830 for Scotland.

The Commissioners have authorised certain undertakers to subscribe to the funds of the Incorporated Municipal Electrical Association, British Engineering Standards Association and the Electrical Development Association. Draft rules of procedure with respect to applications for special orders under the 1919 Act have been prepared, and 23 Orders have been made under sec. 6 of the Electric Lighting Act, 1909, permitting the undertakers to supply electricity to certain specified premises outside their area of supply. Orders have been made in 19 cases for an increase of the statutory charges for electricity supply. An extension of time for carrying out their statutory duties has been allowed in five cases, and 17 consents have been given to the use of overhead wires. On March 23, 1920, an Order was made for the cesser of the powers of the Gloucestershire Electric Power Company under the 1902 Act.

Kynoch's Electric Furnaces.

Messrs. Kynoch, Ltd., the well-known ammunition manufacturers and engineers, are now making electric furnaces of the resistance type which they claim have many advantages over the ordinary gas muffles. These furnaces are of the vertical tubular type, an example of which is given in our illustration. The particular furnace shown is designed for hardening and annealing screw gauges, flat gauges and small delicate tools or machine parts and for the experimental heat treatment of various non-ferrous metals and alloys, and other similar industrial purposes. In its operation the temperature can be regulated from 100 to 1,000 °C., and a great consideration is the tilting arrangement which enables the furnace to be used either vertically or hortizontally. A patent water-sealing arrangement with a gas inlet is provided for the passage of coal gas or any neutral gas, so that it is possible to heat steel or other metals in a neutral atmosphere and to quench it in water, oil or other media as may be necessitated by the conditions of its future use. The furnace illustrated is comparatively small, but we understand that Messrs. Kynoch are also making this type of furnace in any size to suit special requirements and have already installed them in sizes up to 30 ft. long.



Kynoch's 5 in. by 24 in. Furnace.

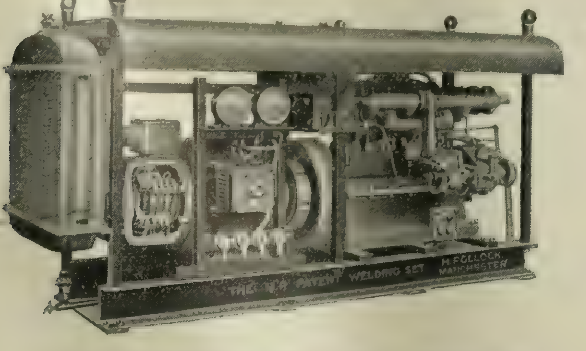
Another interesting application of electric heating to industrial work is the oil-tempering bath made by this firm. This consists of an oil tank of sheet iron filled with a specially prepared oil with a flash point of not less than 350°C. The tank is fitted into a bed containing the patent heating elements, the heat from which is uniformly distributed to the oil tanks and can be adjusted for different temperatures. This bath is used for tempering tool steel and gauges of every description. A somewhat similar principle is used in the electric salt bath furnaces made by the firm, while other specialities are the electric rectangular bench furnace, and laboratory combustion furnaces of both horizontal and vertical types.

As Messrs. Kynoch truly point out, it has for many years been recognised in the engineering world that one of the most essential and useful instruments which could be utilised in the modern workshop or laboratory is a perfect electric furnace. The essentials of such a furnace are that it must be built so that not only can the temperature be regulated at will but that the required temperature may be maintained for any length of time. Experiments conducted in Messrs. Kynoch electrical and physical laboratories have given them extremely satisfactory results in this field, and the experience thus obtained has been applied in the design and construction of the furnaces we have just described, and, as experience shows, with a considerable degree of success.

The "M.P." Welding Set.

In recent issues of The Electrician we have given descriptions of various types of apparatus now on the market which have been designed for carrying out electric welding. Some interesting plant is also made for providing the necessary current for carrying out this work in cases where this cannot be obtained from the public supply mains or from the works generating station. Among this plant is a set recently designed by Mr. H. Pollock and known as the "M.P." welding set, of which we give some details below.

This set, which can be driven either by a petrol engine, as illustrated, or by a motor consists of a dynamo designed upon an accumulative compound basis with special interpoles so arranged as to damp down any tendency towards the hunting which takes place when the arc is struck when an ordinary compound machine is employed. As is well known, the greater number of the welding machines now on the market are designed on the constant watt system, but this is in many ways unsuitable from the welding point of view, as owing to the violent fluctuations of the voltage, due to the varying length of the arc, carbon may be introduced into the weld and bad work, therefore, obtained. We are informed that welds carried out with the "M.P." machine have been subsequently tested and show an increased tensile strength of something like 20 to 25 per cent. over those effected by the ordinary methods.



View of the Petrol-driven "M.P." Welding Set.

Industrial Disputes.

Strikes and industrial disputes continue to be the order of the day, and at present the various branches of the engineering industry are the principal sufferers. An ugly situation has arisen out of the strike of electricians at Messrs. Cammell, Laird & Co.'s works at Penistone, and unless the E.T.U. modifies its attitude there may be a lock-out in the engineering industry which will cause an immense amount of damage and inflict great hardship on many innocent men and women. The origin of the dispute is due to the appointment of a workman, a member of the E.T.U., to the position of foreman. On his appointment he ceased to be a member of the Union; the latter then asked the firm to insist on his continuing his membership, or if he refused to dismiss him. The firm refused to do either, and a strike which has now lasted six weeks ensued. The dispute has now been taken up by the Engineering and National Employers' Federation, and it is to be treated on national lines. About a fortnight ago the Federation threatened a general lock-out of their employees who belong to the E.T.U., but action was deferred pending a conference between the parties. The conference was held in London last week, and failed to reach a settlement. Negotiations are still proceeding and there are still hopes of a settlement. Some of the others unions indirectly concerned are not in accord with the E.T.U., whose attitude has been condemned by some of the men's leaders. A lock-out of the electricians would, it is estimated, quickly affect half-a million members of the Engineering Union, a hundred thousand members of the Iron and Steel Trades Confederation, and at least a quarter of a million members of the General Workers' Federation.

The municipal life of Cardiff has been badly disorganised this week by a general strike of civic employees who have come out in sympathy with the men engaged in repairing the tramways. At present the conductors and drivers of the tram cars, the men employed at the power station, waterwork employees, grave diggers,scavengers, &c., in all between 3,000 and 4000 men, are involved. It is unfortunate that the visit of the British Association members takes place this week as means of local transport will be very limited owing to the strike. The Roath power station is being operated by officials and by some volunteers, and the supply of current is being maintained.

It is a pleasure to be able to record the settlement of one strike. After being out for nine days the Southampton Tramway Dispute has been settled. The Council has agreed to refer the case of the dismissed conductor to the Joint Industrial Council and the men resumed work on Tuesday.

A tentative settlement has been reached in the strike of electric cable jointers employed by the Corporations of Liverpool, Bootle, Birkenhead and Wallasey. The men returned to work on Monday and the matter in dispute has been referred to arbitration by a committee of the Whitley Council.

Commercial Topics.

A Brazilian Telephone Concession.

The British Chamber of Commerce of Sao Paulo and Southern Brazil reports that the Government of the State of Alagoas proposes to install a complete telephone system, and it is suggested that interested firms should send their representatives to Alagoas to study their requirements on the spot unless they have agents in the district. The City of Maceio is excluded and the concessionaires must undertake to connect at least 12 municipalities within two years after the signing of the contract, and the remaining municipalities within a further period of two years. The maximum period of the concession will be 25 years. The Governor is empowered to permit the concessionaires to utilise waterfalls for the generation of electric energy and to give authority to import material free of duty. Before becoming effective, any contract must be submitted to the State Legislature for their approval. The official decree (in Portuguese) may be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

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"Urgent" Telegrams.

We think that the Association of British Chambers of Commerce is justified in its protest to the Postmaster-General against the introduction of urgent telegrams for countries in Europe at three times the ordinary rate, but with priority of treatment. In the opinion of the Association the tendency to give special treatment to such telegrams is wrong in principle. Unless some special method is adopted to deal with "urgent" foreign telegrams more rapidly than at present, the object for which the increased charge is ostensibly made will be defeated, for in a short time all or nearly all messages will be marked "urgent," owing to the fear of senders that if they are not thus marked they will be delayed. Unless some noteworthy improvement in the speed of transmission takes place, the public will thus be paying additional charges for a service which does not warrant them. Not only is the system of treating telegrams harmful in itself, but it creates a dangerous precedent which might be followed in many other of the public services. The considered opinion of the Association is that the system of preferential treatment to foreign telegrams in return for increased payment should be abolished, and that messages should be transmitted in the order in which they are received.

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Trade Advertising in Canada.

In a report on advertising in Canada H.M. Senior Trade Commissioner at Montreal (Quebec) points out that in developing the sale of British goods in Canada and Newfoundland there is an increasing tendency to adopt American methods of advertising and salesmanship. This Americanisation is apparent in the wording and lay-out of advertisements, and in other ways. In Canada manufacturers depend for the sale of their goods much more largely on advertising than on salesmen, and the main method of advertising is undoubtedly the press. It is pointed out that though United Kingdom manufacturers are carrying out a much more vigorous advertising campaign in Canada and Newfoundland than formerly, a good deal of the money spent is wasted through the use of wrong copy, or unsuitable media. For instance, the price of any article in the English currency conveys nothing to the average Canadian householder, and the article must be readily obtainable in the district by potential users.

In framing a successful advertisement for the Canadian press, it is necessary for the copy writer to have a knowledge of local conditions, as well as to know which papers will reach the classes of purchasers he wishes to influence. It is stated that advertising is such a very big factor in Canada in obtaining business under present conditions, that it seems practically essential, if British manufacturers are to obtain a substantial share of the demand in many lines, for them to advertise much more extensively than in the past.

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Swiss Water-Power Development.

In a report by the Acting Commercial Secretary to H.M. Legation at Berne it is stated that there are over 16,000 electric supply undertakings in Switzerland. Electrical energy is used extensively for electric lighting, industrial power, electrochemical and electrometallurgical purposes, for electric traction and for electric heating and cooking. Rivers such as the Rhine, Aare, Reus and the Limmet have at various points been dammed at their full breadth, and the water used for the generation of electric power. A recent innovation is the tapping of mountain lakes (Kloenthal and Ritom), and the artificial creation of lakes for power production by damming up whole valleys. Before the war the Swiss power stations had altogether at their disposal more than 520,000 h.p., taken at a yearly average, the maximum being 887,000 and the minimum 345,000. The erection of electric power stations was delayed owing to the war, but, in spite of the unprecedented rise in the cost of labour and materials, great progress is now being made, as the shortage of coal makes the erection of further power stations a matter of urgent necessity. The amount of water-power immediately available in Switzerland is estimated at 1,189,000 h.p. Of this amount the electrification of the railways will require 245,000 h.p.; but it is estimated that hydro-electric power stations could be built to produce 8,000,000 h.p. The power needed in Switzerland during 1914 was estimated to have been less than one-fourth of this amount. The shortage of coal has been bitterly felt, particularly in winter, with the result that there is now a tremendous demand for electric current, not only for power and lighting, but also for heating purposes and for cooking, &c., in private houses as well as in public institutions.

Electricity Supply.

INCE Urban Council has applied for authority to borrow £9,000 for electric pumping plant at the Golborne station.

Authority to borrow £20,000 for mains and services and £12,000 for meters has been obtained by BIRKENHEAD Corporation.

Sanction to a loan of £12,100 for electric supply extensions has been received by DARTFORD Urban Council.

A sum of £4,000 is to be spent by SHREWSBURY Council on new mains and services.

ALDERSHOT Urban Council has received sanction to a loan of £7,000 for new feeder cables.

CHORLEY Rural Council has been notified that the National Electric Supply Company proposes to construct a new GENERATING STATION NEAR PRESTON. Chorley is in the Mid-Lancs. electricity area.

For the past year there was a profit of £3,000 on the HOVE Corporation electricity undertaking, but owing to increased capital charges and the higher price of coal it will be necessary to increase the charge to consumers.

Owing to the increase in the cost of generation SHREWSBURY Town Council has increased the charges for electrical energy for all purposes from 80 to 100 per cent. over pre-war rates. For the year ended March 31 there was a net profit of £713 13s. 8d. on the electricity department.

GRAVESEND Electricity Committee objects to being included in area No. 10 (London and Home Counties) for INDUSTRIAL COUNCIL purposes, and the Town Clerk is in communication with the Ministry of Labour and the National Industrial Council for the Electricity Supply Industry on the subject.

WALTHAMSTOW Urban Council propose to put down a 5,000 kw. turbo-alternator, two water-tube boilers, and cooling towers, induced draught plant, &c., at the electricity works. The Council are recommended to instal electric light in the houses to be erected on the Higham Hill and Forest-road sites.

SKEGNESS Urban Council has received a report from Mr. C. H. Wordingham on the proposal to erect electric supply works. The estimated cost of a scheme is put at £44,000, and consideration of the matter has been deferred. It is probable that a private company will undertake the work, as some of the members are opposed to municipal works.

The salary of the electrical engineer to MEXBOROUGH Urban Council (Mr. J. B. Feltham) has been increased to £500 a year, though the scale figure is £600. The Electricity Commissioners have intimated that they think it would be a mistake to extend the existing electricity works, as a bulk supply from other undertakers would be more satisfactory.

Owing to the increased cost of coal and wages BEXHILL Electricity Committee has applied to the Electricity Commissioners for authority to increase the existing statutory charge for electric current to a maximum of 1s. per unit. It is thought that it will be sufficient to charge 10d. a unit for light and 3d. for power in order to balance accounts.

The inclusion in the MID-LANCASHIRE ELECTRICITY AREA of Burnley and other authorities in North-east Lancashire is regarded by the latter as a mistake, and they are appealing against the proposal. It is considered that an authority having jurisdiction in North-east Lancashire only would be more economical and efficient than the one proposed. No further extensions of mains will be made at Burnley until adequate generating plant is available.

CHESTER ELECTRICITY DEPARTMENTS accounts for the year ended March 25 show receipts £35,893 (compared with £27,512 in previous year), working and general expenses £25,087 (£16,750), and gross profit £10,805 (£10,762). Interest on loans required £4,859, sinking fund £4,787 and bank interest and commission £82, and the net profit was £1,076. Total maximum supply demanded was 1,764 kw. Costs per unit sold, inclusive of capital charges, were 1·607d. (1·262d.). Units generated were 4,213,205 and sold 3,093,613 (2,718,891).

The revenue of the WEST HAM ELECTRICITY DEPARTMENT for the year ended March 31 was £380,013 (compared with £253,914 in previous year); working and general expenses were £310,777 (£227,312), gross profit being £69,236 (£26,602). Interest required £28,051 (£25,421), and repayment of principal £26,834 (£26,156), leaving a net profit of £14,350 (against a deficit of £24,975). Costs per unit sold, including capital charges but excluding public lighting, were 1·90d. (1·59d.); fuel used per unit sold was 4·53 lbs. (4·67 lbs.), and the average cost of fuel was 38/11·76 (31/0·4) per ton. Maximum load was 12,850 kw. (11,450 kw.), and load factor 36·9 (38·10) per cent. Units generated were 49,701,886 (45,750,681), and sold 41,628,476 (38,216,253).

Complaints are still being received from BIRMINGHAM manufacturers concerning the difficulty of obtaining a supply of electric current. In an official explanation of the position, Mr. E. J. Jennings, secretary of the electric supply department, points out that the department has experienced delay in putting down new generating plant. The moulders' strike put them back five months, and more recently shortage of building labour added to the difficulty. Recently it was found necessary to place restrictions on certain power users, owing to the breakdown of two large machines a few weeks ago. One of those machines would be back in commission in a fortnight's time, when the position would be somewhat eased. The second machine could not be installed again under 10 weeks. The only consumers to whom it had been found necessary to limit supplies were those who contracted for a night supply only, and who had hitherto been allowed unrestricted supplies, or those who signed an undertaking not to make use of the supply during any portion of the day in which the department might find it necessary to curtail output. For the present, the department could not accept applications for new supplies.

Electric Traction.

In order to provide work for ex-service men, LIVERPOOL Tramways Committee propose to construct a big central car works on the Edge-lane estate.

One effect of the engineers' ban on overtime is that some TOWNS IN LANCASHIRE will be without week-end tramcars. On the 15th and the 22nd inst. there were no cars runnng in Burnley. The cars are overhauled nightly ready for the following day, but the men refused to overhaul the cars on the Saturday, and consequently they could not run on the following day.

In spite of the recent increase of fares the LEEDS CORPORATION TRAMWAYS department is still losing money. From July 1 to July 28 there was a net deficit of £4,418, the revenue having been £78,958 and the expenditure £83,376. The deficit per car mile was 1·35d., and the average deficit per day £158. There was a decrease of 3 per cent. in the number of tickets issued compared with the corresponding period of last year. For the period from April 1 to July 28 the revenue was £320,620, and the expenditure £347,745, leaving a deficit of £27,125, or an average of £228 per day.

We are not surprised that the LONDON COUNTY COUNCIL, at the special meeting on Tuesday, rejected the proposal to abolish the mid-day two penny all-the-way fares on their tramways. The system was only introduced as an experiment on March 30 last, but according to Mr. H. H. Gordon 100,000 more passengers were recently carried during a period of five days than in the corresponding period under the old fares. It may be that the twopenny fare is too generous, but it must be remembered that the tramway traffic is very light between 10 a.m. and 4 p.m.; the Council must give a service between these hours, and as the cars can carry more than the ordinary traffic during this period any reasonable scheme for increasing the traffic and the revenue is legitimate. We agree with Mr. Gordon and Mr. J. M. Gatti that the cheap mid-day fares are logically right and financially sound. The two-penny fares improved the load curve and they should not be abolished without full consideration and for very good reasons. We have no objection—nay, we should be pleased, to see the Underground Railway group in a satisfactory financial position, but we do not quite appreciate the action of the Transport Minister in the matter, nor his desire to rush through a complicated question at a special meeting of the Council in the middle of the holidays.

The Ministry of Transport have made an order authorising the Council to increase their fares, but the Council will not put this into force before Sept. 26. The Underground group of undertakings contended that that arrangement would lead to a postponement of the introduction of their new scale, and the Ministry of Transport sent to the Council a letter, in which Sir E. Geddes's great concern at the difficulty thus created was expressed. The Council are authorised to fix sections of about ⅗ of a mile, and charge fares which shall not be in excess of the following, and in no case shall exceed by 100 per cent. the statutory maximum charges: Not exceeding one section, 1d.; not exceeding two sections, 1½d.; three sections, 2d.; five sections, 3d.; and not exceeding eight sections, 4d. For workmen's return tickets the fares are: Not exceeding three sections, 2d.; six sections, 4d.; and exceeding six sections, 6d. In their report the Highways Committee stated that it would take a period of three or four weeks before new tickets could be printed, and the necessary arrangements could be made with the extra metropolitan authorities with whom the Council has through running agreements. They are therefore of opinion that the revision of fares on the Council tramways should not take place before Sept. 26. The Committee were further of opinion that the Council were not in a position to agree with the suggestion of the omnibus companies that the initial minimum fare should be 1½d., and that no difficulty would arise in settling the new stage points. If the omnibus companies agreed that the initial ordinary fare in London should be 1d. instead of 1½d., they might agree to suspend the practice of charging a cheap fare between 10 and 4 o'clock.

The question of granting a seven days' holiday with pay to the skilled employees of the tramways department and electricity works came before the SUNDERLAND Corporation on the 18th inst. in the form of a recommendation by a Special Committee to give the holiday.

Councillor R. Baxter, speaking in favour of the concessions, said they should see that their employees were fairly treated and cited other tramway undertakings which granted holidays. At Bradford the employees got 12 days holiday with pay, in Wakefield they got a week's holiday, also at Huddersfield, Halifax, Manchester, Sheffield, Birmingham, South Shields and Newcastle similar concessions were given. Among the electricity works giving similar privileges were those of the Cleveland and Durham Electric Power, the Newcastle District Lighting, and Newcastle Electric Supply companies, Middlesbrough, Darlington, Tynemouth, South Shields, Stockton and Hartlepool Corporations.

Replying to the discussion, Ald. G. New said at the last meeting of the Council he represented a unanimous Tramways Committee determined to refuse the demand. Of over 300 undertakings in the country, about a dozen had been mentioned as giving a holiday. Public opinion had been brought to bear upon them, and it had been stated that if they did not fall in with the mens' demands something would happen. They were out to combat that kind of procedure. It had been said that the tramways and electricity departments were profit-making undertakings but that was a moot point. He heard that West Ham had given £38,000 out of the rates for the relief of the tramways, and before anything like that happened at Sunderland they would dispose of the tramways to a company. By 34 votes to 13 it was then decided not to grant the holiday.

Imperial and Foreign Notes.

Bowen (Queensland) Council has adopted a scheme for electricity supply, prepared by Mr. W. G. Counsell.

The Australian Institute of Science & Industry has issued a STANDARD SPECIFICATION FOR STEEL for structural purposes, and it is stated that specifications for steel for railway and tramway rails and fishplates will be published shortly.

The Electrolytic Zinc Company, Risdon, Tasmania, intend to commence the production of ELECTROLYTIC ALKALI AND CHLORINE, in addition to electrolytic zinc, of which over 100 tons a week are produced at the company's works.

The report of the Electrical Traders' & Contractors' Association of Victoria states that the Association had recommended that the licensing of wiremen should be compulsory. The Electricity Commissioners had stated that fresh legislation would be necessary to bring such compulsion into force.

It is now reported that, owing to the shortage of coal and fuel oil in certain parts of Canada, the Canadian Pacific Railway Company has taken steps to adopt electric traction on British Columbia lines. The Bonnington Falls plant of the West Kootenay Power & Light Company will supply energy for the railway between Kootenay Lake and Similkameen, and it is possible that a transmission line may be run up the Arrow Lakes to the main line. The company are installing hydro-electric plants at the Donald Canyon on the Columbia River, four miles below Donald, and at Surprise Rapids on the same stream, 25 miles below its junction with the Beaver River. It is considered likely that similar plants will be erected at Death Rapids, on the Columbia River; at Adams River on Shuswap Lake; and on the Thompson and Fraser Rivers. These plants would be sufficient to afford power for the electrification of the entire main line system in British Columbia.

According to reports from Moscow, the first electric train built in Russia has been completed by the Baltic Works. The train is designed for a speed of 31 miles an hour.

At the recent meeting of the Bilbao-Santander Railway Company it was announced that the work of electrifying the line would be commenced at once.

The construction of an electric railway from a Black Sea port to Kars, Alaguesa, Djoulfa and Tabriz is projected. The line, which would tap rich coal and salt mines and pass through a fertile zone, would reduce the route to Persia by 250 versts.

The big new radio-telegraph station at Croix d'Hins, near Bordeaux, which has been designated the "Lafayette" station, which is equipped on the Poulsen system, exchanged messages with America on the 21st inst. The station has eight towers 790 ft. in height, and has a radius of 20,000 km. (about 12,400 miles).

It is pleasant to be able to record the industrial progress of Belgium and its rapid recovery from the ravages of war. The directors of the Ateliers de Constructions Electriques de Charleroi report that, although no orders of importance were booked until the end of May, the value of the orders received in the whole of 1919 was 45,454,000f., and the present year promised to be still more favourable. The year's profit was 2,546,000f., but after deducting the loss of 2,337,000f. incurred in the years 1915 to 1918 the sum of 209,000f. was carried forward.

It is announced that a WORKING AGREEMENT has been made by the American Telephone and Telegraph and the General Electric Companies for the mutual use of all patents and scientific secrets. At present the Genral Electric Company is associated with the Radio Corporation. According to Mr. H. B. Thayer, president of the General Electric Company, the world system of the Radio universal service and the Bell system will now be brought into harmonious relations which will facilitate the use by the public of wireless linked up with the telephone. The service is to be extended to ships at sea, Europe and foreign countries. The arrangements will also make it possible for several conversations to take place on the same wire simultaneously.

According to "The Times" Trade Supplement, the schemes for adopting Electric Traction on the Belgian Railways have been delayed because the Government considered the tenders submitted by Belgian firms too high. It then invited foreign contractors to quote for the conversion of the Antwerp–Brussels line, but could not obtain any firm offers. Before the war the house of Empain quoted 23,000,000f. for electrifying the road. New proposals have recently been made by Belgium firms for the supply of motor coaches. The State Railways Administration intends ordering, in the first instance, 42 coaches (nine consisting of first, second and third class compartments, nine of first and second, and 24 of third class only. The "La Brugeoise" Company has quoted 315,000f. for the first-named type of coach, and the "Dyle et Bacalan" Company 305,000f. for the third class coaches.

According to a statement recently made by Prof. Lomonossow, head of the Russian Traffic Department, 5,000 LOCOMOTIVES are WANTED in Russia, and they will have to be obtained from America and Germany. German prices are considered too high, and the Soviet Government may, therefore, be compelled to offer the orders to Canada. The Government are con- sidering plans for three hydro-electric stations. The first will be on the River Svir, which connects Lakes Ladoga and Onega, the second on the River Volkhov, and the third north of the Black Sea on the Dnieper, between Ekaterinenburg and Alexandrovsk. There is a shortage of water turbines, and America, Germany and Sweden are looked to for the supply of these machines.

Miscellaneous.

The Merchant Shipping (Wireless Telegraphy) Act, 1919, and the rules made thereunder will come into operation on Wednesday next An abstract of these rules appeared in a recent issue of The Electrician.

We regret to learn that Mr. Henry B. Sayers, second son of Mr. Henry M. Sayers, M.I.E.E., died at his father's house at Streatham on Aug. 23 in his 29th year. He has recently been on the staff of Alloy Welding Processes, Ltd., and collaborated with Major J. Caldwell in a Paper on Electric Arc Welding presented to the I.C.E. last year.

In an article on the Wild Barfield Electric Furnaces, which appeared on page 212 of last week's issue, we regret that the footlines to Figs. 1 and 2 were interchanged, and that our original Fig. 2, should have shown the W.B. radiating furnace equipment, and this has an output of 36 lb. per hour, and not 30 lb. per hour, as stated.

A youth named Walter Eckersley, who was engaged in repair work on the signal lines alongside the electric lines of the L. & Y. Railway Company between Manchester and Bury, received an electric shock on the 19th inst. through a signal wire coming in contact with the conductor rail. The youth was badly burned, and he died at the Manchester Royal Infirmary the same evening.

The scope and effect of the Rent Restriction Act, 1920, is set out clearly and succintly in a little work just published by Messrs. Oliver & Boyd, of Edinburgh and London. Parts of the Act are very obscure, and will need judicial interpretation, but the present work, which is in its fifth edition, and incorporates the effects of all decisions of the Courts to date, is written in simple language, and seems as clear and accurate as any of the popular guides we have seen. It is published at 2s. net.

A new London Telephone Exchange, to be known as the Langham, is being erected, and a number of the subscribers in the Mayfair exchange area will be transferred to it in three or four months' time. The new exchange will be at first limited to about 2,000 subscribers, and will begin at the number 1,000, as it is hoped to make this exchange automatic, similar to those at Epsom, Leeds and Derby. An automatic service is also promised in the City some time next year. A new City exchange, the "Gower," as well as a trunk "no delay" service, serving places within 25 miles of London, are also being put through as speedily as possible.

We would remind our readers that the minimum CHARGE for INLAND TELEGRAMS of 12 words will be increased on Wednesday next from 9d. to 1s., with a penny for each additional word. The porterage on telegrams delivered outside the free delivery area will be increased from 3d. to 6d. a mile; the charge for a reply-paid telegram of 12 words will be 2s., and the cost of a multiple telegram to two or more addresses in the same town will be calculated at the new rate for the total number of words in the addresses and text, and an additional fee of 4d. for each copu beyond the first. The charge for redirection, retransmission, repetition, and cancellation of telegrams will also be proportionately increased, while the charge for a registered abbreviated telegraph address will be £2 a year instead of £1 1s.

"Safety First," the slogan of the Accident Prevention Movement, has gripped the imagination of the pedestrian, the vehicle driver, railwayman, passenger and worker. It is a phrase on the lips of everyone, yet possibly few appreciate the beneficial effects of this self-imposed discipline. The doctrine of self preservation is becoming a regular habit, and the need for it is sufficiently apparent. In the streets of London, between 1914 and 1918, traffic casualties were reduced by nearly 50 per cent. In factories and workshops accidents are diminishing and results have been achieved beyond the most sanguine expectations. A great deal will shortly be heard of the "Safety First" movement, for at the Machine Tool Trades Exhibition a great Convention will be held under the joint auspices of the Home Office and the British Industrial "Safety First" Association. The arrangements for the Conference are in the hands of Mr. Gerald Bellhouse, C.B.E., Deputy Chief Inspector of Factories and Workshops, and Mr. H. E. Blain, C.B.E., the well-known operating manager of the Underground Railway and London General Omnibus Group.

Educational.

Alterations have been made in the scope and method of conducting the Postmaster-General's Examination for the Certificate of Proficiency in Wireless Telegraphy. After Jan. 1 next, candidates will have to satisfy the examiners in a written as well as the practical examination. There will be two papers of two hours each, but the scope of the examination is quite elementary, and the knowledge of mathematics required will not exceed simple arithmetic and algebra up to simple equations. In technical wireless telegraphy, similar skeleton diagrams of circuits are required.

In anticipation of the proposed changes, the Newcastle-upon-Tyne Education Committee have drawn up a revised syllabus for the department of WIRELESS TELEGRAPHY at the Rutherford Technical College. From the prospectus issued by the college, we gather that good facilities are now provided for wireless telegraph students. The course of instruction, occupying 12 to 18 months, is arranged so that a student may enter the classes in September, Janaury or April, and thus join a group working at his capacity. A student following the curriculum receives a much wider education than is generally given, so that he is able, after taking up an appointment, to pursue his studies at sea or elsewhere, and make himself competent to take advantage of vacancies in the higher grades of the service as they occur.

Catalogues, Price Lists, &c.

In a neatly printed and well-illustrated catalogue of 32 pages the Sun Electrical Company, Ltd., 57/9, Neal-street, Long Acre, W.C. 2, give details of a great variety of Sunco Electric Signs and Flashers which are manufactured by them. A number of artistic designs are shown, including types suitable for stores, theatres, hotels, clubs, business houses, and also for general public work. Those of our readers who are interested in the subject of electric advertising and signs may obtain copies of the catalogue from the company.

In a booklet recently issued by Messrs. F. & A. Parkinson, Ltd., Guiseley, Leeds, illustrated particulars are given of the design and construction of the company's standard Two and Three-phase Induction Motors. The firm have modern and well-equipped works, and they manufacture motors from $\frac{1}{2}$ b.h.p. to 100 b.h.p. for use on circuits up to 600 volts, 25, 40, 50 or 60 cycles. Parkinson motors have been supplied for a great variety of industrial purposes, and are in use on the systems of a number of supply undertakings in this country and abroad. Tables of sizes and prices of squirrel-cage and slip-ring types, together with connection diagrams and other technical data, are included, as well as the prices of switchgear and other accessories.

In a well-illustrated catalogue of 36 pages Messrs. Marshall, Sons & Company, of Gainsborough, give particulars of the design and construction of the Marshall "Locomobiles" for Industrial Power Purposes. It is claimed that the "Locomobile" represents the highest thermal efficiency in steam engines of small power; it is more economical in coal and steam consumption, and, compared with any other steam engine and boiler, it occupies less space, is cheaper and more easily installed; while it is more advantageous, has a greater range of power at economical working and is simpler to run than suction gas plants of similar power. Tables of sizes and power outputs, indicator diagrams, &c., are given. Many of these engines have been supplied for small electricity supply works, independent lighting plants, &c.

Two seasonable trade publications have been issued by Messrs. Belling & Co., of Edmonton. In a well-illustrated catalogue of 40 pages, particulars and prices are given of the various types of the well-known Belling electric fires and heating elements, electric cookers, warming plates, boilers, kettles, hot plates, glue pots, air warmers and other domestic and labour-saving devices. The advantages of electric heating and cooking are clearly pointed out and estimates are given of the cost of heating various rooms. Another pamphlet of 12 pages is mainly devoted to a demonstration of the economy in labour which can be effected by the use of domestic electric appliances. A long list of the users of Belling apparatus is a testimonial of the success achieved by the firm and also shows the great progress made in heating, cooking and cleaning for household purposes.

Simplex Conduits, Ltd., have just placed upon the market a New Pattern of Ironclad Distribution Board, which is fitted with their new fuse unit, for which quite special claims are made. The board and the mounting of the fuses are of special design. It complies with Home Office regulations, and is designed to afford the greatest simplicity in erection, wiring and inspection. The whole interior, being mounted by a four point suspension which, by the removal of two easily accessible screws, allows the frame to be swung outwards, either to the right or left, or by the removal of four screws to be entirely removed from the case. The appearance is good, and the design and workmanship are of the usual Simplex high standard. All parts are interchangeable and easily replaceable, and we are assured that the prices are quite competitive. Particulars will be sent on request.

Mr. H. W. Sullivan, Winchester House, E.C.2, has just published a set of 21 Working Diagrams for Valve Amplifying Receivers. The diagrams are printed on stout burnished paper $7\frac{1}{2} \times 4\frac{3}{4}$, arranged in the form of a loose leaf file in a size convenient for pocket reference. The printing is beautifully clear, and the arrangement of the circuits made as simple as possible, so that they can be followed by the wireless amateur as well as the experienced radio engineer. To both they should prove invaluable for reference purposes, as the diagrams cover practically every important combination of valves for wireless telegraphy and telephony reception. The 21 circuits cover a range of from one to seven valves, and include one circuit for reception with a frame. Any addition to wireless science which takes the form of a standard for reference will be welcomed by all interested in wireless telegraphy. The book of diagrams is sold at the nominal cost of 1s.

Business Items, &c.

Messrs. Murray Coombs & Richards, who are removing to Premier House, 150, Southampton-row, London, W.C., have been appointed representatives for the United Kingdom of Messrs. W. G. Watson & Co., Ltd., of Sydney, Australia. Telephone No.: Museum 5,303.

Messrs. Arthur Lyon & Wrench, Ltd., of Willesden, manufacturers of "L.W." motors and dynamos, have gone into voluntary liquidation, and Messrs. Todman, Ryall & Company, Ltd., 17, Victoria-street, London, S.W. 1, has been formed to continue the manufacture of these machines. We are informed that the "L.W." machines were so completely jigged and gauged up that there is no difficulty in reproducing interchangeable parts and new machines exactly as before, and the new company, which has purchased all the necessary tools, jigs and designs, has now got improved manufacturing facilities at Hendon. With the new organisation and concentration on motors and dynamos only, a greatly improved service will be given. As there is a demand for larger machines, Messrs. Todman, Ryall & Company are proceeding with the design of these; they have taken over a large stock of finished machines and are well placed for early deliveries.

Tenders Invited and Accepted.

Warrington Corporation want tenders by Sept. 7 for surface condensing plant. Specification from Borough Electrical Engineer.

West Ham Guardians require tenders by Sept. 9 for six months' supply of electrical fittings, &c. Forms from the Clerk, Union-road, Leytonstone, London, E.11.

Nuneaton Corporation want tenders by Sept. 20 for h. and l.t. switchgear, connecting cables and accessories. Specifications from the Borough Electrical Engineer.

Edinburgh Corporation want tenders by Sept. 6 for converting plant for Portobello generating station and sub-stations (specification 26). Specification from the Engineer, Dewar-place, Edinburgh.

Edinburgh Corporation also require tenders by Sept. 7 for the electric lighting of the public health offices, Parkstone-terrace. Specifications from the Engineer, Electricity Supply Offices, Dewar-place.

Manchester Tramways Committee require tenders by Sept. 14 for steel girder tram rails and special track work. Specifications from the General Manager, 55, Piccadilly, Manchester.

Tenders are required by Sept. 13 for six months' supply of electrical goods, &c., to the Cheshire County Asylum, Parkside, Macclesfield. Forms of tender from the Clerk.

Rutherglen Corporation want tenders by Aug. 31 for wiring and fitting the first 52 houses under their housing scheme. Schedules from the Burgh Engineer.

Tenders are invited (by Sept. 20) for steam, exhaust, circulating water and other pipes work at Ipswich Corporation electricity works. Specifications from Mr. F. Ayton, Chief Engineer and Manager.

The Department of Public Works of the Spanish Ministry of Development require tenders by Sept. 21 for the construction and working of an electric tramway from Mantaro to Argentona, in Barcelona Province.

Croydon Corporation invite tenders for the supply and installation of a new feeder cable for the tramways department. Specifications from the Tramways Manager, and tenders to the town clerk (Mr. J. N. Newnham) by 11 a.m. Sept. 8.

Bradford Corporation invite tenders for the supply and erection of Boiler House Equipment, including Buildings, Water-tube Boilers, Economisers, Induced Draught Plant, Feed Pumps, Coal Handling Plant, and Piping Systems. Specifications, &c., from the city electrical engineer, Mr. Thomas Roles, and tenders to the town clerk, by Sept. 9.

The Electricity Committee of Bolton Corporation invite tenders for the supply and erection of one 12,000 kw. turbo-alternator. Specifications and form of tender from the borough electrical engineer, Mr. W. J. H. Wood, and tenders to the town clerk, Mr. Samuel Parker, by noon, Sept. 16.

Manchester Corporation require tenders by Aug. 30 for supply and laying of 33,000-volt 3-phase trunk feeders, pilot cables and telephone cables (specification B7); and by Sept. 20 for 33,000-volt, 19,500-k.v.a., 3-phase static transformers, house service and testing transformers (specification B8). Specifications from Mr. F. E. Hughes, Town Hall.

Walthamstow Council require tenders by 5 p.m., September 8, for (contract 43) two water-tube boilers and economisers; (44) 5,000 kw. turbo-alternator and condensing plant; (45) 1,500 kw. and 1,000 kw. rotary or motor converters; (46) natural draught cooling tower; (47) e.h.t. switchgear; (48) l.t. switchgear; (49) e.h.t. cables. Specifications, &c., from the Electrical Engineer, Priory-avenue, Walthamstow.

The Hong Kong Electric Company has placed an order with the English Electric Company for additional plant of 5,000 kw. capacity.

Llanfyllin Town Council have accepted the tender of Mr. Robert A. Jones, J.P., for street lighting by electricity, at 20s. per lamp per annum.

Carlisle Corporation has accepted the tender of the Metropolitan-Vickers Electrical Company for the supply and erection of a rotary converter and switchgear at £8,824.

Wolverhampton Corporation has let the following contracts: A. Reyrolle & Company, two oil switches, &c., £700; Brush Electrical Engineering Company, eight single-deck tramcars, £15,784; English Electric Company, three double-deck tramcar bodies, £6,362; British Thomson-Houston Company, 16 249A tramcar motors, £5,076.

The contract for converting to electric traction the Jundiaby Compinas (Brazil) Section of the Paulista Railway Company has been secured by the International General Electric Company. The length of the section is about 28 miles, but as there is a double track, with extra sidings, &c., the total length of track is 76 miles. The amount of the contract is nearly $2,000,000, and the equipment will include 12 locomotives, eight freight and four passenger engines, material for the transmission line and sub-station and 3,000-volt overhead construction of the latest type. This is the first railway in Brazil to adopt electric traction, and it is anticipated that the whole of the line (about 128 miles) between Jundiaby and San Carlos will be electrified. Power will be, supplied by the San Paulo Light and Power Company at 88,000 volts 60 cycles. The locomotives will be of the geared type, 3-000-volt direct current. The freight locomotives will weigh 100 tons each, all weight on driving axles and the passenger engine, 120 tons equipped with two axle guiding tracks at each end. Regenerative breaking apparatus will be used. The design of the equipment will be similar to that of the Chicago, Milwaukee and St. Paul, and the Butte, Anaconda and Pacific Railways.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919. Specifications.

144,842 Hyde. Means to be employed in the electric welding of iron, or steel, or alloys thereof. (1/5/19.)
144,854 Terrey. System of, and apparatus for, obtaining and utilising electric energy from a battery. (13/12/19.)
144,860 Fellows. Electric horns. (27/8/19.)
144,914 Browne. Electric lighting systems applicable to trains. (8/8/19.)
144,915 Electrical Apparatus Co. & Martin. Electric switch mechanism. (14/8/19.)
144,958 Paterson. Device for indicating the effective sparking condition or otherwise of the plugs of motor-road vehicles. (22/11/19.)
144,964 Veron & Veron. Electric bells. (8/12/19.)
145,120 Rohman. Installations for electrically lighting, heating and ventilating railway carriages and other vehicles. (19/3/19.)
145,132 Cowey. Electric switching means for preventing the theft or unauthorised use of motor vehicles. (21/3/19.)
145,134 Brooke & Kerr. Automatic contactors, or electrically-operated switches, and such like electrical devices. (22/3/19.)
145,142 Sykes Interlocking Signal Co., & Tarrant. Electric relays, applicable more especially to relays for use in railway signalling apparatus. (24/3/19.)
145,143 Gill. Controlling devices for electric starters for internal-combustion engines. (24/3/19.)
145,145 Rohman. Electric supply systems for lighting, heating and ventilating railway carriages and other vehicles. (24/3/19.)
145,147 Smith. Electric arc welding and cutting. (25/3/19.)
145,162 Carey. Electrically-driven luggage trucks and the like. (27/3/19.)
145,200 Wescott. Electric lighting systems. (22/4/19.)
145,202 Batten. Electrically-operated camera shutters. (26/4/19.)
145,238 Ironclad Switchgear Co. & Morgan. Electric fuse holders. (4/6/19.)
145,250 Coles & Cowper. Process for the production of plates and sheets by electro-deposition. (12/6/19.)
145,256 Jones, Mortimer & Jones. Clips for supporting and fixing electric cables and the like. (18/6/19.)
145,277 Davis. Electric bell apparatus. (12/7/19.)
145,278 Davis. Electric press button. (12/7/19.)
145,293 Wescott. Switches for use in electric lighting systems. (5/8/19.)
145,303 Cubitt. Electric switches. (26/8/19.)
145,330 B.T.-H. Co. (G.E. Co.) Methods for and apparatus for automatic arc welding. (24/10/19.)
145,356 Goldstone. Electrical connector boxes. (13/12/19.)
145,360 Bechoff. Indicators for electric controlling switches. (24/12/19.)

1920 Specifications.

138,102 Bosch Akt.-Ges. Electric lighting of automatic vehicles. (25/11/18.)
145,368 Schleper. Clamp for electric wires. (21/1/20.)
145,373 Hulbert. Electrical resistance control. (29/1/20.)
145,375 Siemens Bros. Dynamo Works & Howard. Windings for dynamo-electric machines. (31/1/20.)
145,377 Siemens Bros. & Co., Petit-Hory & Collyer. Selecting devices for automatic telephone systems. (26/2/20.)
145,380 Siemens Bros. & Co. & Petithory. Subscribers' instruments for automatic telephone systems. (8/3/20.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

March 9.

7,069 Automatic Telephone Mfg. Co. & Harrison. Telegraph Printing systems.
7,084 Swinbourne. Key and receiving gear for wireless telegraphy.
7,092 Bridges & Urwin. Method of using electric lamps to illuminate heated chambers, &c.
7,106 White. Junction box for wiring systems.
7,140 Elphick. Electric targets.
7,142 B. T.-H. Co. (G. E. Co.). Electric ship propulsion.
7,147 Pritchett & Gold & Electrical Power Storage Co. & Minchin. Storage batteries.
7,160 Oldham. Miner's electric lamps.
7,163 Stephens. Automatic switch for electric-heating appliances.
7,176 Lilienfeld. Electron-releasing devices. (12/12/19, Germany.)

March 10.

7,199 Bradley & Millington. Guiding devices for trollies of tramway, &c., vehicles.
7,210. Marples. Electric heaters.
7,255 Andre. Electric starting apparatus.
7,256 Brydon, Cusins, Johnson & Whittaker-Swinton. Thermionic tubes for wireless transmission systems.
7,266 Benjamin Electric, Ltd., & Campbell. Reflectors.
7,280 Matthis. Deflagration apparatus for testing electrostatic rigidity of insulating materials.
7,286 Spencer. Telephone fittings.

March 11.

7,342 Ellerton. Electrically-operated signs.
7,346 B. T.-H. Co. (G. E. Co.). Circuit interrupters.
7,348 B. T.-H. Co. (G. E. Co.). Switches.
7,359 Beach. Grill for gas or electric stoves.
7,363 Ferranti, Ltd., Higg, Hawkins & Hanstock. Generation transmission, &c., of electricity.
7,365 Siemens-Schuckertwerke. Safety device for electric generators.
7,377 Eckersley. Aerials for wireless signalling.
7,378 Premier Electric Welding Co. & Paterson. Electrodes for welding.
7,386 Mancha Storage Battery Loco Co. Battery locomotives. (31/8/18, U.S.)

March 12.

7,431 Edley. Device for winding armature coils.
7,452 Major & Wates. Electric signalling apparatus.
7,458 Barrasford. Telephone receivers.
7,490 Sterling Telephone & Electric Co. (Bell & Davey). Electric signalling systems.
7,503 Pudumjee Macrorie. Electric signals.
7,504 Appleton & Long. Producing low frequency varying current or voltage by thermionic valve circuits.

March 13.

7,519 Woods. Means for securing ends of cables.
7,523 Blunt & Mitchell. Switches for signalling systems.
7,542 Callender's Cable & Constructional Co. & Watson. Switch and fuse contacts
7,544 Stenton & Co. & Margerison. Starting and regulating switches.
7,561 B. T.-H. Co. (G. E. Co.). Electric motor control.
7,573 Telegraph Construction & Maintenance Co. & Riddle. Galvanometers.

March 15.

7,614 Angold & Railing. Arc lamps.
7,664 Marks (Scovill). Electric furnaces.
7,699 Maxwell & Stergold. Electric fuse holders.
7,732 Treguany & Vila. Accumulators.

March 16

7,785 Western Electric Co. Vacuum tubes.
7,793 Gandell & Macrorie. Automatic electric steering gear for ships.
7,797 Fabr. Elektr. Apparate F. Santer. Electric time switches. (15/4/19, Switzerland.)
7,799 Sykes Interlocking Signal Co. & Tarrant. Railway electric track circuits.
7,801 Bolton. Resistances.
7,804 Marks (Reed). Electric fires.
7,809 Siemens & Halske A. G. Gas filled glow lamp. (20/9/13, Germany.)
7,815 Barri. Generating devices.
7,824 B. T.-H. Co. Magneto electric machines.
7,831 Igranic Electric Co. (Cutler Hammer Mfg. Co.). Switches.
7,838 Walton. Motors for use in mines, &c.
7,849 Morris-Airey, Macrorie & Long. Wireless reception.
7,850 Morris-Airey, Macrorie & Long. Wireless reception, particularly direction finding.
7,851 Morris-Airey, Macrorie, Long, & Randall & Shearing. Wireless transmitting circuits employing thermionic valves.

March 17.

7,867 Smith. Electric light distribution devices.
7,872 Hutchinson. Power factor calculator for use with idle current meters in alternating current systems.
7,887 Angold & Railing. Means for supporting arc lamps.
7,911 Ramsay & Wood. Condensing steam-electric locomotive.
7,925 Cooper. Electric machines.
7,932 Angell. Combined electric motor and compressors or pumps.
7,941 Fletcher & Jones. Reflectors for electric lamps.
7,943 B. T.-H. Co. & Clough. Systems of electric ship propulsion.
7,945 Tritle. Electric motor control.
7,973 Monson. Electrical apparatus for medical purposes.

Companies' Reports, &c.

The Adelaide Electric Supply Company, Ltd., has declared the half-yearly dividend on the 6 per cent. cumulative preference shares for the half-year ended Aug. 31.

The directors of the Melbourne Electric Supply Company, Ltd., have declared the usual dividend on the 7 per cent. cumulative preference shares for the half-year ended Aug. 31.

The directors of W. T. Henley's Telegraph Works Company, Ltd., have declared a dividend on the preference shares at the rate of 4½ per cent. per annum (less tax) for the half-year ended June 30 last, and also an interim dividend on the ordinary shares of 1s. per share (less tax).

For the half-year ended July 31 the profit of the Aberdeen Suburban Tramways Company was £1,262. After adding balance brought forward, the directors propose to add £1,000 to renewal and depreciation account, to pay a dividend of 7 per cent. for the year, carrying forward £2,432.

The directors of Vickers, Ltd., announce interim dividends for the half-year ended June 30 on the preferred stock and preference shares; but the question of interim dividends on the ordinary shares will be settled when the accounts for the years 1916 to 1919 inclusive are ready for presentation to the shareholders.

The transfer books and register of members of the South Metropolitan Electric Light & Power Company, Ltd., are closed from the 18th to the 31st inst. (inclusive) for the preparation of warrants for dividends on the 7 per cent. cumulative first and 6 per cent. cumulative second preference shares, payable on the 31st inst., for the half-year ended June 30. Fifteen thousand ordinary shares of £1 each were recently offered to the ordinary shareholders at par.

Mr. Vincent W. Yorke, who presided over the recent meeting of the Vera Cruz Electric Light, Power & Traction Company, Ltd., stated that during 1919 the revenue from both sections of the company's business showed an improvement compared with 1918. In the light and power section the gross revenue increased by 10 per cent., and in the tramway section over 4 per cent. Operating expenses were much the same as in 1918, and the combined net revenue increased by approximately 17 per cent. Exchange account again showed a profit, inasmuch as they were able to remit the major portion of the earnings through New York at favourable rates. The floating assets at Dec. 31, 1919, exceeded liabilities (including year's dividend) by upwards of £30,000. After providing out of the profits for dividends, amounting to 10 per cent., and placing a further £15,000 to reserve, the carry forward (£23,399) remained practically the same as last year and the depreciation and reserve account now stood at £60,000. So far the company had incurred no liability for excess profits duty, for the reason that it had several lean years during the Mexican Revolution, and spread over the whole period of the tax the assessable profits had been off-set by the lean years when the profits were considerably less than the pre-war standard. Though conditions in Mexico could not be considered settled, they had every reason to believe that the part of that country which they served was again occupied in its normal pursuits. The history of the past few years proved that in times of revolution public utility companies were allowed to carry on their business with little or no molestation, and their properties were on the whole respected. The company, largely because of the skill and tact of the management, had been particularly fortunate and they owed a debt of gratitude to the manager and staff in Mexico for the capable manner in which they had handled the many difficult situations that had arisen. The extension of the tramways to Balneario had proved a valuable asset, and the board had recently authorised the purchase of additional shares in the Balneario Company. The company continued to receive its power from the Tuxpango plant of the Puebla Tramway Light & Power Company, and during the past year practically a continuous service was provided. During the few interruptions, which were of short duration, the Vera Cruz own plant carried the load. This plant, which consists of six Diesel engines, was now very old, and the board was considering the advisability of installing a new steam turbo unit of some 2,500 h.p. as a standby. In that event, the existing plant would be disposed of. For the first five months of the current year the net earnings in Mexico were somewhat lower than in 1919, owing to increased labour charges.

New Companies.

R. DARBYSHIRE, LTD. (169,746).—Private company. Reg. Aug. 19, capital £10,000 in £1 shares to acquire and turn to account any lands and buildings in the U.K., U.S.A., Canada or elsewhere, and to carry on the business of electricians, mechanical engineers, &c. First directors are: R. Darbyshire, W. Darbyshire and J. Hollas. Reg. office Up:10, per Talbot-street, Blackpool.

ELECTRO-FERROUS ENGINEERING COMPANY, LTD. (169,546)—Private company. Reg. Aug. 10, capital £10,000 in £1 shares, to carry on the business of iron, steel and non-ferrous metal smelters and founders, mechanical, electrical and marine engineers, manufacturers of agricultural implements, motor engine manufacturers, &c., and to adopt an agreement with B. H. Thomas and D. S. Kennedy. First directors are D. S. Kennedy, B. H. Thomas, E. A. Rose, H. Niblett and D. de Smith.

ERIC RIVERS-SMITH, LTD. (169,658)—Private company. Reg. Aug. 16, capital £1,000 in 800 ordinary shares of 10s. each and 600 deferred shares of £1 each. To carry on the business of electrical engineers and contractors, manufacturers of and dealers in fittings, accessories, &c. First directors are R. Stagg and Eric Rivers-Smith.

FERROUS LIGHT CASTINGS, LTD. (169,600).—Private company. Reg. Aug. 18, capital £40,000 in £1 shares (30,000 "A" and 10,000 "B"), to carry on the business of manufacturers of fine castings for the electrical trade, founders, moulders, manufacturers of iron and steel castings and castings of ferrous and non-ferrous alloys, &c. First directors are: P. S. Brook, J. A. Hirst, E. N. Humphreys and J. E. Grace. Reg. office: The Foundry, Stafford-road, Wilderspool, Warrington.

FINE CASTINGS, LTD. (169,482)—Private company. Reg. Aug. 6, capital £25,000 in £1 shares, to acquire from S. Milson certain premises at Fishponds, Bristol, and to carry on the business of founders, constructional, hydraulic, mechanical and electrical engineers, manufacturers of motor cars, &c. Reg. office: 24, Baldwin-street, Bristol.

JENNER LIGHT & POWER COMPANY. LTD. (169,663)—Private company. Reg. Aug. 16, capital £5,000 in £1 shares (4,000 preference), to take over the business of electrical engineers and contractors carried on as H. Jenner & Company, and to adopt an agreement with H. Jenner. First directors are H. Jenner, C. G. Maisey and C. G. Wood. Secretary: D. J. Gaillard. Reg. offices: 11, Red Lion-square, W.C.

PERCY DOVE, LTD. (169,554)—Private company. Reg. Aug. 10, capital £600 in £1 shares, to take over the business of an electrical and mechanical engineer carried on by P. Dove. First directors are P. Dove, A. Kendrick and A. Mole. Reg. office: 15, Greenhill-street, Stratford-on-Avon.

SALMON & PAGIS, LTD. (169,749)—Private company. Reg. Aug. 19, capital £1,000 in £1 shares, to carry on the business of electrical, mechanical, civil, motor and general engineers, engineers' sundriesmen, &c. Solicitors: Simmons & Simmons, 18, Finch-lane, E.C.

THOR ELECTRIC SAFETY LAMP COMPANY, LTD. (169,558)—Private ompany. Reg. Aug. 10, capital £25,000 in £1 shares, to adopt an agreement with Haslam & Stretton, Ltd., to develop the business referred to therein, including the trade mark "Thor" electric safety lamp, to carry on the business of manufacturers, importers and exporters of and dealers in electric or other lamps, &c. Solicitor: S. Hosgood, 10, Newhall-street, Birmingham.

ZEPHYR MOTOR TRANSMISSION, LTD. (169,702)—Private company Reg. Aug. 17, capital £75,000 in 10s. shares, to acquire improvements relating to the application and transmission of motor power to bicycles and other light road vehicles, lathes, drills and other power machinery, &c. First directors are Arnold J. Marks, Sir Buchanan Scott, K.C.I.E., W. A. Colyer and two others. Reg. office: 25, Victoria-street, Westminster.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics":—"Can Airway be Made to Pay?"; "Screw Propellers," by M. A. S. Riach, F.A.S.; "Theory of Lifting Surfaces," by L. Prandtl.

"The Cabinet Maker" (Annual Colonial Number):—"Colonial and Overseas Markets for Furniture"; "The Making of Upholstery Springs"; and "The Artificial Lighting of Shop Windows."

"The Chemical Age" (First Annual Colonial Number):—British Association at Cardiff: Special Reports of Chemical Section.

"The Fruit-Grower":—Pershore Commercial Fruit Show (illustrated); "Industrial Patriotism" and "Disquieting Agricultural Returns."

"Hardware Trade Journal" (Special Colonial Issue):—"Hints on Retail Organisation"; and "Recent Developments in Pottery."

"The Gas World":—"An Investigation into the Efficiency of the Domestic Coal Fire," by Dr. Margaret Fishenden; "The British Association and Fuel Economy"; and "Valuation of Gasworks."

"Ways and Means" this week contains an article by Sir Harry Lauder, on "American Business Men," in which the celebrated comedian embodies his impression of his recent visit to the United States. Mr. N. M. Ramsay writes on the subject of the conservation of our coal resources, and Mr. Austin Hopkinson, M.P., has a very suggestive contribution entitled "Industrial Path-making." A pungent silent comment on the shortness of the public recollection is implied in the reprint, without note or apology, of President Wilson's Fourteen Points. We gladly refresh our memories and observe how diverse are the ideals and actualities of peace.

Forty Years Ago.

(The Electrician, August 28, 1880.)

The Legal Authority of Telegrams.—In the Court of Bankruptcy a few days ago a telegram from one branch of a firm in Smyrna addressed to another branch in London was accepted as sufficient authority for filing a petition in liquidation. The application was, however, granted on the understanding that a power of attorney was on its way to this country.

British Association.—One of the most interesting applications of the telephone yet made will shortly be ready for exhibition. We refer to the telephone line just laid down from the Velindra Reservoir to the office of the Borough Surveyor in the Swansea Town Hall. The distance between the two points is over 7 miles. Another important illustration of the practical uses of electricity will be the lighting of the pavilion by the electric light. This work has been undertaken gratuitously by the Compagnie Generale d'Eclairage Electrique, of Paris. The lighting will be on Jamin's principle, and will be under the control of Mr. J. A. Berty, C.E.

Experimental Trial of the Siemens' Lamp at the Strasbourg Railway Terminus.—A trial of the electric light is here being made against the perfected gas lamps of Sugg, each equal in illuminating power to 100 candles. The light from the gas burners is considered to be insufficiently diffused, and parabolic reflectors of a new form—convex instead of concave—will probably be brought into requisition. In point of brilliancy, it need scarcely be said, the electric illumination far surpasses that of the gas; whether the sum total of advantages will also be favourable to electricity, under the conditions of the trial, is a point not yet decided. The apparatus generating the electric current is worked by a 20-h.p. engine on the Hefner-Alteneck system, and the trials are to be made with two electric lights each of the power of 1,200 candles, and six smaller ones, each of the power of 400 candles.

The Analogy of Electric Phenomena with the Effects of Mechanical Action.—Bodies which possess great molecular mobility, such as liquids, when submitted to the action of high tension electric currents, present phenomena analogous to those which result from the action upon the same bodies of mechanical force, particularly when this force is represented by great velocity, communicated to a small mass of matter; the relations which exist between the two orders of phenomena being more apparent in those in which static electricity is employed. A number of experiments and observations are detailed, in which physical and electrical actions were carefully compared, and the author, in summing up the views he enunciates, states that he believes that electricity may be considered as a movement of ponderable matter.—Abstract of a Paper by G. Planté, in "La Lumiere Electrique."

Prices of Metals, Chemicals, &c.

Tuesday, Aug. 24.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£107 0 0	£1 0 0	—
Electro Wirebars...	,,	£118 0 0	£2 0 0	—
H.C. wire basis......	per lb.	1s. 4 9/16d.	¼d.	—
Sheet	,,	1s. 5⅞d.	—	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. 9 9/16d.	¼d.	—
Brass 60/40—				
Rod, basis	,,	0s. 10¾d.	—	—
Sheet, basis	,,	1s. 4½d.	¼d.	—
Wire, basis	,,	1s. 3⅞d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 10 0	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£38 10 0	10s. 0d.	—
Foreign or Colonial	,,	36 6 0	12s. 6d.	—
Tin—Ingot	,,	268 0 0	—	£6 10 0
Wire, basis	per lb.	0 3 4⅝	—	⅞d

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 7d.

Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 9½d.: plantation 1st. latex, 1s. 11d. per lb.

Shellac.—T.N. Orange, 675s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and rubber prices by Messrs. W. T. Henley's Telegraph Works Co

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Notes.

The Lock-Out.

WHAT was an insignificant bit of grit in the machine at Penistone now bids fair to throw the whole industrial power-house out of gear. Fortunately at the last minute the Ministry of Labour has intervened and hopes are, therefore, high that the lock-out notices issued by the Engineering Employers Federation against the members of the Electrical Trades Union will not take effect. But time is very short. The executive of the Electrical Trades Union was to meet yesterday and a Negotiating Committee of the General Workers who are likely to be adversely affected are also endeavouring to find a way out of the deadlock. We certainly hope that they will do so. But without any wish to prejudge the issue we must insist that that way must not be by requiring the Employers Association to yield on the point at issue. That point is one of discipline upon which there can be no compromise without disaster. The Electrical Trades Union, like the bantam in the farmyard, is, by its high spirits and lack of balance, constantly bringing down trouble on its head, and, in so doing, involving others in disputes with which they are not immediately concerned. It is the duty of both employers and kindred Trades Unions to put this precocious youngster in its right place and keep it there. We are glad to see that in this instance the employers have taken this desirable step.

The Coal Crisis.

AT the time of going to press there is really nothing new to be said about what is conveniently called the coal crisis. It is as well to make this clear for the day-to-day bulletins in the Press rather tend to give the impression that a movement is being made towards settlement and to obscure the fact that neither party to the dispute has so far shown little more than a pious desire for negotiation. The ballot showed, as was expected, a vote in favour of a strike, though the majorities in several districts were not so large as was expected, and the result in Yorkshire is virtually against a stoppage. This, however, is little more than a formal matter. What is more important is that the "Triple Alliance" met on Wednesday without any definite result having been reached at the time of going to press; and there is also talk of referring the matter to the Trades Union Congress. The one bright spot is the evident reluctance of the miners themselves, as apart from some of their leaders, to force the issue by using the strike weapon combined with the realisation, both by the public and the other Trades Unions, of the results of cutting off the coal supply at the present time. Unfortunately, the hot-heads are still rampant and may do the damage before they can be stopped. On the issues which are now being put forward we feel there can be no compromise without danger to the community, but we hope that a way out may be found by the acceptance of a wage increase based on output. This would benefit both the miners and the public.

The Future of the British Association.

THE great pressure on our space caused by the publication this week of our Annual Marine Issue has necessitated the postponement until next week of a detailed account of the proceedings at the British Association meeting at Cardiff. It may, however, be stated that, in spite of the small numbers attending, the meeting was a great success. And it was a success in spite of the action of the municipal employees of the City, who by striking at such an inopportune moment, greatly offended against the sacred laws of hospitality. In our last issue we criticised the composition of the programme and we hope that before next year's meeting in Edinburgh attempts will be made to obtain representative Papers reflecting closely the latest advances in electrical science and technology. This is desirable in both the Physical and Engineering Sections. In addition, advantage should be taken of the opportunity given by this gathering to bring to the public notice through the Press the progress that is being quietly and steadily made in all branches of science and technology. This year the accounts of the meetings in the lay Press have, in general, been lengthy but exceedingly ill-informed, for the reason, we think, that the subject matter of the Papers was abstruse, hard to report interestingly and not likely to appeal to the public imagination. But a series of communications on the latest discoveries in physical science, on the problems of electric traction, on advances in wireless communications, on the use of electricity in the solution of domestic problems (to take a few of the subjects which occur to us) would not only be instructive to scientists themselves, but would popularise the Association at a time when it needs new life.

Some Large American Installations.

Those who are influenced by mere size in electrical apparatus will be interested in a pamphlet recently issued by the Westinghouse Electric International Company. This describes firstly a 4,200 h.p. locomotive, of which 10 are being built for use on the Chicago, Milwaukee & St. Paul Railway between Avery, Idaho and Harlowtown, a distance of 440 miles. Each locomotive is equipped with six motors, and also with regenerative working, which will, of course, be specially useful for operating the train over the mountainous gradients found on this section. The system employed is direct current at 3,000 volts. The second exploit is of special interest on the occasion of our Annual Marine Issue. The Company had recently secured the contract for the equipment of two new battle cruisers in the U.S. Navy with the necessary propelling gear while similar work is also in hand for four battleships. It should be added that the U.S. Naval authorities have decided to equip all their new capital ships with electric propulsion. In the case of these ships four propellers will be used, each driven by an 8,000 h.p. motor. Moreover, there are now 312 ships either built or building, fitted with electric propulsion by this firm, and it is stated that the Port of New York is visited every 24 hours by at least one ship so equipped. This system, therefore, seems to be coming to its own in the United States. Finally, there is the 70,000 kw. steam turbine set which has recently been installed in 174th Street generating station of the Interboro' Rapid Transit Company of New York. This unit can develop 80,000 h.p. continuously, 100,000 h.p. for a period of two hours, and, in an emergency, 120,000 h.p. for half-an-hour. Truly the United States is a big country in more ways than one.

A Chance for the Electric Vehicle.

The sudden increase in the price of petrol by 7d. per gallon will have effects almost as far-reaching on the trade and industry of this country as a coal strike. The growing need for road transport in large towns and the new tendency to use this form of locomotion for inter-urban work has largely increased the demand for petrol and other similar fuel so that the rise in price will mean an immediate further jump in the cost of living with all the incidental troubles that such a movement connotes. And the question is complicated by the suspicion that there is unfair dealing in the matter and that the price is now being increased by the same figure by which, owing to an arrangement with Sir Eric Geddes, it will have to be reduced in January next, so that whoever suffers it will not be the controlling firms. It is this sort of behaviour on the part of privately owned concerns which brings in recruits for a policy of nationalisation. Nevertheless, there is a remedy which, though not applicable to Government and municipal undertakings, will bring even an Oil Trust to its knees. A substitute for petrol must be employed and fortunately one is to hand in the electric vehicle. On the score of cost, adaptability, and utility, it has already proved its worth. What is lacking are schemes for mass production, selling and, above all, for the provision of charging stations. We hope the Electric Vehicle Committee will set to work and deal with these matters very closely, as there is now a chance for development such as is unlikely to occur again.

Unemployment Insurance.

A wide extension of the principle of insurance against unemployment has been made by the new Unemployment Insurance Act which will come into operation on November 8 next. It is calculated that the new Act will affect 12,000,000 persons compared with those numbering about 4,000,000 engaged in engineering, shipbuilding and certain other industries which are now insured. In future, insurance will be compulsory upon substantially all persons for whom Health Insurance contributions have now to be paid, except outworkers and persons employed in agriculture and private domestic service. Employees of local authorities, railways and certain public utility undertakings, and persons with rights under a statutory superannuation scheme are also excepted under certain conditions. A distinction from Health Insurance is that workpeople over 70, except old age pensioners, will be insurable. The general scheme provides for a weekly contribution by employees, employed and the State. Previous contributions towards unemployment insurance will be treated as an equal number of contributions under the new Act, and the benefit will be 15s. per week for men, and 12s. for women. No benefit is payable for the first three days of unemployment, but thereafter it is payable for a maximum of 15 weeks in any year, though the amount of benefit drawn must not exceed the proportion of one week for every six contributions. During the first year benefit up to eight weeks may be claimed as soon as four contributions have been paid.

Disqualification for Relief.

In general the disqualifications for relief laid down in the 1911 Act are re-enacted. An insured contributor who becomes unemployed through his own fault is debarred from benefit for six weeks unless the Insurance Officer decides otherwise. This at present covers the case where a strike in one industry throws men out of employment in another industry, and therefore is of special interest at the present time. During the discussion on the Bill the Labour Party contended that any man out of work was entitled to the benefit unless he was actually a striker. But this is carrying things too far, and would in these days when Trades Unions support one another virtually mean that the State and the employers by their contributions were financing a strike which is an essay in State Socialism for which the country is not yet prepared. The Act is one which requires careful study by those affected. In general it may be said that it is a wise piece of legislation, but we wish that wiser policy both on the part of employers and employed would render it virtually unnecessary. For such an Act, however much it may be concealed, is more an encouragement to laziness than a prevention of unemployment.

A Waste of Effort.

Speaking at the Annual General Meeting of Messrs. Benn Brothers, Ltd., last week, Sir John Benn described the technical and trade Press as a national asset which provides a store house for the best brains and hands of the arts and crafts, a platform whence the scientist can get a hearing; and an opportunity for the inventor or man with an idea to obtain an early reward for his talents. The prosperity of a technical journal is, therefore, to some extent, a reflection of the prosperity of the industry with which it is connected, unless, of course, that industry fritters away its resources in a vain attempt to do more than its strength permits. We are not sure that the electrical industry is not fast approaching that condition. For besides supporting more or less whole-heartedly a number of commercial journals, which in itself connotes a certain amount of overlapping, it wastes its substance in publishing house and association journals with a profusion which is as startling as it is unwise. A little more economy in this respect seems desirable, especially at the present time.

Loan Periods for Electric Vehicles.

There is a good deal of difference of opinion as to the period of repayment which should be granted on loans raised for the purchase of electric vehicles by municipal authorities. According to a contemporary the Ministry of Health has placed this period at seven years in the case of vehicles used for refuse collection, as against five years allowed for steam and petrol vehicles used for the same purpose. The Electric Vehicle Committee think ten years a safe period owing to the small rate of depreciation in the body, chassis and electrical equipment. This is in our opinion a conservative figure, but for the present, no doubt, it is better to be on the safe side, though there is no need to carry this policy to the extent adopted by the Ministry of Health, for experience shows a much longer period could easily be granted. We are being forced to the conclusion that the average driver of a commercial petrol vehicle knows very little about his work, with the result that the streets are fouled by oil droppings and the atmosphere by fumes caused by weird ideas on the subject of lubrication, and a steam operated vehicle is anyhow a monstrosity on the road. The general introduction of commercial electric vehicles will go far to improve this state of affairs. Every encouragement should, therefore, be given them, especially by a department whose primary object is presumably the maintenance of the national health. Incidentally, it would seem that the particular authority chosen to sanction a loan for electric vehicles is decided by what the particular vehicle is to be used for. Thus the Ministry of Transport, the Ministry of Health, the Electricity Commissioners, and doubtless others, all have fingers in the pie. This is another example of the fearful and wonderful way in which our bureaucrats work. An effort should be made to coordinate and to simplify the work of these sanctioning authorities.

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Municipal Electricity Supply in the U.S.

In this country municipal electricity supply is flourishing, and there seems no reason to suppose that it will not equally flourish in future, though there will, we hope, be a total abandonment of the old idea that electricity supply can be safely limited by municipal boundaries. On the other hand, with certain notable exceptions the privately-owned electricity supply company has been almost as conspicuous a failure. Into the reasons for this we do not propose to go. We merely state the fact. But it is interesting to notice that things are contrariwise in the United States. We know full well the abounding prosperity of such concerns as the Commonwealth Edison Company, of Chicago, and of similar privately-owned concerns in Boston and New York. But a recent issue of the "National Electric Light Association Bulletin" draws attention to the other side of the picture. It gives a list of between 300 and 350 erstwhile municipally-owned lighting plants "which are dead and buried. They have gone out of business as losing propositions, and the taxpayers have had to pay the losses." But surely this does not represent the whole of the story. Take Chikopee, Minn, for instance, where the plant was shut down in 1912 or Garretson, S.D., where "the gas plant blew up" has nothing been done to "get back" their whilom modernity by embarking once again on the great adventure of electricity supply under happier auspices, or will the remains of the plant attract sightseers in years to come as the tombs of the Incas do now? We know the average American likes to be in a paying proposition, and we hear strange stories of municipal graft in that country. Can these be the true reasons for these failures? Some further information would be interesting.

Marine Electrical Practice.

This week's issue of The Electrician forms the third occasion upon which we have devoted practically the whole of our contents to a consideration of the problems which arise from the employment of electricity on shipboard and for driving quayside or other machinery used in marine work. The subject is of considerable importance. To talk of key industries is *vieux jeu* now-a-days, but it is nevertheless true that the trade and prosperity of this country is so bound up with shipping that the development of the latter must go hand-in-hand with any improvement in the others; and that all three must stand and fall together. What is our present position in this regard? We possess the largest Navy in the world, whose discipline, enterprise and fixity of purpose pre-eminently assisted to lead us through War to Victory. Our mercantile marine is also the largest in the world, and has proved itself by its courage and self-sacrifice equally first in war as in peace. It suffered heavily during the war, but it is now fast regaining its old position and the tonnage afloat is no less than 20,582,652 tons contained in some 10,850 ships, these figures excluding all vessels under 100 tons burthen. There is no port in the world into which out ships do not penetrate and few in which they do not find themselves in the majority both in number and size. Here there is a worthy field for electrical enterprise; and it is one of which electrical engineers have taken full advantage.

Some Essentials.

A study of the articles by Mr. C. H. Wordingham, wherein he gives us the benefit of his wide experience of Admiralty practice, and by Mr. L. Miller, in which certain problems connected with the drive of auxiliaries on board ship is considered, indicate clearly the reason for this. The advantages of the control, flexibility, economy and high efficiency made possible by the use of electrical equipment are no less appreciated on ship than on shore, and though the installation of motors and other electrical apparatus under such conditions gave rise to certain problems these have now been overcome. The nature of these problems may, however, be indicated by a reference to the difference between land and sea operating conditions. Firstly, the plant must be reliable. In addition, it must also be economical and light. But reliability is essential, for a breakdown at sea is a much more serious occurrence than a similar happening on land, while it is obvious that there is a limit to the number of spares that can be carried and those not carried are practically unattainable in emergency. Ease of handling is another essential. In addition to these fundamentals there are other questions, such as gyroscopic action, the effects of moisture and weather and insulation troubles which have to be considered in the case of electrical machinery. Insulation is indeed of supreme importance as Mr. Wordingham rightly points out.

Progress in Propulsion.

Propulsion is the most recent application of the electric drive on board ship. In Mr. Rettie's opinion British progress in this direction has been retarded by the conservatism of the shipowners. As usual we were the pioneers, but there has been little development and now the pre-eminence in this respect has passed to the United States. Here electrical propulsion has been singularly successful, so much so that the Navy Department has given orders that in future all capital ships are to be electrically driven, it being found that in economy, ease of manœuvring and general utility they possess outstanding advantages over the older drives. It may be added that, as is now becoming universally the case, in this country, all the auxiliary machinery is operated electrically. It would be absurd, however, to suppose that finality has been reached in the matter of propulsion; and it is, therefore, fortunate that the electrical drive will be tested under such arduous conditions as those found in naval working and that comparisons with the operation of other ships fitted with the ordinary drive will also be possible. So far as the "New Mexico" is concerned these comparative tests have been remarkably successful.

GEARED TURBINE DEVELOPMENTS.

In the special issues of The Electrician we have always made a point of publishing views on all sides of the special question dealt with and we make no exception to our rule on this occasion. There is good reason for this. For while under the naval conditions of working with its varying speeds and frequent manœuvring the electric drive shows up well, the advantages are not so conspicuous in the mercantile marine where constant speed for long periods is the rule. Under such conditions the geared turbine is a formidable rival; and the articles by Mr. A. V. Jarratt and Mr. R. J. Walker indicate how much has been done in this direction. To many, gearing is an abomination, but there seems no doubt that the numerous initial difficulties have now been successfully overcome; and that it forms an efficient and reliable link between the turbine and the propeller.

WIRELESS TELEGRAPHY.

No issue dealing with marine electrical practice would be complete without reference to the part played by wireless telegraphy. The benefits which the development of this form of communication has already conferred on those whose life's work is on the sea is already too well known to need further mention. The increase in our knowledge of wireless telegraph and telephone fundamentals will certainly do much to assist this development in the future. But curiously enough, as Major H. MacCallum points out, for the moment there is semi-stagnation, for the dual reason that the war necessitated wireless experimenters working in other fields, and that marine practice had already reached a commercial stage of development and so could, for the time being, be safely discarded. This, however, will not be more than a temporary state of affairs and before long the most recent improvements in wireless apparatus will be employed in conjunction with direction-finders, calling-up devices, and, we need hardly add, the thermionic valve, so that together with an increasing knowledge of the theoretical basis of these apparatus, a further long step in progress will be made.

QUAYSIDE MACHINERY.

Though not strictly coming under the head of marine practice, some mention must be made of the place the electric drive is finding in the operation of quayside machinery, thereby ousting the pioneer hydraulic plant, much to the dismay of some conservative engineers. Several articles which we publish in this issue indicate this tendency clearly, and, whether in the handling of general merchandise or of more specialised products such as coal and china clay, the electric drive is being more and more adopted. In shipbuilding and ship repair work electricity for welding purposes is beginning to play an important part as is signalised by the recent launch of an entirely electrically welded ship and by the greater ease and cheapness by which repairs can thus be effected.

In the main, electrical practice in the future is not likely to be less successful than in the past. Fresh developments may be expected, especially in the use of electric heating and cooking for which the large liner forms an exceptionally favourable field of exploitation. In the meantime progress in other branches is not likely to stand still, and we shall hope in future years to see this particular form of electrical activity spreading into still wider fields of usefulness.

Legislation in 1920.

The zeal for producing fresh enactments which characterised the 1919 Session of Parliament continued with unabated vigour during the first part of the 1920 Session; and though the year's output may not constitute a record, the number of Bills passed at the date of the adjournment was unusually high. Of the 128 public Bills introduced 65 were Government measures, private members being responsible for the remainder. Altogether 58 Bills were passed and received the Royal Assent, and several are being held over until the Autumn Session. Though many of the measures were necessary and represent serious, if not quite successful, attempts to legislate for post-war circumstances, some of the legislative proposals are distinctly unwise and are calculated to do more harm than good. Many members of Parliament seem to be under the delusion that legislation *qua* legislation is a panacea for every ill, whether it be due to moral, physical or economic causes, and consequently as soon as a section of the public discover a grievance, whether real or imaginary, an appeal is at once made to the Legislature to provide a remedy. In order to maintain the favour of the public, attempts, are, therefore, made to legislate for conditions for which legislation is not the proper remedy. The fact is, of course, that an alteration of one part of a complicated machine cannot be made without throwing everything else out of gear.

A FOOLISH MEASURE.

A good instance of this is the Profiteering (Amendment) Act, which has definitely failed in its purpose; it has not lowered prices and it has not stopped "profiteering" (a term which was undefined in the Act, probably because it was incapable of definition); but it has let loose upon certain branches of industry a foolish inquisition which has done more harm than good. We need only refer our readers to the recent report of the Sub-Committee on Electric Lamp Manufacture in justification of this statement.

GOVERNMENT BY OFFICIALS.

One bad effect of the overcrowding of the Session is that Bills are hastily drafted and are then pushed through both Houses of Parliament without adequate consideration. Consequently, the sphere of the Executive has received a dangerous extension and we see Government Departments rushing into print with explanatory pamphlets as soon as a Bill is passed and popular journals are compelled to keep legal departments to answer the queries of a bewildered public. This is a form of legal interpretation by newspapers of which we have already had more than enough examples within recent years. The Increase of Rent & Mortgage Interest (Restrictions) Act is one of the latest examples of this kind of legislation; it is vaguely worded in places and it complicates an already difficult position. Though it may do some good and appease popular clamour, it was dealt with too hastily, and the only thing that can be safely predicted of it is that it will cause much litigation and bring grist to the lawyer's mill, neither of which are primary objects of an Act of Parliament.

PUBLIC ACTS.

Of the new measures only a few affect the electrical industry. The Telegraph (Money) Act enables the Postmaster-General to raise £10,000,000 for the development and improvement of the telephone and telegraph services, and should, therefore, mean much work for telephone and telegraph apparatus manufacturers. There are still many complaints of the inefficiency and inadequacy of the telephone service, but it would appear that serious steps are now being made to make up for war arrears by providing new exchanges, laying additional trunk lines underground, &c., and we hope that this improvement on the engineering side will be followed by a correspondingly improved service.

The Tramways (Temporary Increase of Charges) Act provides a much needed measure of relief for tramway undertakings which have been badly affected by the increase in the prices of materials and by the frequent demands of the men for increased wages. The Public Utility Companies (Capital Issues) Act may assist the electric supply and tramways companies in raising fresh capital, and the Overseas Trade (Credit & Insurance) Act should be of assistance to engineers and manufacturers in building up their trade connection with Rumania, Jugo-Slavia, Czecho-Slovakia, Poland, &c. The burden of the Finance Act, which increased the Excess Profits Duty from 40 to 60 per cent., imposed a tax on tramcars and increased the tax on other mechanically propelled vehicles, &c., will be severely felt and will tend to check progress in the industry.

THE ELECTRICITY (SUPPLY) BILL.

The most important measure introduced during the Session from the electrical point of view was the Electricity (Supply) Bill, but as it has not yet been read a second time its fate is still uncertain. There can be no doubt that some further legislation is necessary to round off the useful Act of 1919; and, although the financial clauses which were omitted from that Act may not have been wisely drafted, some monetary assistance from the Government is essential in order that electricity supply may be generally developed and extended to rural districts and that the water-power resources of the country may be utilised. The Compulsory Powers conferred by the Bill are also necessary, though we hope they will not often have to be used.

An important Act of the Session, though only of indirect interest to electrical engineers, is the Gas Regulation Act, which does for the gas industry what the Electricity (Supply) Act of 1919 did for electricity supply and introduces the thermal basis of charging for gas. The National Health & Unemployment Insurance Acts throw increased burdens upon the industry and make important changes in the law relating to health and unemployment insurance. The benefits to sick and unemployed persons have been increased, though it is doubtful if they will satisfy the beneficiaries.

PRIVATE LEGISLATION—TRACTION.

As regards private legislation, neither in number or in subject matter was the Session up to the average pre-war standard, but about 45 Acts, which confer additional electric supply and tramway powers have been passed. An outstanding feature was the number of local authorities who have been authorised to provide motor omnibus services. Of the 26 authorities in this category the great majority own tramway undertakings, and in these cases it is only intended to run omnibuses in out-lying districts to act as feeders for their tramway services. There were several contests as to the contribution to be made by motor omnibus owners for the maintenance of the roads over which their vehicles run, and after conferences with the Ministry of Transport a model clause for dealing with the matter has been elaborated. Nine of the new Acts authorise tramway extensions; in four or five cases power is given to use trailer or coupled cars, and in three or four instances tramway authorities are allowed to carry goods and minerals on their systems. These are useful powers which will help to increase the utility of the services. We notice that three Acts confer inter-running powers, but we would point out that under the Ministry of Transport Act of 1919 the Minister of Transport can now give authority for through running on adjacent tramway systems; and it will be unnecessary to promote Bills for this purpose in future. Many of the Acts, including that of the London Electric Railway Companies, authorise an increase of fares, but it is probable that procedure under the Tramways (Temporary Increase of Charges) Act of this year will be found sufficient for future cases of increased charges. An extension of time to complete authorised lines and works was granted to several undertakings, and, in addition, Lowestoft Corporation acquired authority to introduce a trolley vehicle service, Halifax Corporation to alter the gauge of their tramways, and the Hastings Tramways Company to use the overhead system on the sea-front line. Unfortunately, the most important tramway measure of the Session, the L.C.C. Tramways & Improvements Bill, was not allowed to proceed owing to failure to comply with the Standing Orders and the County Council only secured very limited, but totally inadequate powers, to run omnibuses. The Tramways Bill of the Middlesex County Council was rejected in Committee, though the Derwent Valley, Calver & Bakewell Railway, which may be equipped for electric working, was passed.

ELECTRICITY SUPPLY.

Like the tramways, fate has been rather unkind to the electricity supply bills. The most interesting scheme of the Session—the Dartmoor & District Hydro-Electric Project—had to be abandoned owing to the great outcry raised against any interference with the scenery and attractions of Dartmoor. Several existing undertakings obtained power to extend their area of supply, to lay mains in private streets, to give a bulk supply, &c. Among these were Blackpool, Bristol, Cardiff, Halifax, Huddersfield, Manchester, Portsmouth and Salford Corporations. There were two or three Bills which sought (*inter alia*) powers to extend the borough boundaries and the electricity supply areas, and one of these (the Edinburgh Bill) led to a strenuous fight, but ultimately Edinburgh Corporation succeeded and it has been authorised to acquire the electric supply and tramway undertakings in Leith and Musselburgh. The Masham Urban Council has been given authority to purchase the local electric supply and gas undertakings; Tredegar Urban Council to establish electricity supply and to take current in bulk; while the South Wales Electric Power Distribution and the North Metropolitan Electric Power Supplies Companies have obtained additional capital powers and the latter company has also secured the right to link up with the Luton undertaking.

PROVISIONAL ORDERS.

Owing to the changes introduced by the Electricity (Supply) Act, 1919, there were no provisional electric lighting orders, and there was only one Tramway Provisional Order Confirmatory Act, and that authorised an extension of the Warrington tramways. There were five Bills under the Private Legislation Procedure (Scotland) Act. Two authorised an increase of fares and one the through-running of tramcars over an adjacent system. The Motherwell and Wishaw Burghs (Amalgamation & Extension) Order confers powers as to the amalgamation and workings of the existing electricity undertakings of the Burghs.

It will therefore be seen that a very wide field has been covered, but a consideration of the hurried summary which we have been able to give above is a not unconvincing argument for some change in the Parliamentary procedure for dealing with such measures. Whether this can be effected best by the institution of local Parliaments or by some other scheme of devolving powers is a question which will soon have to be gone into. In the meantime we suggest that all private Bills might be referred to a Joint Committee of both Houses of Parliament. This course would introduce more certainty and more uniformity in procedure; it would be an economy of time and it would reduce the great cost of piloting a measure through Parliament.

The Design of Electrical Installations for Ships.

By C. H. WORDINGHAM, C.B.E.
(Ex-Director of Electrical Engineering, British Admiralty.)

Introductory.

EELCTRIC lighting was introduced on board ships at a very early date in its history, because its intrinsic merits were intensified under the conditions obtaining afloat. The introduction of electric motive power, however, was much more tardy, and it is only of late years that reliance has been placed upon it. Great caution on the part of those responsible for the planning and operation of a ship is not only justifiable, but imperative, and it was necessary to wait until the case for electric power had been proved up to the hilt on land before it was introduced at sea. A breakdown of plant on land usually causes nothing worse than inconvenience or loss of money, but on a ship, failure at a critical moment—for example, of steering gear—may be fraught with serious or even disastrous consequences. Again, defective plant on land can usually be repaired quickly, or spare parts can be obtained at short notice, while a ship may be hundreds or even thousands of miles from a repairing shop, and spare parts that may be wanted must be bought in advance and stowed on the ship, occupying valuable space.

The Case for Electric Power.

Now, however, that good design has made electric plant at least as reliable as that operated by any other means, and now that actual ship experience on a widely extended scale has demonstrated its reliability, there is no longer any excuse for neglecting this form of motive power which is rapidly ousting all others for the distribution of power on land. Its advantages are peculiarly great on board ship, for, in addition to its convenience, adaptability and ease of manipulation, it has the further great merits of being available at any instant without preliminary warming up or the losses while standing unavoidable with steam plant. Unlike hydraulic machinery, it is unaffected by frost, and in many respects, especially in regard to efficiency, it is greatly superior to pneumatic plant.

The ease with which cables can be laid along circuitous routes and can pass through restricted spaces enables electric motors to be fixed where any other kind would be difficult or even impossible to install, while the absence of the high temperature inseparable from steam engines and the pipes leading thereto and of the low temperature associated with condensation and inevitable with hydraulic pipes and machinery are further valuable points in favour of electric driving. It is incontestable that the distribution of electric motive power on board ship in lieu of other forms, and its adaptation to all the uses of which it is capable result in a saving of labour in carrying on the working of the ship and a diminution in the cost of upkeep of the power plant. A substantial amount of energy that would otherwise be dissipated by inefficient plant and stand-by losses of heat is saved with corresponding economy of coal; this results not only in direct saving of money, but, what is even more important, in saving weight and setting free space. The ventilation of the ship is much better, and at the same time the water-tightness of compartments is much less interfered with by the introduction of motor-driven fans. The absence of pipes, some of large size, carrying steam and water, also contributes greatly to the maintenance of water-tightness.

There is no need to labour these points; in the Navy, where reliability, efficiency and convenience are ruling considerations, electric power has to all intents and purposes displaced all other kinds for general use, with the one exception of the operation of turrets. In ships of the mercantile marine questions of cost are given more prominence than in the Navy, but here, if the broad view be taken and consequential savings allowed for, it will be found that the scale inclines strongly to electric power.

Electric Cooking and Heating.

Electric cooking is coming into increasing favour on board ship, especially on passenger vessels, with the associated hot-cupboards and warming plates, while electric radiators are peculiarly adapted to the confined spaces of individual cabins.

In this article it will be assumed that the advantages of electrical working are appreciated and admitted, and the question of the most economical and efficient equipment will be considered.

System of Supply.

A ship is a very small area in which to distribute electrical energy, and therefore only a low pressure is called for. Saving of weight is, however, of paramount importance, and on these grounds the pressure may with advantage be kept up to 220 volts. Simplicity and reliability are essential and therefore, in the absence of special conditions necessitating special treatment, three-wire and four-wire alternating current should be avoided. Three-wire direct current involves the use of balancers, the risk of complicated earths, and unbalanced pressures in case of short circuits, together with risks attendant on the opening of the middle wire. There are no advantages sufficiently great to compensate for these drawbacks if a pressure of 220 volts be used across the outer conductors. If the pressure be put up to 440 volts the middle wire must be earthed for safety, and in consequence an earth on either of the outer conductors will involve interruption of supply. Quite objectionable shocks also may be anticipated in handling motors supplied at 440 volts.

Alternating Current Inferior.

Alternating current, if attractive in some respects, is inferior to direct current on board ship. It must be borne in mind that the importance of shock is greatly accentuated on board ship. In the first place the hull is of steel, and a practically perfect earth is brought into close proximity to almost every piece of gear which has to be handled. Secondly, water is very much in evidence, whether as spray or in the washing down of decks, and many of those who may have to use the gear have damp hands and damp boots or no boots at all; hence their skin resistance is low. In engine and boiler rooms moisture is present from condensation, and men are perspiring freely, the conditions again being conducive to shock. So long as direct current is employed and the pressure is confined to 220 volts there is no danger to life, though distinctly unpleasant shocks may be obtained. With alternating current, however, the case is very different, and under the conditions described fatal cases of shock would certainly take place.

The Cable Question.

Apart from shock, other considerations militate against alternating current. In view of the cables having to pass through steel bulkheads four-core cable is practically essential. These cables must be of greater sectional area than the aggregate area of single cables, owing to their inferior facilities for dissipating heat, and the various boxes, switches and fuses must be much more complicated and heavier than those required with two-wire direct current. A large proportion of the machines to be driven on a ship are essentially of variable speed—*e.g.*, hoists, capstans and lifts—and although hydraulic variable speed gear can be used advantageously to give this variation, its relatively low efficiency and high cost are against it unless the motors be used intermittently and for very short periods of time.

Just as the drawbacks to alternating current are accentuated, so its advantages are discounted on a ship. The outstanding advantage of ease in changing pressure has little or no application, the generators are small compared with those in a power station, and it is doubtful whether they are any more simple or reliable than direct current generators. The motors have the advantage for what it is worth of having no commutators, but against this must be set their extra weight as compared with direct-current machines, which is of material importance. There is some advantage no doubt in diminished sparking at fuses and switches, but this is not great enough to be a serious factor in the choice between the two classes of current.

The writer would unhesitatingly pronounce in favour of direct current for ship use, and for distribution on two wires at a pressure of 220 volts. An exception may be made for very small vessels in which there is little demand beyond that for lighting, 110 volts having certain advantages. The lower pressure is more convenient if secondary batteries be employed as is frequently done on board yachts, while the lamps are somewhat more efficient and durable with 110 volts than with 220 volts.

System of Conductors.

In the Merchant Service the radiating system is almost exclusively used at present—*i.e.*, heavy main circuits are brought from the switchboard to which all the dynamos are connected, and these circuits supply the principal individual motors and auxiliary switchboards fitted in appropriate parts of the ship. These auxiliary switchboards are often interconnected for increased security of supply. This system, originally in use in the Navy, had to be abandoned when motive power was applied on a large scale, as the number and size of cables became so great that it was physically impossible to find space to run them. The water-tight bulkheads had to be pierced in so many places that they became like sieves rather than water-resisting partitions. In place of the radiating system the Ring System with central control was fitted. In this system a pair of conductors forming a ring is run round the ship, passing through all the principal compartments. Each compartment is served by a tapping from this ring, and all the dynamos feed into the ring, which is to all intents and purposes an extended omnibus bar, the various main switches being at the point of entry of the supply into the main or of egress from the main to the compartment. Each tapping is controlled by an electrically-operated circuit-breaker, which can be worked either locally or from a central point.

Advantages of the Ring System.

The advantages of this system are so great that it may be well to consider them in detail :—

1. A single pair of cables running right round the ship replaces dozens of pairs of separate cables.
2. Every point at which the supply to a principal motor or to a compartment is taken off has an alternative supply, since the current can come in either direction round the ring.
3. The dynamos can be placed anywhere where most convenient, and need not all be in one compartment ; this is a matter of supreme importance in a fighting ship, and may be an advantage in a merchant one.
4. The full advantage of diversity, very high on a ship, is reaped in the main distribution cables, which only have to be large enough to carry the full load of the generators. In the radiating system each circuit must carry the full load of the motor or auxiliary switchboard supplied, so that the aggregate section of the conductors is that corresponding to the total load of all consuming devices simultaneously instead of to the demand on the generating plant.
5. Great simplicity, saving of space and cost both for labour and material.

There is no reason whatever why this system could not be employed for merchant ships, especially for passenger liners, and there is no real need for retaining the central control. If this centralisation were given up the cost would be greatly reduced, as the electrically-operated breakers would no longer be necessary nor the control wiring for them.

Cables and Wiring.

For the main cables, wire-armoured lead-covered paper-insulated cables, similar in all respects to those used for underground mains, are unquestionably the best. Such main cables have been used exclusively on all H.M. ships, and in fifteen years there was not a single failure. They are cheaper, more reliable, much more durable, will stand a higher temperature, and carry current at a higher density than rubber-insulated cables. For the branch cables in ordinary spaces, rubber-insulated cables are possibly more convenient, though paper-insulated are still to be preferred. In hot spaces, paper-insulation should certainly be used.

Flexible wires should be avoided where there is no real need for them, but the great convenience afforded by their use, which is one of the special advantages attaching to electrical appliances, should not be overlooked nor lightly thrown away. Cab-tyre sheathing is probably the best protection to use for such flexible conductors, but when the conductors are small it is desirable to embed steel wires in the sheathing, in order to prevent it stretching and allowing the conductor within to break. This is a more effectual safeguard than including a steel wire in the strand.

Protection of Cables.

The best method of protecting cables on board ship calls for consideration. A general system of conduits is entirely out of place, because the condensation is necessarily serious, and the insulation is almost certain to suffer therefrom. Moreover, it is a first essential that all cables and wires should be readily accessible for inspection and repair. Conduit work is, therefore, rightly excluded by the Institution of Electrical Engineers' Rules from ship work. Isolated lengths of conduit may, however, be used for giving extra protection in positions exceptionally exposed to mechanical damage, but steel plating is preferable. Wood casing is much in favour in merchant ships, more particularly in saloons and places where much ornamental work is in evidence, and there is no serious objection to it under these circumstances.

Lead-covered Cables.

A good deal of difference of opinion exists as to the merits of lead covering for cables. Lead-covered cables are exclusively employed for naval work, whatever the dielectric may be, and they have given uniformly excellent results. In merchant practice, however, there have undoubtedly been cases in which the lead has perished, and some designers are very strongly averse to their use. Probably the reason for this difference of experience lies in the painting of the exterior. As is well known, paint is plentifully used in the Navy on everything that is not brilliantly polished, and it is probably for this reason chiefly that no trouble has been experienced, though another reason may be that purity in the lead is carefully safeguarded by the Admiralty. The writer is strongly of opinion that lead-covered cables are the best, and that they are not open to the objections sometimes raised against them if they be properly painted.

Armouring on the main cables is greatly to be desired as a protection, but it should be on lead-covered cables. A pattern which is a good deal in use comprising an ordinary cable with wire armour has little to recommend it, and in large sizes it is awkward to install. The armouring admits moisture to the covering of the cable, and tends to hold it in position.

Fixing Methods.

The most efficient method of fixing cables is that adopted in the Navy—viz., the clipping of the separate cables in full sight by means of brass clips. Where no woodwork is available for the attachment of these clips it is very convenient to fix light steel plating having oval perforations rather than to drill and tap the bulkheads for the securing screws. The oblong slots enable the screws to be fitted in the most convenient positions, and the drilling is greatly reduced as the plating can be held at relatively long intervals by only a few screws.

Watertight bulkheads are not nearly so numerous on merchant vessels as they are on warships, and therefore the question of making cables watertight where they pass through such bulkheads does not arise to anything like the same extent. Experience shows that the most efficient way of dealing with this matter is to employ glands in which a plastic compound is used. Where a number of small cables have to be passed through a bulkhead multiple glands with similar packing are greatly superior to a number of separate small glands.

Accessibility.

Those who have practical experience of ships are well acquainted with the extreme difficulties often met with in regard to space available for electrical gear. Not only is there very little room but it is often necessary to fix plant and apparatus in positions difficult of access. Wherever possible such positions should be avoided, but where they cannot be the work is greatly facilitated by allowing ample clearances within the cases so that the wiring can be readily carried out. It is most important to ensure that electrical gear and cables are not fixed where they will be subjected to unduly high temperatures or to drippings from water, whether condensed or finding its way in from outside, and from access of oil. The risk of mechanical damage also must be carefully watched for, and wherever it is liable to occur adequate protection must be afforded. It is important also to remember that sailors, as a rule, are ingenious, and apt to take advantage of conveniences ready to their hands; therefore, cables should not be placed so as to afford a ready purchase for lifting tackle, nor should electrical apparatus be conveniently placed for the storage of cleaning rags and articles of personal property.

Plant Appliances and Fittings Generally.

A low standard of design of fitting and of installation generally has usually prevailed in connection with merchant ships, chiefly because the work has been left to wiring contractors without supervision by those having the necessary technical knowledge, and partly because the work has been given to the lowest tenderer without a definite or binding specification as to quality. This low standard has been rendered possible by the use of a pressure in most cases of only 100 volts; with the raising of the pressure to 220 volts the designs must be improved, and it is greatly to be hoped that a better class of work will become more general.

Directions for Improvement.

A few of the directions in which improvement is desirable may be indicated:

It is most important to eliminate as far as possible all hygroscopic material, especially in the construction of generators and motors. The prevalence of damp has already been referred to, and if such materials as presspahn be relied upon for insulation the insulation resistance will certainly be low; in the case of motors left standing for considerable periods it may readily become dangerously low. Micanite insulation for armature conductors and for insulating field coils as a whole from the magnets should invariably be employed; the results will more than justify the additional cost, the reliability of the plant being vastly greater.

The control gear and switchgear generally should also be constructed without the use of hygroscopic materials; vulcanised fibre in particular should be absolutely barred. So far, it has been customary in merchant ship practice largely to employ ordinary land apparatus with the usual huge heavy slabs of useless slate and marble. Nothing could be worse adapted than these materials for ship plant where every ounce of weight is of importance. For naval work, micanite insulation is exclusively employed, and it has been found to meet the most exacting conditions. It leaves nothing to be desired in insulation resistance and reliability. It enables very light construction to be achieved and affords complete immunity from fracture.

The most convenient way, and by far the most satisfactory, is to mount the various parts on metal bars, square in section, wrapped with an appropriate thickness of micanite. It is most important that the micanite should contain a low percentage of binding material, and that the micanite should be wrapped on hot and thoroughly compressed during the process of cooling. By clamping the parts on a diagonal of the square section they are retained rigidly in position.

The Elimination of Wood.

Wood is still largely used in merchant ship practice for distribution boxes, and generally in conjunction with electrical fittings. This is partly on account of the cost, but probably quite as much on the grounds of appearance. It is always better to eliminate wood from electrical apparatus, but particularly is this the case under the damp conditions of ship use. Properly designed sheet steel boxes are not unduly costly, and they are very much better in every way than wooden ones.

The fuses ordinarily used in merchant ship practice are the ordinary cheap house type, with porcelain carriers and spring slips, though in some instances plain wires gripped under the heads of cheese-headed screws are still employed. With a pressure of 220 volts something much better than either of these is essential, and improvement is urgently required in this direction.

Special care should be given in the purchase of incandescent lamps to see that a non-hygroscopic cement is used for attaching the caps to the lamps. The nature of the cement employed by different manufacturers varies greatly, and if this point be not watched, the whole installation may acquire a very low insulation resistance.

Much may be done to simplify the upkeep of a ship installation by proper colouring of the poles in the case of switchboards and similar apparatus, and by keeping strictly to different colours for the covering of the wires and cables. Suitable conventions for these are laid down in the Ship Electrical Equipment Rules of the Institution of Electrical Engineers.

Standardisation.

A strong effort should be made to introduce rigid standardisation in connection with all the more commonly used accessories of a ship's installation. Standardisation is peculiarly valuable for ship work as, if properly established, it enables repairs to be much more readily and expeditiously carried out. By its means only a relatively small number of patterns need be kept in stock at the various ports of call, and any ship fitted with standard gear can readily make good defects from such stocks. This matter was very fully dealt with by the Committee which drew up the I.E.E. Rules above referred to, and at their instance the British Engineering Standards Association has prepared standards which enable the desirable results indicated to be attained.

Ship Propulsion.

Space does not permit of more than a reference to the subject of electric ship propulsion. This has been debated for a very considerable time, but very little so far has been done in this direction in this country. In the United States, the naval authorities have definitely decided on propelling their largest ships by means of electric motors driven from turbo-generators, and this decision has been upheld after considerable experience in actual use on the battleship "New Mexico." This evidence is conclusive that electric ship propulsion is thoroughly practicable, and can be applied to the exacting needs of a warship. Whether its advantages are sufficient to impel our own naval authorities to make the change in future construction remains to be seen. It is claimed that there is a large resultant economy of fuel, that there is a substantial saving in weight arising largely from this increased economy, and that better sub-division of the propelling machinery can be made than with the direct steam drive. In this article we are more immediately concerned with merchant vessels, and here the merits of electric propulsion will necessarily vary with the class of ship concerned. Inasmuch as the main economy arises when a ship capable of running at a very high speed normally runs for considerable periods at a relatively low speed, it is obvious that the advantages are likely to be less in a vessel running always at top speed than in one which only does so occasionally. There is, however, a class of vessel in which there can be practically no question that electric propulsion has outstanding merits, namely those ships of moderate power which can best be propelled by internal combustion engines. The electric drive enables a number of individual engines to be employed, each driving its own dynamo, and these dynamos can be employed to drive only a few motors on the propeller shafts. In this direction a large development of electric propulsion may be anticipated.

Personnel.

In conclusion a few words may not be amiss about the class of men who should be responsible for the electrical installation on a ship. In the days when electrical energy was used for lighting only, no very high degree of skill was necessary to run and maintain the installation, but with the introduction of motive power and the consequent greatly increased importance of efficient operation, together with the necessity often for making repairs while a ship is at sea, it is necessary to employ men properly trained in electrical work. On passenger liners and the more important vessels, electricians are carried, but they suffer from a serious and unfair disadvantage in comparison with the ordinary engineers holding Board of Trade certificates in respect of their having no proper status. An electrician, however competent, and however well trained, usually ranks below the lowest of the certificated engineers, and this state of things calls aloud for remedy. A strong feeling exists among these men that the Board of Trade should hold separate examinations for them, and should grant certificates, just as they hold examinations for the steam engineers and grant them certificates.

It is true that certain questions on electrical matters are included in the examinations for these latter engineers, but it is only necessary to glance at their nature to see how absurdly inadequate they are to secure competence in looking after a modern electrical installation for lighting and power. It is greatly to be hoped that efforts which are being made to secure this reform will be successful.

The Drive of Auxiliary Machinery on Board Ship.

By L. MILLER, A.M.I.E.E.

It has been proved in practice that the electric drive of the auxiliary machinery on board ship has resulted in a considerable saving in the coal consumption of the vessel. Furthermore, the more efficient the propelling machinery the greater the saving to be obtained by the adoption of the electric drive. This is due to the fact that with steam-driven auxiliaries, the exhaust steam from the auxiliaries in the engine room is utilised in the feed-water heater and where the total steam consumption, including the propelling machinery, is heavy, a larger quantity of this exhaust steam can be efficiently utilised than in the case where the total steam consumption is not so great. This, of course, applies only to such auxiliaries as are in constant use during the voyage. It is quite clear then that until the limit of feed-water heating has been reached that a reduction in the steam consumption taken by the auxiliaries will not have anything like the same effect on the coal consumption as will be the case after this, what might be called critical point, has been passed. The limit of feed-water heating is more quickly reached, of course, in the case of the most efficient propulsion machinery. Ideal conditions would be obtained where the exhaust steam from the auxiliary turbo-generator is just sufficient to obtain the limit of feed-water heating during the voyage. These remarks apply to such vessels using steam for their propelling machinery. In the case of ships driven by Diesel engines or the Diesel electric drive the problem is much simpler, being purely a question of the efficiency of the electric transmission with a large and reliable oil engine driving the generator against a number of small and inefficient oil engines.

Where the Electric Drive Scores.

Reverting back again to the steam-propelled ship, the foregoing remarks apply to only such auxiliaries that can efficiently exhaust to the feed-water heater, such as circulating pumps, boiler feed pumps, forced draught fans, refrigerator machinery, general service pumps, air pumps, lubricating oil pumps. Apart from these, there are such auxiliaries as steering gear, winches, capstans and windlasses which are located some distance from the boilers and where tremendous losses take place in the steam piping feeding them. In these cases the electric drive is far the most efficient proposition and quite a comparatively large saving in coal consumption can be achieved by its adoption. There appears to be an almost complete absence of reliable figures on steam consumptions of these small steam-driven auxiliaries, but some idea can be obtained of the loss of steam on this type of auxiliary when it is stated that it is often considered essential always to keep steam on the winch and windlass engines when the ship is trading in cold climates. This is to prevent the cylinders being cracked due to the water freezing inside them. Test bed figures on the operation of these auxiliaries are of little use as wear and inattention to leaky joints has such a tremendous influence on the steam consumption. Anybody who has seen these auxiliaries operating, often in a cloud of steam, will appreciate the importance of the point.

The electric motor does not suffer from this defect and its efficiency remains constant; this in itself is a matter of very great importance, but apart from this the loss in the cables feeding the motor are only a small portion of those losses which take place in the steam piping.

Reliability and Economy.

In a modern equipment with propulsion machinery consisting of double reduction geared turbines using superheated steam, a saving of 8 to 10 per cent. of the coal bill can undoubtedly be obtained by the adoption of the electric drive of the auxiliary machinery, generating the necessary power by means of an impulse type back pressure turbine, driving a generator through double reduction gearing, the exhaust steam from the turbine being utilised for feed water-heating, as previously described.

In all shipwork reliability is of first importance and economy must not be gained at the expense of reliability. If economy can only be gained by spending long periods in port overhauling the machinery, then it is of no use to the shipowner. This, of course, is a very obvious truth, but it is merely put forward to illustrate the cautious attitude of most shipowners to anything which has not years of proved reliability in service to back its claims. It is not possible to raise any objection to the electric motor drive on the score of reliability, when reasonable care is taken to select the type of motor best suited for the drive and ordinary precautions are taken to see that it is sufficiently protected from damage under the conditions in which it has to operate. These conditions, however, need to be carefully studied, and too great stress cannot be laid on the point because it is on the protection to meet seagoing conditions that the successful operation of the electrical machinery depends. Motors on deck will, in many cases, be frequently awash and may be hit by heavy seas; also when the deck hands are washing down the deck the hose will be played over the motor. On vessels trading in tropical climates the motor, if mounted on deck may be subjected to the direct rays of the tropical sun; wherever possible adequate protection should be provided to prevent this. In the engine room leaky steam pipes are another danger to the motors driving the auxiliaries and care should be taken to see that the insulation cannot be damaged by a leak developing in an adjacent steam pipe. The conditions should be such that it is never necessary to make repairs at sea, such repairs are rarely satisfactory and are generally very expensive in the long run. Where Diesel engines are used for the propulsion machinery then the motors in the engine room should be carefully protected from oil fumes. The only satisfactory way of doing this is to force ventilate the motors from a clean air supply, keeping the air in the ventilating pipes and motor casing under pressure so that oil fumes cannot leak into the pipes or the casing of the motor and damage the insulation.

The conditions should be such that the ship cannot be delayed due to a failure of the windlass or capstan motor. Suitable spares should be carried or a standby arranged for this application, so that not more than an hour's delay can take place in the raising of the anchor.

Tilting and Gyroscopic Action.

It is hardly necessary to point out that all bearings must be arranged so that the motor can be tilted 15 deg. from the horizontal in any direction without affecting the means adopted to lubricate the bearings. Well-designed roller bearings meet this condition, of course, but where oil rings are used it is necessary to take suitable precautions to see that the rings cannot stick.

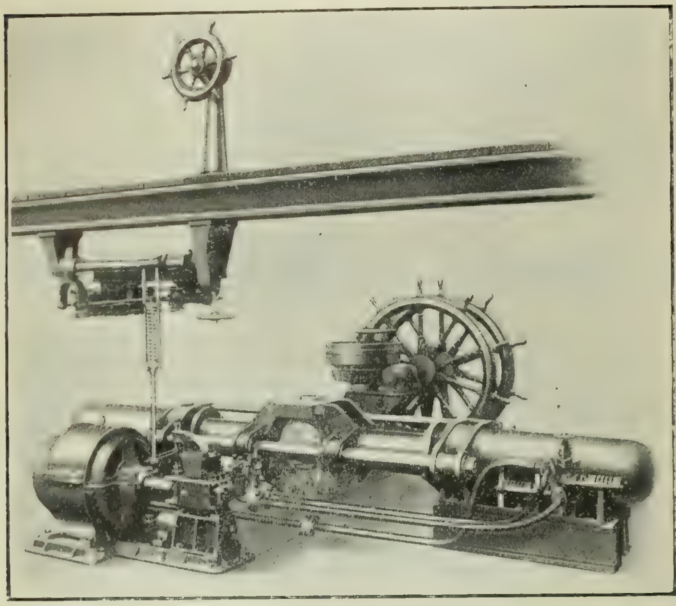

Fig. 1.—A Williams Janney Steering Gear of the double ram type.

Gyroscopic action is important on high-speed motors, with regard to its influence on the wear of the bearings, and where the stored energy of the rotating masses is high it is best to arrange the motors so that the bearings run fore and aft.

Choice of Cables.

Particular attention should be paid to the choice of cables. Where tropical climates are likely to be met with, trouble is likely to occur with bitumen or rubber cables due to the high temperature. In such circumstances it is best to use paper-insulated cable wire-armoured and lead-covered. The objection to the use of paper-insulated cables lies in the fact that all joints of any kind must be efficiently sealed to prevent moisture getting into the insulation. Most cable makers have, however, carefully trained jointers who are capable of making these joints satisfactorily, and the services of such a man should be utilised to ensure that the cable system is watertight and no one should be allowed to interfere with a joint after once being made unless a trained jointer is at hand to make good. Bitumen-insulated cables are being used now almost exclusively for colliery work and there is no reason, where the ship is trading in temperature climates, why this type of cable should not be successful on board ship, provided suitable precautions are taken with regard to armouring. Conduit should be avoided wherever possible on board ship, owing to the condensation which takes place inside the tubing ; this results in the ultimate deterioration of the cable.

Switchgear should be Simple.

The control and switchgear generally should be of the very simplest description suitable for the roughest handling It should be of the totally-enclosed ironclad type, with the exception of the main switchboard, which can generally be placed in a well-protected situation.

In some locations, such as winches, capstans and deck work generally, the master controller must, of course, be watertight. In arranging the switchgear, arrangements should always be made to accommodate a shore supply. This constitutes an important advantage of the electric drive and illustrates its flexibility. It enables the whole of the generating plant and the engine room auxiliaries to be shut down when in port and any overhaul undertaken while the shore supply is utilised for cargo-handling auxiliaries, pumps, lighting, &c. The insulation of all electrical gear used on board ship should be of a type to resist the damp, salty atmosphere and condensation which occurs. All apparatus should be efficiently earthed to prevent any danger of shock in case of a breakdown of the insulation.

The foregoing are a few of the points that should be given attention when laying out the auxiliary equipment of a ship. There are, of course, others which are special to the class of ship, but enough has been said to indicate how important it is to study the operating conditions, and it is in the failure to grasp these conditions in the past that most of the breakdowns that have occurred can be traced.

Electricity and Increased Speed of Handling Cargo.

One of the important advantages of the electric drive of cargo-handling machinery, such as deck winches, lies in the increased speed of handling the cargo as compared with the steam winch. It has been found that in some cases the speed of handling the cargo has been increased 25 per cent. by the use of electric winches. The control should be of such a nature that it is only necessary for the operator to push a handle over or preferably turn a handwheel to start up ; the acceleration of the motor should be automatic and should be outside the control of the operator. To obtain this result, automatic contactor gear should be used preferably mounted between decks and a watertight drum-type master controller on deck. Drum controllers for the direct control of the winch motor cannot be regarded as satisfactory as the class of labour that handles these controllers is such that the wear and tear on the controller fingers is very heavy, and in many cases the fingers have been burnt off due to the operator throwing his controller handwheel from "full forward" to "full reverse." Under these circumstances it is essential that the control should be of such a nature that in the event of an operator performing

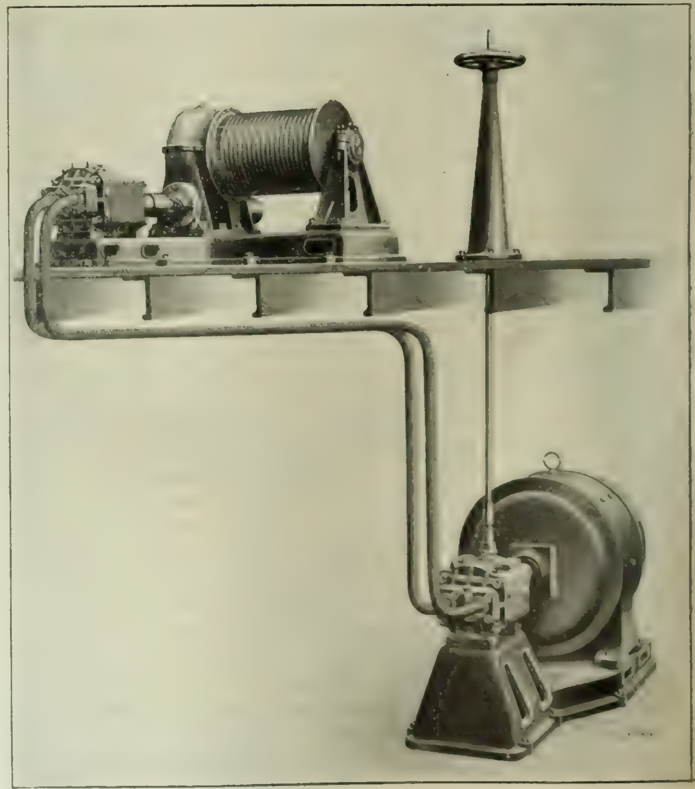

Fig. 2.—45 cwt. Williams Janney Winch.

the above operation no damage can be done to the control gear or the motor. The arrangement previously mentioned of a master controller operating contactors with automatic accelerating devices fulfils this condition. An electric brake should be fitted to come into action in the "off" position of the master controller, and in addition an emergency foot brake is found useful. A device must also be fitted which will prevent damage in the event of the cargo or empty hook catching the hatchway—this usually takes the form of a slipping clutch. Potentiometer control or dynamic braking has been found of great service on the lowering side of the master controller and simplifies the control of the load considerably. If this is fitted there is no necessity for the overspeed brake which must otherwise be installed to prevent heavy loads driving the gear and attaining a dangerous speed.

The Williams-Janney gear operated by a motor has also been successfully applied to winches, and this gear undoubtedly gives a very convenient smooth and easy control equally as foolproof as the all-electric control described above. (See Fig. 2)

It is clear that any winch fitted with either the all-electric control or the Williams-Janney gear could be handled by any type of labour without fear of damage to the equipment or the cargo.

The series-wound direct-current motor is usually employed to drive winches, with the all-electric drive, the characteristics of such a motor being best adapted for this class of service. For this reason direct-current power is usually utilised for cargo carrying and passenger steamers.

Steering Gear.

The steering gear engine where steam is used for this purpose is a most inefficient piece of apparatus, the efficiency being somewhere in the neighbourhood of 30 per cent. with the very best type. The Williams-Janney steering gear, driven by an electric motor is, on the other hand, highly efficient, an overall efficiency of about 70 per cent. being easily obtained, and for the small movements of the tiller the efficiency is still higher. The Williams-Janney steering gear has proved itself to be very reliable in service and cannot now be looked upon as an innovation. (Fig. 1.)

Oil Ship Desiderata.

The tanker or oil-carrying ship is peculiar to itself and carries very little, if any, cargo-handling machinery in the shape of winches, and for this reason and also because the conditions under which the cargo pumps operate are similar to those that obtain in a mine where explosive gases are present, it is best to adopt alternating-current motors of the simple squirrel-cage type. In the case of these cargo pumps for oil tankers very special precautions must be taken to ensure that the explosive gases which may be present in the pump room cannot be ignited by arcing at the motor. In some cases this has been taken care of by operating the pump by means of a shaft extending through a suitable bulkhead, the motor being on one side and the pump on the other, suitable precautions being taken to prevent explosive fumes getting into the motor room. In other cases a squirrel-cage alternating-current motor has been used, forced ventilated from a clean air supply, the ventilating pipes and motor casing being kept under pressure so that no explosive fumes could penetrate into the same. The starting arrangements being such that the pump motor can only be started after the ventilating fan has been running for some time, and in the event of failure of the ventilating fan, the pump motor is cut out of circuit.

Importance of Efficiency.

The importance of increasing the efficiency of the auxiliaries on board ship is illustrated in some recent tests which were taken on a modern equipment as far as the propelling machinery was concerned, but where steam-driven auxiliaries had been adopted. The propelling machinery in this case consisted of an impulse turbine driving the propeller through double reduction gears, superheated steam being supplied to the turbine. The steam consumption of the main turbine was 10 lb. per shaft horse power, and the steam consumption of the auxiliaries running during the voyage was found to be 30 per cent. of the total steam consumption of the whole vessel.

This figure shows what an important factor the auxiliary load is in the economy of the ship, and in these days of soaring fuel prices it is essential that this question be given the very fullest consideration.

The Development of the Rateau Geared Turbine for Marine Work.

By **A. V. JARRATT.**

THE employment of the Rateau impulse type turbine in conjunction with double reduction gearing represents the latest development in the steam propulsion of vessels, and the reasons for its adoption are not difficult to find.

In the first place ship owners were forced to seek a more economical prime mover than the reciprocating engine or direct coupled reaction turbine by reason of the increasing cost of fuel, and secondly it was only natural that the rapidly increasing popularity of impulse turbines on land, largely due to their strong mechanical construction and freedom from any risk of stripping as compared with the reaction turbine, should attract the attention of marine engineers. It is interesting to note that whereas a decade ago 80 per cent. of the turbines built for land purposes were of the reaction type and only 20 per cent. were of the impulse type, the direct opposite is the case to-day, and the proportion is still increasing.

Land Experience and Marine Work.

The recent developments in high-speed gearing, which are dealt with later, have enabled practically the same design of turbine to be used both for land and marine purposes, and the large amount of experience already obtained in the former type can therefore be applied to the marine type with considerable benefit. There are, of course, special features in the marine type, such as reversibility and other similar characteristics, which result from special requirements of marine practice and the application of gears, but these are comparatively simple and do not present any difficulties. It follows, therefore, that the impulse turbine has the same advantages when applied for marine purposes as when used on land.

The Rateau Turbine.

The Rateau turbine as manufactured by Messrs. The Metropolitan-Vickers Electrical Company, Ltd., has been successfully applied to marine propulsion and although the characteristics of this turbine are comparatively well known, a short description may not be out of place. The turbine is constructed with two cylinders, high and low pressure, mounted side by side, both driving high-speed pinions on the reduction gearing. These pinions run at the same speed, usually in the neighbourhood of 3,000 revs. per min., which enables them to be interchangeable. This arrangement enables the turbine to be made highly efficient and also has the advantage that each cylinder can be used independently in case of necessity, thereby providing a standby. The general arrangement of the turbines is shown in Fig. 1. The expansion of the steam is carried out in successive stages, the number of which depends upon the pressure range and relative blade velocity. The steam first expands through nozzles in which the potential energy in the steam is converted into velocity or kinetic energy. This energy is utilised on a compound velocity wheel, and as a rule a higher efficiency combined with simplicity is obtained by this method of dealing with the steam in its initial stage than is possible with any other construction. After the steam leaves the velocity wheel, its expansion is continued in single stages until the exhaust pressure is reached. Each of these stages consists of a diaphragm fixed to the cylinder and a moving wheel on the shaft. The diaphragm nozzles are of mild steel cast into place, and the moving blades are of 5 per cent. nickel steel machined from the solid bar. The construction of the wheels and method of securing blading is shown in Fig. 2. The design of the high-pressure nozzles, through which the steam first expands, is of very great importance, owing to the large pressure drop and converging of energy which takes place in them. They are, therefore, very carefully built up of forged steel angles and guide plates machined all over in order to secure the necessary high degree of accuracy. Astern sections are provided in both the high and low pressure cylinders, the power available being approximately 65 per cent. of the ahead power. A low pressure cylinder is shown in Fig. 3.

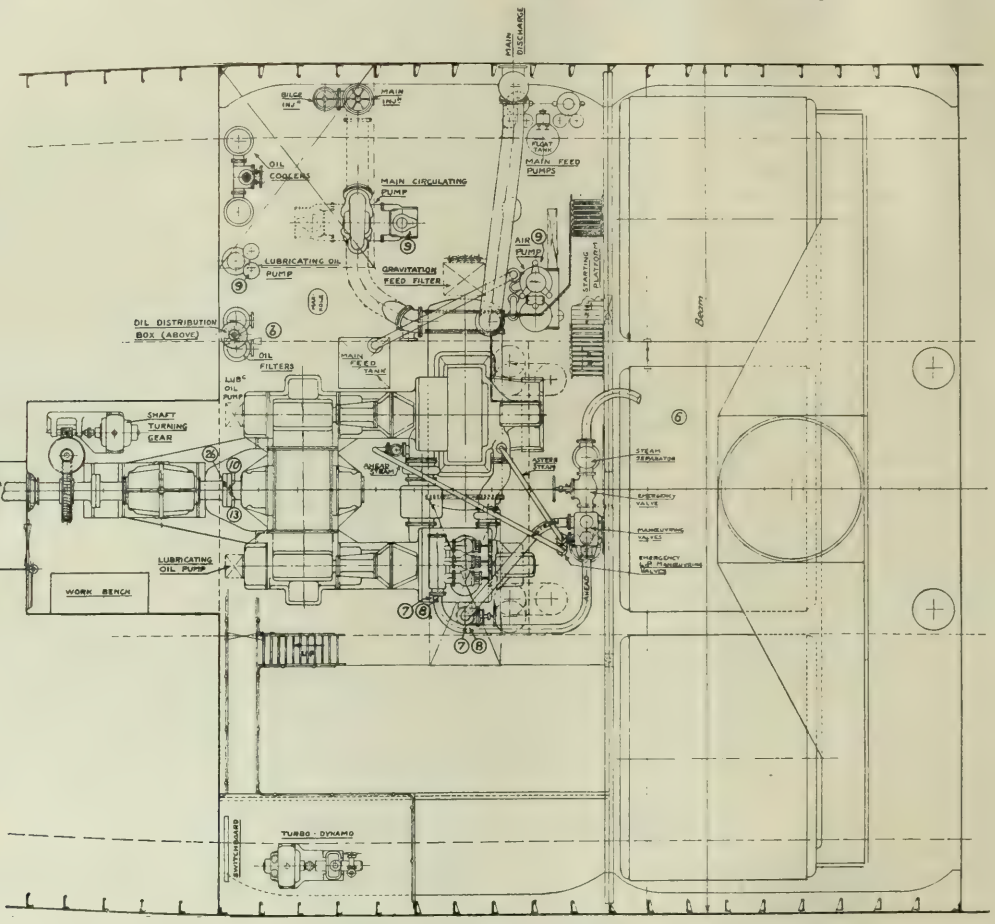

Fig. 1.—Plan View of Engine Room showing Arrangement of Turbines, Gearing and Auxiliaries

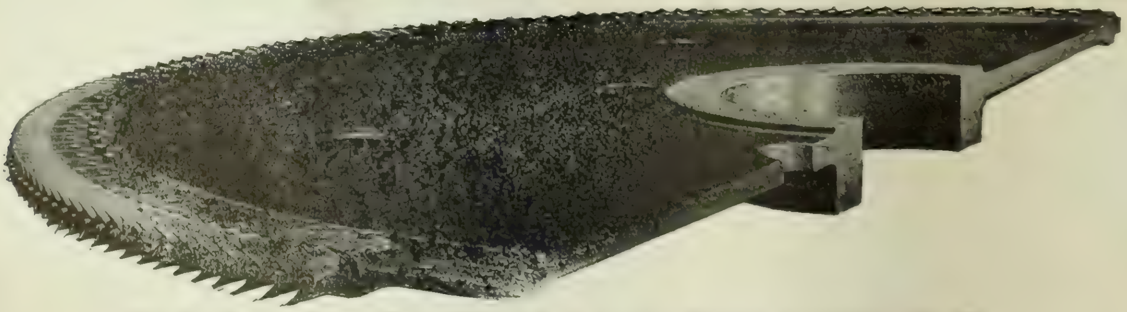

Fig. 2.—Rateau Blade Wheel Cut in Half to show Method of Securing Blades.

The advantages of the Rateau impulse turbine may be summarised as follows: (1) The clearances are much larger than in the reaction turbine and do not affect the efficiency; (2) differences in expansion between the rotor and turbine stator have also no detrimental effects upon the efficiency; (3) end thrust is practically absent, the necessity of elaborate thrust blocks or dummies being thereby obviated; (4) the casing is shorter and more uniform in shape than the reaction turbine and is therefore less liable to distortion; (5) the high pressure steam is confined to specially constructed nozzle-boxes, which are free to expand, and does not come into contact with the turbine casing.

The Clearance Question.

The above features it will be seen are conducive to a high degree of reliability, and attention is specially directed to the large clearances which entirely obviate any risk of blade stripping, which was a *bête noire* of the marine engineer where reaction turbines were concerned. The clearances of the Rateau turbine are never less than $\frac{1}{8}$ in. axially and $\frac{1}{4}$ in. radially as compared with $\frac{1}{32}$ in. on the reaction type. Another and very important reason which has led to the adoption of Rateau turbines for ship propulsion is its capacity for utilising a high degree of superheat without any possibility of trouble, the blading being of 5 per cent. nickel steel which will withstand high temperatures without any deterioration of its physical properties. If brass, bronze or other similar alloys are used they become crystalline when subjected to high temperatures and their physical properties deteriorate to a remarkable extent. The use of superheat on board ship was practically nil until quite recently, as in addition to the fact that reciprocating engines and reaction turbines did not give very satisfactory results with superheated steam, marine engineers were somewhat chary about installing additional complications which increased the risk of breakdown. The case is, however, different with Rateau turbines, and big strides have been made in the last few years with the result that the modern superheater is now recognised as a reliable piece of apparatus which effects a considerable saving in fuel without requiring an excessive amount of attention. The degree of superheat adopted is usually in the neighbourhood of 150°F.

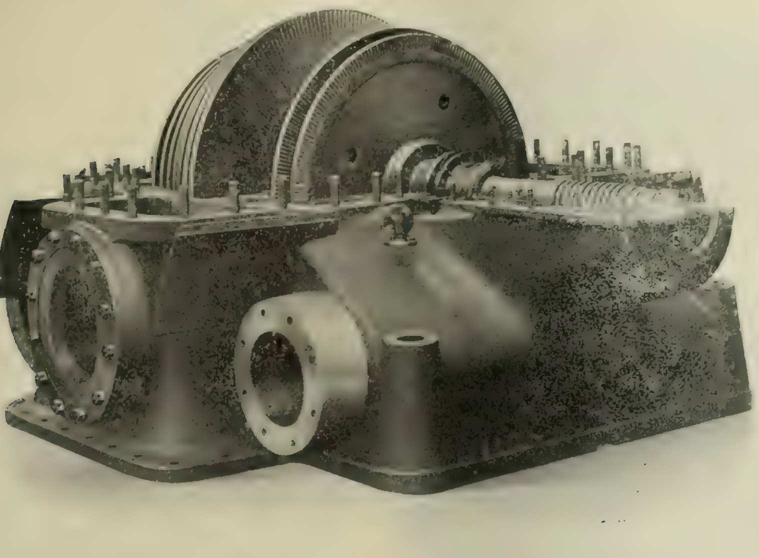

Fig. 3.—Low Pressure Cylinder of Rateau Marine Turbine with Top Cover Removed.

From observations extending over many years it has been proved that 100°F. of superheat will give a saving of approximately 10 per cent. in *steam consumption* as compared with saturated steam, and 200°F. superheat a saving of approximately 18 per cent. The actual saving in *coal consumption* is about 12 to 13 per cent. for a superheat of 200°F. as compared with saturated steam. In comparison with a reciprocating engine using saturated steam the saving is usually about 25 per cent.

Saving in Weight.

The weight of the propulsion machinery is also an item which must be seriously taken into account, as any saving in this direction means increased cargo carrying capacity, and it can be taken that the weight of an impulse turbine installation is approximately 30 per cent. lighter than that for corresponding reciprocating plant. This, together with the saving due to smaller boiler capacity required and also with the reduction in the amount of coal necessary, means a considerable increase in cargo carrying capacity.

Applications of the Rateau Turbine.

The Metropolitan-Vickers Rateau impulse marine turbine is now in service or is being installed in upwards of 40 vessels, including oil tankers, passenger liners, and cargo vessels with the most successful results. Experience with the turbines at sea has proved them to be absolutely reliable and to need a minimum of attention. A turbine was recently opened up for inspection after a year's continuous service at sea and the blading was found to be as good as when it was put in. It will be seen from the above that the application of the Rateau turbine to marine propulsion was a perfectly natural development, but which was materially helped by the increase in the cost of fuel compelling shipowners to seek a more economical method of propulsion.

The Use of Double Reduction Gearing.

Until recently it was the practice on turbine driven vessels to couple the turbine direct to the propeller shaft which was obviously bad practice, as the turbine is fundamentally a high speed machine, while the screw propeller is not. It was, therefore, necessary to effect a compromise as regards speed with the result that neither the turbine nor propeller was working at its best efficiency. It was realised that some form of speed reducing gear was necessary, but it is only comparatively recently that reduction gearing has been developed. In its early form it was of the single reduction variety and the credit for having originated the application of geared turbines to ships must be given to the Hon. Sir C. A. Parsons, K.C.B., who was responsible for the pioneer work in this direction. The single reduction gearing, while giving satisfaction in service, did not quite meet the case, however, owing to the fact that it is not desirable to have a bigger reduction ratio than 20 to 1 in a single step on account of the large difference in diameter between the wheel and pinion, and as the size of the wheel cannot exceed certain limits the pinion must necessarily be kept on the small side which is not desirable.

It was, therefore, considered advisable to carry out the reduction in speed in two stages which enabled the two reduction ratios to be kept within safe limits. The average propeller speed on a single screw cargo vessel of, say, 3,000 S.H.P. may be taken as about 75 revs. per min., while the turbine would run at about 3,000 revs. per min., this gives a reduction ratio of 40 to 1. One convenient arrangement of gearing is to incorporate the two reductions in one casing, the gears being interleaved as shown in Fig. 4.

"Gearing" Trouble.

A certain amount of trouble has been experienced on vessels fitted with double reduction gearing, usually taking the form of the teeth pitting badly or stripping completely

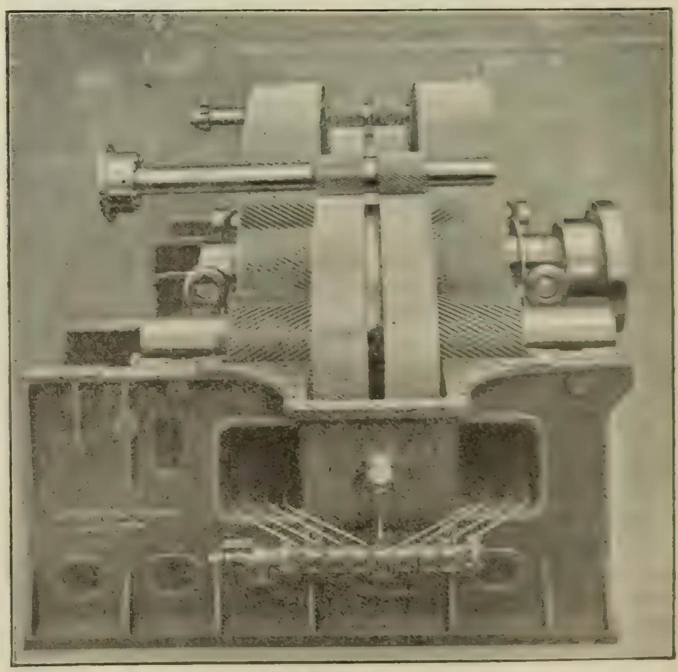

Fig. 4.—5,000 S.H.P. Double Reduction Gearing Ratio. 3,000/85 revs. per min.

It would, however, have been surprising if no trouble of any description had been experienced on the first sets of double reduction gearing as what might be termed "teething" troubles are usually expected with new designs when first put into operation. Shipowners naturally took alarm at the report of troubles that had been experienced with double reduction gearing. Some of the troubles have been experienced with British boats and a large number have been on American vessels. The shipowners' views were generally that with good freights obtainable their steamers must be in the first place absolutely reliable and that even at the cost of additional fuel, weight and space, they were not prepared to lose any time with their steamers idle in port whilst repairs were being carried out on gearing. Their market was too good to run any risk with machinery which they had any doubts about. This attitude naturally threw back the double reduction geared turbine proposals quite considerably, but it would seem that the earlier troubles that were experienced have been almost entirely met with and the primary cause was the inaccuracy of the teeth. It cannot be too strongly emphasised that the teeth must be accurately cut so that they shall bear evenly over the whole face width. Fortunately, where trouble has been experienced in British ships, it has been very thoroughly investigated and the cause of the trouble brought to light. There is undoubtedly nothing fundamentally wrong with double reduction gearing, and shipowners will do well to consider its installation in view of the high cost of fuel and the undoubted saving to be effected by its installation. It may be of interest to give a few causes of troubles which have been investigated, and they may be classified as follows: (*a*) Defective design; (*b*) faulty or unsuitable material; (*c*) bad workmanship; (*d*) faulty assembly and erection.

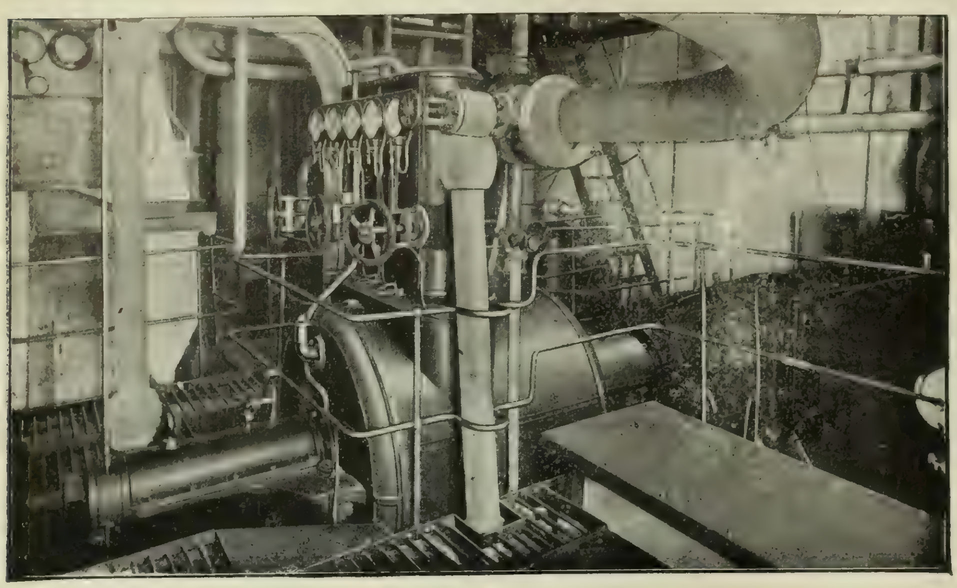

Fig. 5.—View Inside Engine Room of Vessel Fitted with Rateau Turbines Showing High Pressure Cylinder.

The first cause may now be eliminated, as designers now have plenty of experience to draw upon. Recent developments in metallurgy have produced materials which can be relied upon to stand up to their work. Bad workmanship is, unfortunately, still to be contended with and may be put down to certain manufacturers not having the experience or machines sufficiently accurate to produce satisfactory high speed gearing.

Importance of Accurate Design.

However, on the other hand, some manufacturers, notably the Metropolitan-Vickers Electrical Company, have realised the necessity of accuracy in design and manufacture and have therefore taken steps to ensure that this desirable state of affairs is realised in practice. It is obviously absurd cutting well designed gears on inaccurate machines, and therefore machines have been tested and re-adjusted so that records of tests taken of 10 pitches or divisions at 20 different points on the work table revealed that in five positions there was no error in 10 pitches, and that in the other 15 positions the maximum error was 0·0025 in., which is as accurate as can reasonably be expected. Further, the hobs used for cutting the teeth are measured and tested for accuracy both for tooth form and pitch, and no hob is used which does not come up to the high standard of accuracy now insisted upon. Finally, the finished wheel and pinion is measured tooth by tooth, and it will be seen from the above that it is now possible to obtain gearing of a very high standard, and shipowners on installing gearing should satisfy themselves that an actual measurement of the gears is made and that they are supplied with the results.

With regard to the materials used for gearing it is now the standard practice to construct both the high and intermediate pinions of forged nickel steel. The wheels usually have forged steel rims (of about 31/35 tons tensile strength), shrunk and pinned on to cast-iron centres. The casing does not call for any special comment, being usually of cast iron, well ribbed and provided with white metal bearings in either bronze or cast iron shells.

The Alignment Question.

The question of alignment is also very important as it is obvious that any error in this respect will prevent even bearing across the whole of the face width with the result that the intense tooth pressure at the restricted point of contact will cause disintegration of the metal and consequently pitting, which tends to spread across the whole tooth. It is, therefore, important to see that the gearing is accurately lined up when erected and also *that the alignment is maintained in service.* Some form of measuring instrument or meter is, therefore,

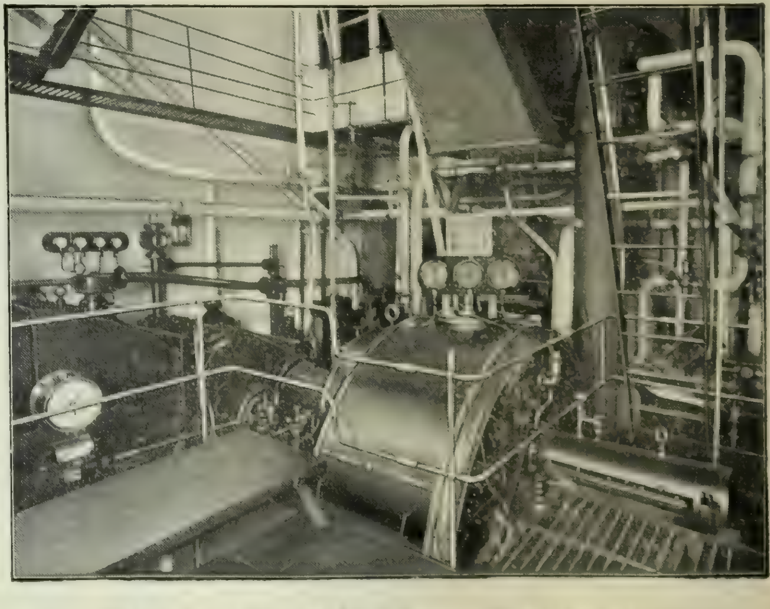

Fig. 6.—View Inside Engine Room Showing Low Pressure Cylinder.

desirable and a meter of this description has been designed and patented[*] which enables the alignment to be checked at any time and the magnitude of any errors which may exist to be indicated on a dial.

While on the question of alignment it should be pointed out that errors of this description may be caused by the twisting of the ship due to rough seas, &c. The design of seatings is therefore very important and these should be as stiff as possible and also constructed that they do not twist with the ship. However, it may now safely be said that all the difficulties which have arisen with double reduction gearing have now been removed, and geared turbines are now more reliable and cost less in maintenance than the reciprocating engine, and there is no doubt that they are rapidly becoming the standard method of utilising steam for the propulsion of ships.

Recent inspection has shown that double reduction gearing has run upwards of 100,000 miles without showing any signs of wear and a nil repair account. This is highly satisfactory and speaks well for the rapidity with which gearing has been developed into commercial success. All classes of vessels are now being equipped with double reduction geared turbines, including passenger liners, cargo boats and oil tankers. Illustrations of a typical installation are given in Figs. 5 and 6.

In conclusion, the writer would like to express his thanks to the Metropolitan-Vickers Electrical Company, Ltd., for the loan of the blocks used in the article.

Electric Propulsion of Ships.

By CHARLES RETTIE.

In the "Naval Annual" for 1919, Sir Alexander Richardson, in his opening remarks on the "War Developments in Warship Propelling Machinery," in the paragraph on the electric propulsion of ships, says :—

"The system appeals to the imagination, particularly of Naval officers of executive rank ; it savours of the simplicity of you touch-the-button and the engine does the rest." I hardly knew at the time whether to take Sir Alexander seriously or not, especially as he goes on to say in the article that electricity as a means of propulsion of ships has many advantages over all other systems. However, at the present time there is a ship sailing over the banks of Newfoundland which is electrically driven, and is actually worked on the touch-the-button principle, inasmuch as there is a controller on the bridge, so that when docking or in dangerous waters the officer on the bridge can work the motors direct without telegraphing to the engineer on watch.

The craft referred to is a trawler of 500 tons, length over all 150 ft., beam 24 ft. The propelling plant consists of two eight-cylinder four cycle 350 revs. per min. Diesel engines, each direct connected to a 165-kw. 125-volt continuous-current generator.[†]

The two self-excited generators are normally connected in series, and supply current to a 400 H.P. 250-volt 200 revs. per min. motor, which is direct coupled to the propeller shaft. Referring to Sir Alexander Richardson's remarks, it is this apathy of our people in this country to any new ideas which comes out. There is a lack of enthusiasm and want of faith even amongst our own men in the "electrical engineering field" ; we allow other countries to develop ideas to our detriment, so much so that when they come to electrify our ships for marine propulsion we shall be left behind, and all orders, even for our own ships, will go abroad.

Little Headway in Britain.

There has been very little headway in this country in the development of the electric propulsion of ships. The first ship that was fitted up was the "Tynemount," a full description of which appeared in The Electrician for October 17, 1913. She was not a success ; not that there was any failure in the electric plant, but the designers omitted to provide a reserve power, and the plant was taken out and replaced by steam. We have to go to America for the successful accomplishment of the electric propulsion of ships, with the exception of the cargo ships on the Continent, and one or two built here on the Ljungstrom system.

The United States Government have given orders that all capital ships built for them must be electrically driven. There are two battleships of 33,000 H.P. each, the "New Mexico" and "Tennessee," already in commission, electrically driven, and there are two more of the same class nearly completed. They are also building two battle cruisers similar to our H.M.S. "Hood," which are to have installations equal to 180,000 H.P., and will be electrically driven : they will probably mount six 18-in. guns, according to the "Scientific American" for July 10th. Referring to four of these ships the Vice-President of the G. E. C., in an article which appeared in the "Electrical World," October 4, 1919, states "we are working on contracts for the machinery of four of these vessels having an aggregate capacity of 720,000 S.H.P. and calling for 16 35,000-kw. generating units. The price of these equipments aggregates over $11,000,000, and their acceptance is, as usual, dependent upon a perfect performance of their functions."

Motor Regulation.

One of the most important problems in connection with electric propulsion of ships is the question of the regulation of the motors. In the case of small craft, such as yachts, ferry boats, trawlers and submarines and the like, there is no reason why continuous current should not be used, as is done on the yacht "Elfay," recently fitted out in America with Diesel engines. It is, however, another matter when battleships or large liners using powers up to 180,000 H.P. are considered in a single installation, which throws continuous current out of the question, and we have to fall back on alternating current, with its many intricacies and problems which have to be overcome, and of which we have little knowledge at present. In a Paper given during the war by Mr. Hird before the Society of Shipbuilders and Engineers in Scotland, after he had referred to the pioneer work of the late Mr. Henry Mavor on ship propulsion, and his inventions in systems of regulation of the speed of alternating-current motors by pole-changing and changing the periodicity of supply, states that he thought the American Navy would alter their original plans to have three-phase motors and wound rotors and resistances, and adopt a system which was invented by Boucherat,[*] and use two windings on the rotor, one a high-resistance with low inductance, and the other low resistance and high inductance, the idea being that on starting, instead of having a wound rotor with slip rings with a resistance inserted, as soon as the generator is started it picks up the first winding on the rotor with its high resistance and low inductance, and as soon as the rotor reaches its proper speed the first winding automatically drops out, and the second winding with its low resistance and high inductance does the work.

It seems that, in the case of the "New Mexico," the General Electric Company have adopted the system Mr. Hird thought they would. I think this shows Americans are alive to the new ideas that are being developed on this subject. The system, however, has one fault, and that is it has a low efficiency, so much so that in a letter I received from Mr. W. L. R. Emmett, the consulting engineer of the General Electric Company, he says that in the future ships the designs are being modified as regards the regulation of the motors in question.

The battleship "Tennessee" is not the same as the "New Mexico," inasmuch that wound rotors with resistances are employed, instead of the squirrel-cage winding and no resistance is used.

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[*] See "The Engineer," May 28, 1920.

[†] "General Electric Review," May, 1920.

[*] Hobart's "Electric Motors," p. 327.

This question of regulation of alternating-current motors both as regards starting, speed regulation and control for ship propulsion, is the principal point for development and research. Referring to speed control by pole changing, there is an interesting article by F. Creedy in The Electrician for February 2, 1917, which was referred to in a special article on ship propulsion in "L'Industrie Electrique" for July 10th last. After explaining a system of speed control by pole changing and a phase converter, he says: "The well-known advantages of the standard induction motor are retained, such as a squirrel-cage or slip-ring motor, capable of satisfactory service under the roughest and dirtiest conditions with the minimum of attention." Mr. Creedy, after giving a description of the theory of his motor, goes on to say: "By the use of this phase converter and a suitable controller it is possible to vary the phase difference between adjacent sections of the stator winding in such a way as to produce any desired polarity." In Fig. 1 of the article reproduced herewith is shown such a winding, having 13 terminals connected to a phase converter giving 13 phases in such a manner as to give 2, 4 or 6 poles. If every terminal of the motor is connected in order to the corresponding terminals of the phase converter the phase difference between the adjacent sections of the motor will be the same as that of adjacent sections of the phase converter, that is (360 divided by 13 in the case shown) when the motor will operate as a bipolar machine. If the motor terminals, starting from a given period are connected to every second converter terminal, the phase difference between adjacent sections will be doubled and the motor will operate with 4 poles.

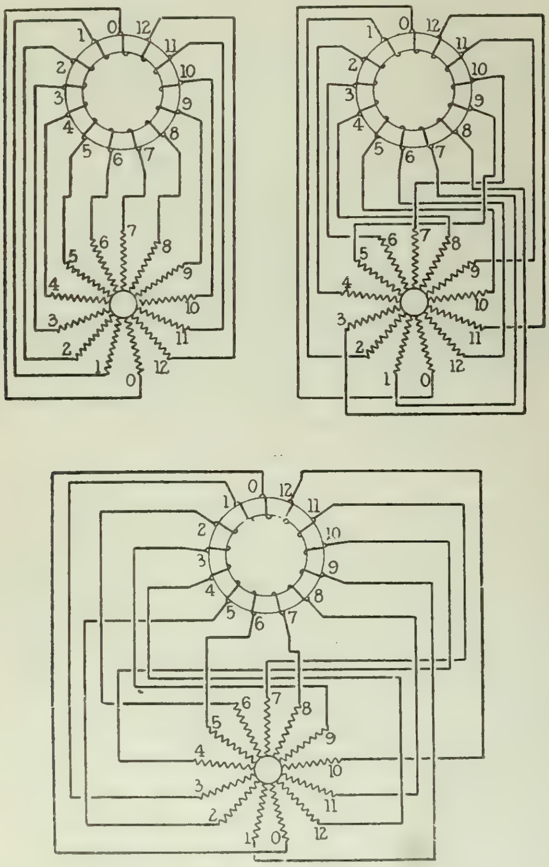


Fig. 1.

"Similarly, if the motor terminals are connected to every third phase converter terminal, the phase difference will be tripled and the motor will operate with 6 poles, and so on. . . . . The well known advantages of the standard induction motor are retained, such as a squirrel cage or slip ring motor, capable of satisfactory service under the roughest and dirtiest conditions with the minimum of attention, &c." The above would be ideal for ship propulsion, except that when three or more changes are made the system is not practicable: for instance, the "New Mexico" and the "Tennessee" only have two changes—24 poles and 36 poles. The system used on the "New Mexico" is that known as the "quarter-phase," supplying current to the motors at 2,800 volts on the 36 pole connection when going slow, and at 4,000 volts on the 24 pole connection when going full speed. The system used on the "Tennessee" is the three-phase system.

There is another important point which is brought out in a report of two years working of the U.S.S. "New Mexico" in "International Marine Engineering" for May last. One of the phenomena of the induction motor is that if a sudden load is thrown on the motors, such as would occur when a ship is turning, it would fall out of step and stop. In the case of rough weather this phenomena of the induction motor would be an advantage, as, in case of the ship pitching, the stern rising out of the water, the motors, instead of racing, would stop; but in the case of a ship turning, either motor port or starboard, stopping would be serious.

The "New Mexico" has been operating for nearly a year in company with two sister ships, the "Idaho" and "Mississippi," which have hulls identical with that of the "New Mexico." During this time it has been possible to obtain an accurate comparison of the relative economy of the three ships and also the relative manœuvring qualities. In the latter respect, the "New Mexico" is decidedly superior, and the remarkable part of it is that nearly all the manœuvring in restricted waters has been done with one turbo-generator. When this installation was first proposed, its opponents maintained that, while a ship like the "Jupiter" could be satisfactorily operated with the propellers on both sides of the ship running at exactly the same speed, it would not be possible to get satisfactory operation with such an arrangement on a ship which had to operate in formation. But exactly the reverse has proved to be true; it has been found that more satisfactory operation is obtained when using one generator than when using two, and it is customary, when in dangerous waters, where it is desirable to take all possible precautions, to use one generator for driving the ship and to keep the other turning over idly. If the ship is getting under way from an anchorage and has to turn, as soon as the anchor is away the signal is given for standard speed ahead on one side and the same speed astern on the other; with this arrangement the ship will turn absolutely on her keel without gaining ground either ahead or astern; with other engines, where it is not possible to regulate the speed so quickly and accurately, the probability of getting speed on the ship in one direction or the other is much greater.

All the predictions in regard to trouble on account of the condition that when operating with one generator the propellers on both sides of the ship must run at the same speed (if run at all) have proved to be groundless.

In conclusion, I would just like to refer to one of the great advantages of electric overgeared turbines, and that is the fact that no reversing turbine is required, which is a very important point in favour of electric propulsion. In a letter which appeared in the "Times Engineering Supplement" for May last, referring to a previous article in the same paper on the dangers of manœuvring of steam turbines, by Mr. H. N. Guy, chief engineer Turbine Department, The Metropolitan-Vickers Company, Ltd., says: "When discussing the 'Danger of Manœuvring' in the same article, the writer speaks of the sudden admission of live steam into an astern turbine which has been exposed to exhaust temperature for a considerable period being fraught with danger, &c., and various methods of reducing the temperature of the steam admitted when the reverse turbine is brought into operation are described. The assumption behind this statement and the object of the methods of reducing the temperature of the steam supplied to the reverse turbine is that when it is running idly (*i.e.*, the ship running ahead) its temperature is reduced to something approaching that of the exhaust steam, and that if hot steam is suddenly admitted to it danger arises from differential expansion which would result in it."

This assumption is incorrect when applied to geared turbines, and it is doubtful even in the case of slow speed direct coupled turbines, the opposite representing the true conditions, as will be seen from the following :—

" The idle turbine, which may be either the ahead or the astern unit, is rotating in a comparatively stagnant atmosphere of steam at approximately the density of the exhaust steam from the operating unit. The rotation of the idle turbine in the opposite direction to that in which it operates necessitates the expenditure of work in disc friction and/or windage of the blading. Although the proportion of the power developed in the operating turbine which is expended in thus rotating the idle turbine is small, its absolute magnitude is sufficient to raise the temperature of the steam in the idle turbine to very high figures, temperatures as high as 1,000 deg. F. having been recorded in a very short time. Thus, when the unit which has been idle is brought into operation the temperature of the steam admitted to it is usually lower than that of the atmosphere in which it has been rotating when idle. On the other hand, the temperature of the unit which is now running idle begins to rise rapidly, and this rise is fraught with serious dangers, among others that arising from the differential expansion, unless proper means are adopted to cope with it."

It is very difficult to know exactly what does take place, but the fact remains that this question of reversing of steam turbines is a very serious one, and when they come to use a very high superheat there is going to be some trouble which is bound to react in favour of the electric propulsion over all other systems.

In a letter I received recently from America from the consulting engineer of the General Electric Company, Mr. W. L. R. Emmett, whom I have already referred to, he states that since he gave his Paper on the " Electric Propulsion of Merchant Ships " to the Institution of Naval Architects of America, they tried an experiment in the G.E. shops in Schenectady, N.Y., on an idle turbine doing no work, that when on reversing the temperature rose 500 deg. F. in ½-minute, and while no damage was done it shows the necessity of taking precautions when reversing steam turbines for fear of the danger that might arise. I have said very little as regards the possibility of the combination of internal combustion engines and the electric drive, but there is no doubt a great future for this because, while the former working by themselves show a very low consumption of fuel, the fact that there is always some inherent trouble with them that without the combination of the electric motor they will not be a success.

Electrical Instruments for Use on Board Ship.

By A. F. HARRIS. A.C.G.I., A.M.I.E.E.

The extensive application of electricity for almost all purposes on board ship makes the selection of suitable instruments a very important point. For the purposes of this article, the instruments are divided into various classes according to whether they are used in the engine room, in positions where subject to moisture, or on deck, where a thoroughly water-tight instrument has to be selected.

Lighting Instruments.

In connection with the lighting of the ship the equipment of the switchboard and the instruments used in connection with it, are probably so well known as to need little detailed description ; instruments of the moving coil type are almost invariably employed, but in cases where moving iron instruments are used, they must be of the spring control type, in order to read accurately—independent of the motion of the ship.

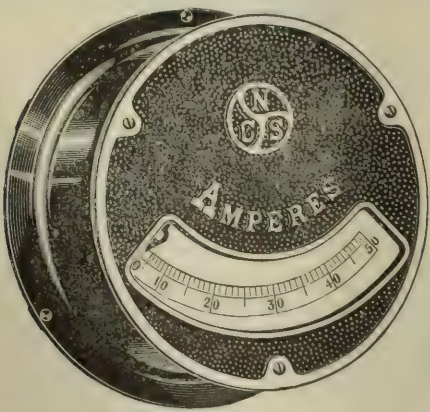


Fig. 1.—Dead Beat Moving Iron Instrument for Marine Work.

Fig. 1 illustrates a dead beat moving iron instrument fitted with spring control.

The question of indicating instruments to meet conditions of moist atmosphere and rough treatment has been very carefully considered by the leading makers in conjunction with Mr. C. H. Wordingham, late Superintending Electrical Engineer of the Admiralty. As a result, a specially designed line of moving coil instruments has been evolved. The movements are of the standard moving coil type, fitted in special splash-proof cases, the chief features of which are the interchangeability as far as the cases are concerned, thereby ensuring that the instruments of one manufacturer are interchangeable with those of another. Another advantage of this class of instrument is that different designs are adopted for ammeters and voltmeters, so that the possibility of mistakes in reading is largely reduced, voltmeters being either round or edgewise and ammeters of the sector pattern.

Fig. 3 illustrates a group of these instruments. It will be noticed that they are all fitted with auxiliary pointers which can be set to the required standard reading. The instruments comply with the Admiralty Specification No. 827 and where supplied to the Admiralty are of special colouring—the voltmeters being enamelled red and the ammeters blue.

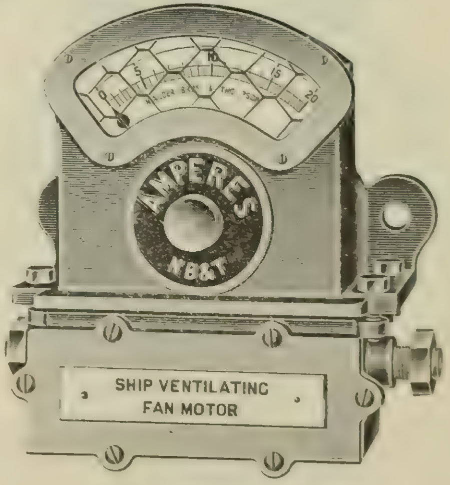


Fig. 2.—A Typical Motor Ammeter.

Motor Ammeters.

In ship work it has been found good practice in every case where a large motor is used to employ an ammeter to ensure that the motor shall not be overloaded, either in starting or when working under full load conditions. For this purpose an ammeter has been designed which is of the water-tight type, that is, will pass a test of total immersion in water, so that it can be installed either on deck or in any exposed position without danger. This instrument was primarily got out for Admiralty use, but is now generally employed in cases where a water-tight instrument is required. Fig. 2 illustrates such instrument. It is of the moving iron pattern, fitted with spring control, and terminal box to which access can be obtained without removing the front of the instrument. If lead-covered cables are employed a water-tight joint can be made, thus rendering it impossible for water to obtain access either in the instrument chamber or the terminal box.

Another feature of this instrument is that it has been designed on extremely robust lines and is fitted with anti-vibration fixing, it is almost impossible for it to be damaged, although cases have been met with where the instruments have been mounted direct on the bulk-head of the ship and rivetting has been proceeded with alongside it, even these trying conditions have not put the instrument out of commission.

The instrument is also fitted with a maximum demand pointer which is sealable from the front, so that this pointer can be set to the maximum admissible safe current for the motor in which circuit it is placed.

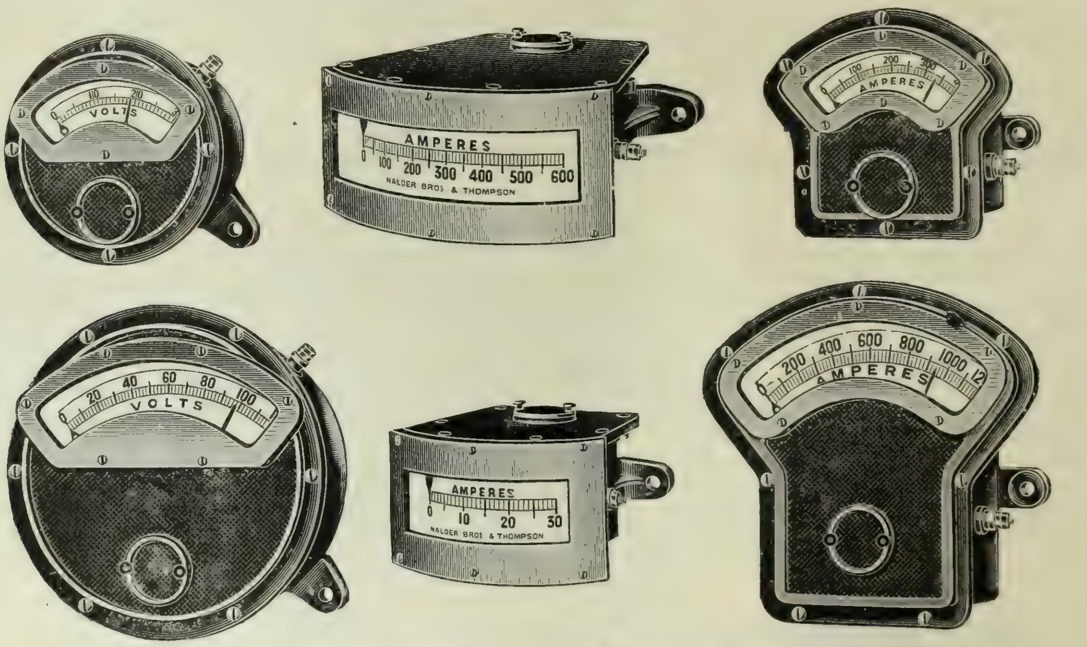


Fig. 3.—Group of Standard Admiralty Moving Coil Instruments.

Fig. 4 illustrates a combined moving coil ammeter and voltmeter in water-tight case. This instrument also can be immersed in water without danger, and can be made to comply with the most stringent requirements likely to be met with in all parts of the world for outdoor use on land or on board ship. Glands are provided for receiving the incoming leads.

The instrument consists of two movements, one of which is employed in conjunction with shunts for the measurement of current and the other for the measurement of pressure. The shunts are sometimes supplied in splash-proof or even water-tight cases with glands.

Illuminated Dial Instruments.

The water-tight instrument shown in Fig. 2 can be made in the illuminated dial pattern, the dial being of opal glass, on which the word " alive " is engraved in red so that at night the instrument can be read and gives warning that the circuit is alive. The opal dial is protected so that it cannot be damaged in use.

It will be noted that the instruments briefly described above are ammeters and voltmeters of the indicating type. Whilst recording voltmeters and ammeters are sometimes used on board ship the employment of this type of instrument is not very general, though types of recording instruments are manufactured which are suitable for use on ship-board.

Gyrostatic Compasses.

In addition to ammeters and voltmeters a large variety of electrical instruments are employed for various purposes on board ship, which are either wholly or partly electrical, electricity offering advantages in cases where it is desired to make measurements in one part of the ship and transmit the indications to instruments which may be installed wherever convenient.

The gyrostatic compasses illustrate a case of this kind. The gyrostat consists of a three-phase motor revolving at a very high speed, the indications from the master compass which is installed in some convenient and protected part of the ship can be transmitted to any number of receivers with great ease. The description of the gyrostatic compass is rather outside the scope of the present article, but descriptions of the Anschutz and Sperry types have appeared in the technical press from time to time.

Temperature Recorders.

There is hardly a better illustration of the advantages offered by electrical apparatus than the indicating and recording of temperatures at various parts of the ship at a convenient central point. Messrs. Nalder Bros. & Thompson some time ago developed a system of centralised distance thermometry, known as the telethermometer, which can be used for measuring the temperature of cold storage chambers, coal bunkers, or, in the case of battleships, ammunition holds

Amongst many advantages connected with the use of this system on board ship is that the thermometer trunks from the holds to the deck are entirely done away with, so that there is no interference with the cargo and no risk of carrying water from the deck into the holds.

All the thermometers on the ship can be read from the central point and this point may be anywhere that is convenient, such as the engineer's cabin, for example. They can be easily read in all weathers and the readings booked direct in a log-book kept for this purpose. The saving in time where a number of measurements have to be made, is considerable.

Briefly, the method is a Wheatstone bridge in which one arm is of copper and is wound in a watertight copper tube which is installed in the part of the ship, the temperature of which it is desired to obtain, and the remaining three arms of the bridge are wound of a non-temperature metal such as constantan, and are fixed in the case of the indicating instrument. The instrument itself consists of an ohmmeter, the deflecting coil being connected across two arms of the bridge and the controlling coil across the other two. A source of direct current is required for actuating the instrument, generally at a pressure of about 30 volts, and can be secured by a tapping placed across the lighting mains, or by means of a small hand generator, two turns of which are sufficient to bring the instrument to its reading.

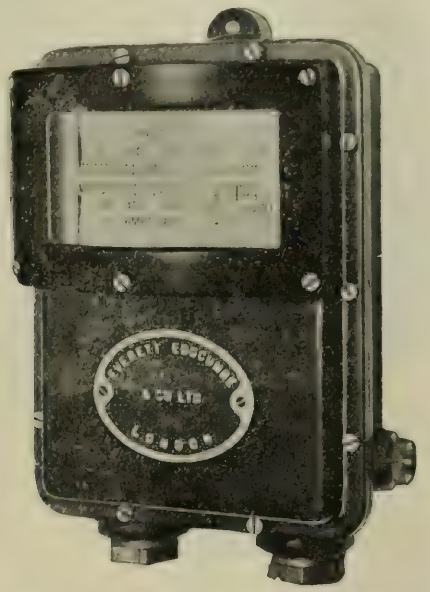


Fig. 4.—Combined Moving Coil Ammeter Voltmeter in Watertight Case.

The connections from the tubes to a multi-way switch are made by means of twin lead-covered cable, and a number of readings can be taken at extreme speed by successively switching over from tube to tube, the instrument being dead beat and coming to rest almost immediately. Fig. 5 illustrates the indicating instrument and Fig. 6 gives diagrammatically the scheme of connections.

Electric Tachometers.

Among the practical applications of electricity on board ship that of tachometers or speed indicators is perhaps the most important. The ease with which indications can be given at different parts of the ship, and the simplicity and reliability of the mechanism is well known. The most general arrangement consists of a permanent magnet generator fitted into a rust- and damp-proof case provided with a pulley which is driven by a belt from the main shaft. The voltage given by the generator is proportional to the speed of revolution of the shaft, and the indicators consisting of moving coil voltmeters are calibrated direct in revolutions per minute. These indicators can either be of the "indicating" or "recording" type, and as many indicators (Fig. 7) as required can be worked from one generator.

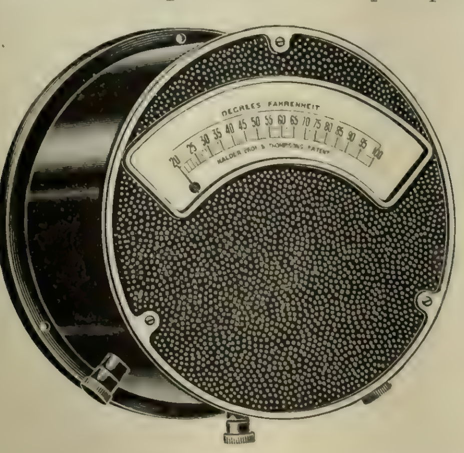


Fig. 5.—View of an Indicating Telethermometer.

A somewhat elaborated arrangement of the above is the "Forbes Ships' Log and Speed Indicator," which has been designed to give the speed and distance travelled by any vessel. The apparatus gives at any desired positions in the ship (1) the distance travelled by the ship through the water, (2) an indication of the speed in knots at which the ship is moving through the water at any moment. The apparatus consists of a valve fitted in the bottom of the ship, preferably about one-third of the length of the ship from the bows; the valve is fitted with guide-rods and carries a gland for holding suitable hydraulic packing. A bronze tube protrudes through the valve and gland, having an opening facing forward for the admission of water, as the tube is carried forward by the ship, and another opening facing aft for the exit of the water. Between these openings is a propeller operating the transmitting mechanism, which is so designed as to make a definite number of revolutions while the ship travels one nautical mile. The transmitting mechanism consists of a magneto generator, as described above, only that it is driven by gearing from a shaft rotated by the propeller in the tube. In addition to the generator a commutator is provided for transmitting electric signals to one or more "distance recorders," which is arranged so that 100 electric signals are made while the ship travels 2,027 yds., *i.e.*, one nautical mile.

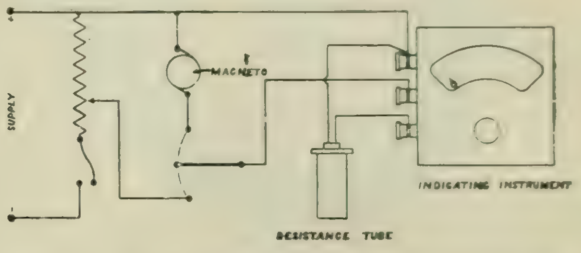


Fig. 6.—The Connections of the Telethermometers.

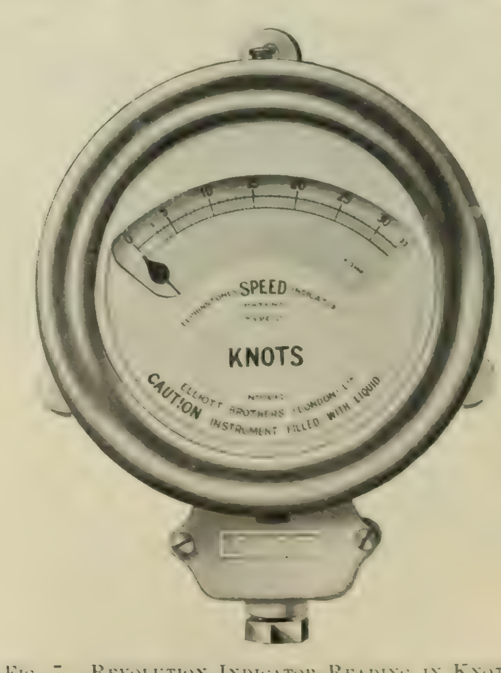


Fig. 7.—Revolution Indicator Reading in Knots.

Fig. 8 shows the general appearance of the distance recorder. It is contained in a watertight case, but its mechanism is easily accessible for adjustment if necessary, as it is carried on a hinged frame which swings out on the removal of one screw, as shown in Fig. 9. The motion is obtained by the attraction of an electro-magnet on a soft iron armature against the action of a spring. At every one-hundredth of a nautical mile the circuit of the electro-magnet is made in the transmitter, the armature moves, carrying with it a pawl which moves a wheel forward one tooth. When the circuit is broken the armature is pulled back by means of a spring. A red

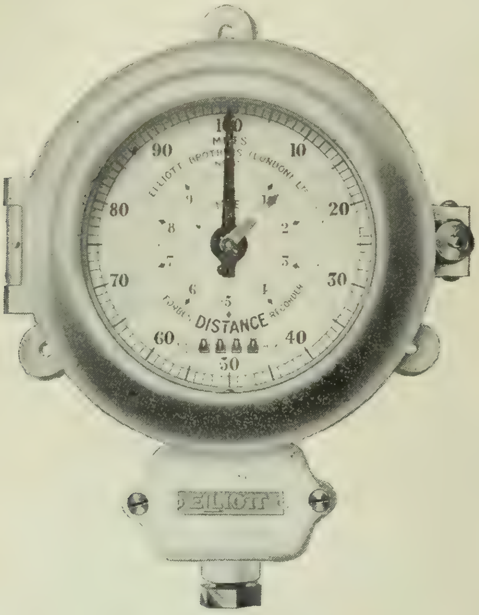


Fig. 8.—General View of a Distance Recorder.

pointer makes one revolution for each mile travelled by the ship. A black pointer makes one revolution for every 100 miles travelled by the ship. The pointers are friction-driven and can be set at zero at will. The total distance travelled is registered in figures shown at a small window in the dial.

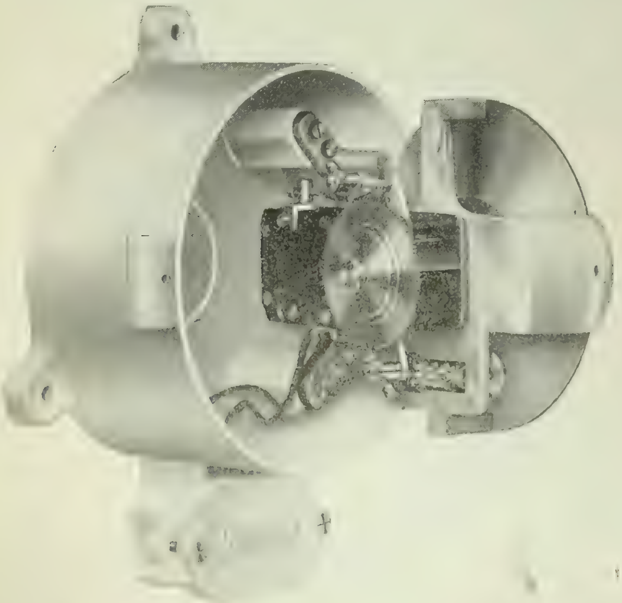


Fig. 9.—Distance Recorder with Frame Swung Out.

Stoking Indicators.

This article is concluded with a brief description of Kilroy's stoking indicators. Realising that in order to obtain the maximum boiler efficiency with the minimum of smoke production it is essential that furnaces should be fired uniformly throughout a ship. Mr. Kilroy devised a system of stoking indicators which have been in use since 1903 in the British Navy, and their use is becoming general in the larger ships of the British mercantile marine; the Cunard and White Star companies having fitted them to all their recent ships. Briefly described the system consists in giving a number to each boiler furnace door and providing a "stoking indicator" in each stokehold which signals these numbers in rotation at regular

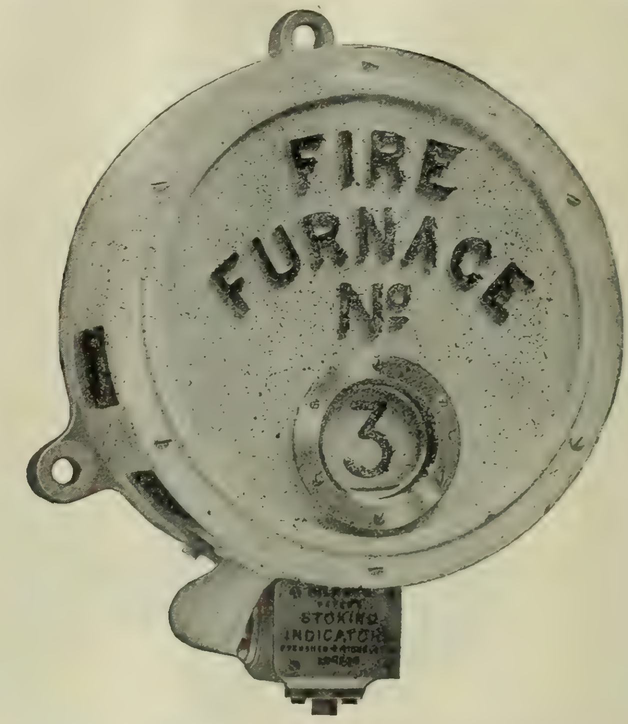


Fig. 10.—Single Type Kilroy Stoking Indicator.

intervals, ringing a loud gong to call attention at each change of signal.

Fig. 10 illustrates the "single type" indicator. The interval between successive signals is controlled by the engineer by means of a regulator (see Fig. 11). The regulator and indicators are worked from the ship's electric lighting circuit. The regulator or timing apparatus consists of a special time-switch mechanism (operated entirely electrically), which, at uniformly recurring intervals closes electrical circuits which actuate the stokehold indicators. The mechanism is so designed that the indicators do not all ring simultaneously, and the arrangement of the number of signals is made such that the minimum of furnace doors will be open at one time. A lever is provided on the regulator to enable the rate of firing to be varied (see Fig. 11).

The regulator consists of two magnets which act alternately on a pivoted cast-steel armature which drive a train of gear wheels, actuating an escapement which determines the timing of the regulator. The escapement is an electromagnetic device, and has no delicate parts such as would be necess-

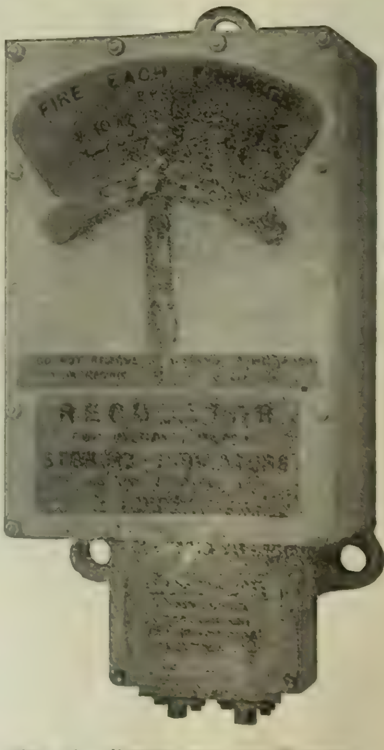


Fig. 11.—Regulator for Stoking Indicator.

ary in ordinary clock-work. The timing of the escapement may be varied widely by means of a regulating lever fixed on the outside of the instrument.

Mounted on the same spindle as the armature is a tripping device, which, at the end of the travel of the armature produced by the action of one driving magnet in one direction, breaks one set of contacts and makes another set; this has the effect of energising the other driving magnet and thus reversing the cycle of operations. Connected to the contacts above mentioned are also the stokehold indicators. The dial movement and the gong mechanism are worked on the same circuit, as already explained.

INDICATORS.

The single-faced indicator consists of a strong outer case protecting the bell which is mounted on an inner watertight case containing the electro-magnet and the mechanism for moving the dial which has numbers on it corresponding to the furnace doors. When the current is on, and the electromagnet energised, the outer armature is attracted, so that a single stroke is rung on a bell. The inner armature is attracted at the same time. When the current is off both armatures will return by the action of their springs to their normal positions without changing the number shown, and will be set ready for the next operative stroke.

Stoking indicators are also made in the duplex type, which is an improvement on the single pattern. The dials are in duplicate, so that the instrument may be read from both sides, and the size of the opening has been increased so as to show a larger number. For simplicity, however, the single type has been described.

In conclusion, with the multiplicity of electrical apparatus which is collected on board ship now-a-days, the careful testing of each piece and the maintenance in proper condition of the wiring used in connection with it makes it essential that periodical tests of insulation be made. For this purpose an insulation testing set is an essential part of a ship's electrical equipment. Fig. 12 illustrates an "Ohmer," which is a very light and convenient form of testing set, with which rapid and accurate insulation tests can be made.

The ohmmeter is of the electrostatic type, thus giving a light instrument entirely unaffected by external fields. The instrument is provided with two ranges, thus giving a very long effective scale.

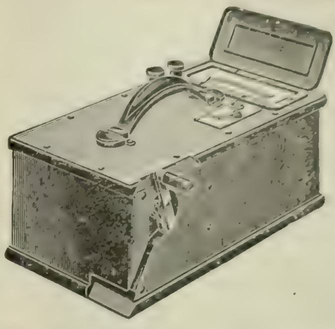


Fig 12.—The Standard "Ohmer."

In conclusion, my thanks are due to Messrs. Nalder Bros. & Thompson, Messrs. Elliott Bros., Messrs. Evershed & Vignoles and Messrs. Everett & Edgcumbe for description of the various apparatus described in this article and for the loan of the blocks used to illustrate it.

Wireless in the Mercantile Marine.

By H. MACCALLUM, B.SC.(Lond.), A.M.I.C.E.

NOTWITHSTANDING the fact that remarkable technical progress has been made in wireless during the last five or six years, no great advancement has been evident in its practical application at sea until just recently, and it would almost appear to the onlooker that wireless in the Mercantile Marine had reached a period of stagnation. It is true that something like stagnation in commercial wireless occurred during the war, but there are very good reasons for this. The maximum output by all manufacturers of apparatus in any way useful for war purposes was essential at that time, and in the case of wireless in the Mercantile Marine, the existing patterns of apparatus met all requirements. The only valid reason for introducing new patterns was to cheapen and expedite manufacture, or more efficiently to utilise the material available. With the exception of one or two minor alterations in design, introduced with this object in view, the apparatus fitted to ships in large quantities during the war was of pre-war pattern. The energies of designers were fully employed in bringing out new patterns of wireless gear for use in the theatres of war, and it is in this direction that the technical advances referred to have been made.

THE USES OF WAR EXPERIENCE.

The experience gained in this work, and the developments and inventions introduced, became available shortly after the end of the war for ordinary commercial purposes, but the types of apparatus which had been manufactured for war purposes were, for the most part, entirely unsuitable for commercial service, and much work had to be done before satisfactory commercial patterns could be put upon the market. As is now generally known, the technical advances referred to were mainly in connection with the use of the three-electrode thermionic valve, which was in process of development when the war broke out. All ships in the Mercantile Marine which were fitted with wireless before and during the war were equipped with apparatus working on the "spark" principle, and the receivers were of simple and robust pattern, but, compared with modern patterns, extremely insensitive. In recent apparatus fitted on the larger liners, the thermionic valve is used both for transmission and reception.

VALVE TRANSMITTERS.

Valve transmitters possess very marked advantages over "spark" transmitters—they are silent, compact and highly efficient. For a given power, a valve set has something like 2½ times the range of a "spark" set. The tuning is also very much sharper in the case of a correctly designed valve transmitter, and there is, therefore, considerably greater ease in avoiding jamming. It is unlikely, however, that the continuous wave system, in which valve transmitters are employed, will replace the "spark" system in the Mercantile Marine, if only for the reason that the extremely sharp tuning of the former introduces difficulties in the matter of calling up a number of ships, as is necessary in the case of a distress call. Such calls are best sent out by a "spark" transmitter, the signals from which are very much more easily "picked up" by other ships.

A pattern of wireless transmitting apparatus which is likely to be installed in large quantities in the Mercantile Marine, consists of a valve transmitter combined with a "spark" transmitter of the quenched gap type, both sets receiving power from the same motor alternator unit. At the present time, apparatus of this pattern has been used experimentally only, and although a number of the larger Atlantic liners have been equipped with valve transmitters, in most cases the equipment is of a temporary nature, the transmitters being of a pattern designed for land purposes, and used for the time being in conjunction with the existing "spark" installation Before the end of the present year, it is probable that standard sets of the new marine pattern will be available in quantities for installation on board ship.

SENSITIVE RECEIVING APPARATUS.

The installation on a large scale of the new type of transmitting apparatus will form a very great step in the progress of ocean wireless, but the introduction of new and very much more sensitive patterns of receiving gear forms an almost equally important advance. Ships are now being fitted with receivers of a sensitiveness quite unknown five or six years ago, and it will be seen that this change in type is an important factor in bringing about the very greatly increased ranges now possible. As the number of ships fitted with the new apparatus increases, ocean wireless will gradually assume a new aspect, and the time is not far distant when it will be possible to send messages from Great Britain to ocean liners in any seas without resorting to the continental telegraph services, and so to avoid the delays incurred in this way. Already, a business man can send a message to certain of the larger Atlantic liners, wherever they may be, and receive a reply in the course of an hour or so.

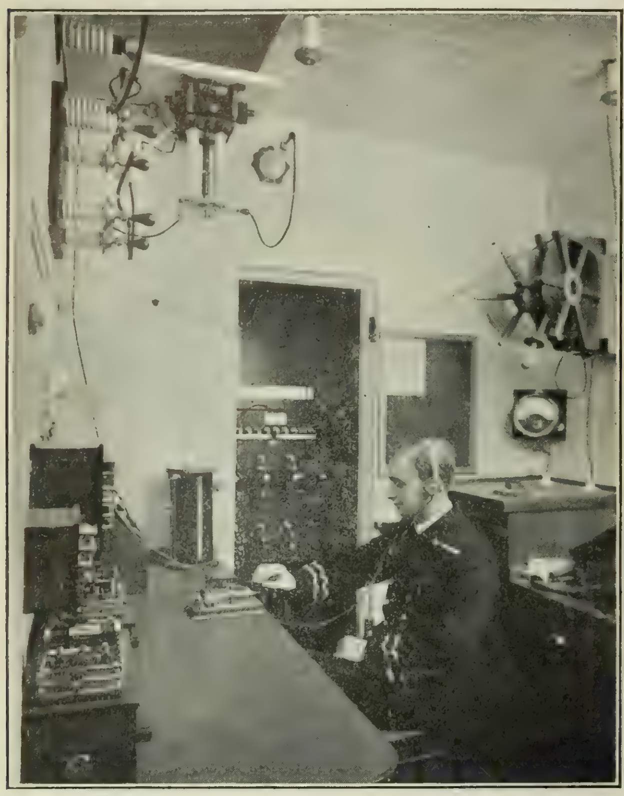


Fig. 1.—"Imperator" Wireless Cabin Showing Temporary Valve Equipment.

Wireless Telephone Apparatus.

Much has appeared in the press recently on the subject of wireless telephony, which may be regarded as an extension of the continuous-wave system of telegraphy, and for which the new type of transmitter is admirably adapted. In a standard continuous-wave transmitter, keying apparatus for Morse signalling only is supplied, but by the addition of a control panel, such a transmitter is easily converted into a wireless telephone. It should be stated at once that the range is reduced, when the set is used for telephony, to something like half that obtained by the same set when used for telegraphy. However, there are many cases in which extreme range is not of importance, for example, in inter-ship communication, and the telephone has the advantage that messages are sent at great speed. Telegraphic transmission aboard ship is usually carried out by hand, and the maximum speed is of the order of 20 words per minute. Messages sent by telephony go through at something like 150 words per minute.

At the present time the commercial apparatus available for telephony works on what is known as the simplex principle; in other words, conversation can be carrried on from one end only at a time—simultaneous conversation and "cutting in" is not possible. Duplex wireless telephony, which corresponds in every way to the ordinary wired telephony, has been carried out experimentally, and it is not unreasonable to anticipate rapid commercial development in this direction, but for the moment the speaker on the wireless telephone is obliged to operate a switch when he wishes to change from "speaking" to "listening." The end of each phase of conversation is signified, as a rule, by the words "Changing over," upon hearing which the listener at the far end is made aware of the fact that he is expected to switch over and speak.

The articulation of the wireless telephone is remarkably good, and a point worthy of note is that the articulation is equally good whatever may be the distance over which the message is sent, there being no distortion whatever, as there is in the case of wired telephony. The strength of the transmitted speech falls off, of course, as the distance is increased, but its quality remains the same whatever the distance may be.

Possibilities of Marine Wireless Telephony.

The possibilities of the wireless telephone aboard ship are undoubtedly very considerable, but it is somewhat difficult at the present time to forecast to what extent this means of communication will be adopted. With the advent of powerful installations on land it may be that Transatlantic liners, at any rate, will be fitted with wireless telephones, in order that they may be in continuous telephonic communication with the British and American shores, but at the moment it would appear that the need is met by the new pattern of wireless telegraph equipment. There are cases, however, in which the wireless telephone has a very marked advantage, and in which it will no doubt be adopted in preference to the wireless telegraph. For example, a North Sea trawler may very well be fitted with the wireless telephone, by means of which it can communicate with its base regarding the catches made, whereas it might not pay to fit the wireless telegraph which necessitates the presence on board of an expert Morse operator.

The Development of Maritime Wireless.

Whatever may happen in regard to wireless telephony, it is evident that in the immediate future maritime wireless telegraphy will develop commercially in a remarkable manner. Finality will not be reached until all the principal passenger liners are equipped with the new type of apparatus, and a number of cargo boats are similarly equipped, the latter to act as relays in cases of extra long-distance transmission, where the passenger liners concerned are out of range of each other.

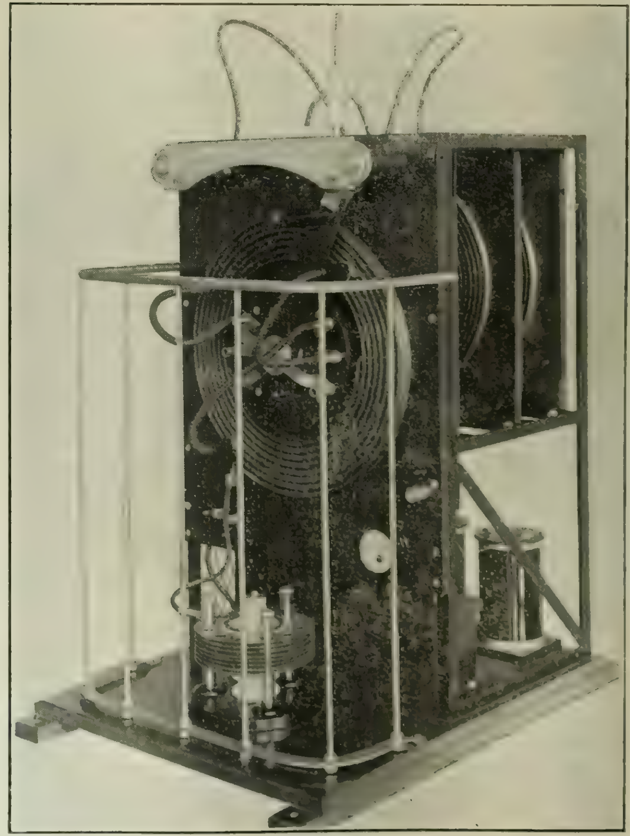


Fig. 2.—Marconi 1½ kw. Quenched Gap "Spark" Transmitter Set for Ships.

That such a development is possible, and, in fact, is reasonably certain to be brought about within a year or so, is due to the enterprise of the Marconi Company, and the enthusiastic co-operation of the leading steamship companies and the British Post Office. The latter department, which is responsible for transmission and reception on land, has given every possible assistance in connection with the scheme of development put forward by the Marconi Company. At the present time, continuous wave traffic with those ships fitted in accordance with the new system is dealt with by arrangement with the Post Office, at the Admiralty Station, Aberdeen. Shortly, this traffic will be diverted to a new station especially erected for the purpose, and a further improvement is to be anticipated.

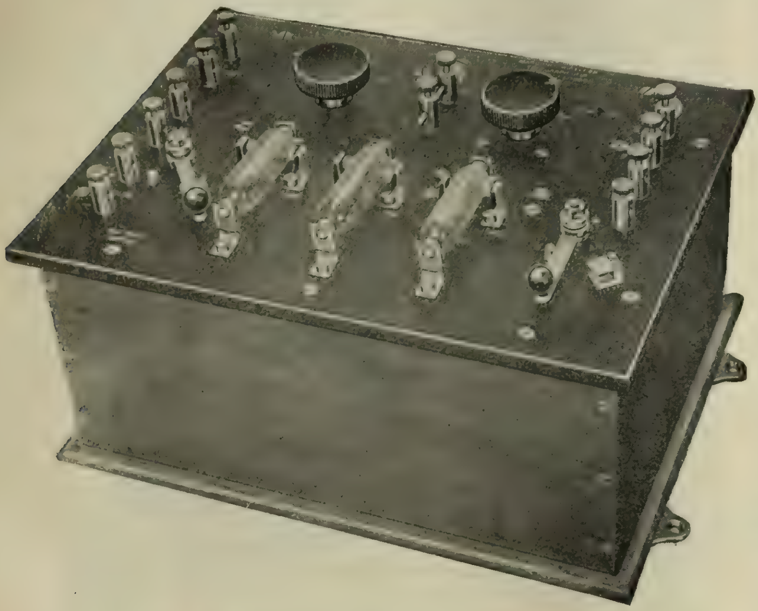


Fig. 3.—Marconi 3-Valve Amplifier for Ships.

It may be of interest to note that the first liner to be equipped with the new long-range wireless, was the ex-German liner "Imperator." This boat was selected on account of the fact that the German wireless gear, with which she was equipped, was out of order and had to be removed for repair. An experimental set was immediately put in and the experience gained with this set proved to be extremely valuable in connection with the design of the permanent type to be installed eventually inother liners. Our illustrations show the apparatus used on this ship (Fig. 1) and also a number of other pieces of marine wireless equipment of the standard Marconi pattern.

The Direction Finder.

Any reference to the subject of wireless in the Mercantile Marine would be incomplete without a consideration of the possibilities of the wireless direction finder This remarkable invention, the principal object of which is to enable ships to continue navigation in fog, is likely to be generally adopted on all classes of sea-going craft. It is becoming a recognised aid to navigation when for any reason the usual means fail. A ship fitted with a wireless direction finder, whatever may be the weather conditions, is able to take bearings relative to the fore and aft line of the ship, upon known points where land wireless stations are situated. By taking two such bearings and carefully noting the direction of the ship's head at the time these bearings are taken, the position of the ship may be ascertained to a degree of accuracy considerably greater than is required for the purpose of navigation in fog. The apparatus itself is extremely compact and reliable. It is installed in the wireless cabin and operated by the wireless operator, for the simple reason that a knowledge of Morse is required if the instrument is to be utilised to its best advantage. Since the bearings obtained are relative to the direction of the ships' head, it is evident that close collaboration must be obtained between the wireless room and the bridge, the bridge being responsible for noting the direction of the ship's head at the time the wireless observation is made, and for converting the relative bearings into true bearings. Although the standard Marconi direction finder is sufficiently sensitive to pick up the ordinary shore stations at distances of 300 to 400 miles, it rarely occurs that bearings are taken at distances greater than 100 miles, and very frequently the readings are taken over distances considerably less than this. Up to about 100 miles the bearings may be set off on the Mercator's chart, but over greater distances special charts must be used. These are supplied with the instruments. The special charts are gnomonic projections, upon which great "circles" appear as straight lines, whereas on the Mercator's chart great circles appear as curves, the curvature of which depends upon the the latitude and the mean direction of the bearing. The necessity for the use of special charts for long-distance work is evident when we bear in mind the fact that wireless signals travel along great circles on the surface of the earth.

The Direction Finder in Fog.

Apart from its use in the manner already indicated, the wireless direction finder is of considerable value in connection with the avoidance of collisions at sea. In foggy weather, a ship will be aware of the presence of other ships, by means of the ordinary wireless, and will know the course they are steering The relative positions, however, will be unknown, since in fog as a rule each ship is in ignorance of its exact position, and cannot indicate same to another ship in the neighbourhood. By means of the direction finder, the direction in which the second ship lies may be ascertained, and a skilled operator will have no difficulty in forming a rough estimate of its distance. For this purpose, the sensitiveness of the instrument is, for the moment, considerably reduced, and ships at a greater distance than 10 or 15 miles are put out of range.

Elimination of "Vertical."

The marine direction finder is a very much improved and simplified form of the Bellini-Tosi radiogoniometer, the principle of which is well known. The most recent improvements consist of an elimination of the non-directional component or "vertical," and the introduction of a means of determining "sense," as well as direction, without risk of ambiguity due to incorrect phasing. Considerable simplifications have been introduced and, in the present type of instrument, tuning is brought about by the revolution of one handle, and the necessity for balancing has been done away with.

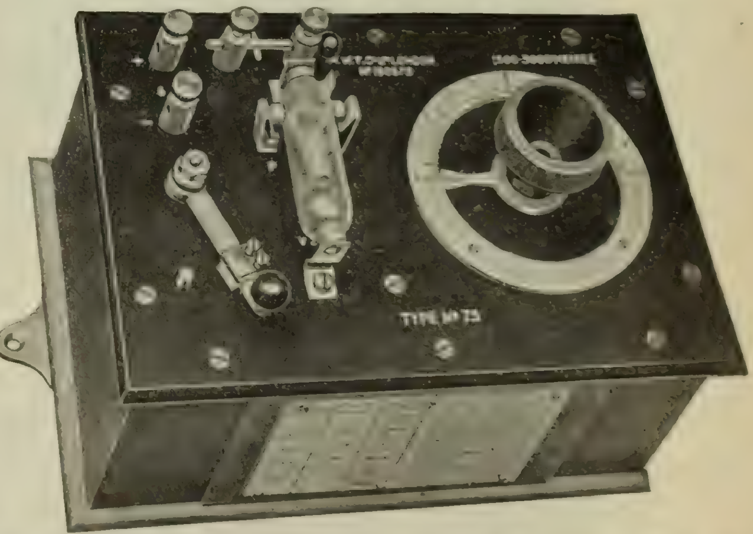


Fig. 4.—Marconi "Independent Oscillator" Beat Reception Ship Type.

The instrument is accurate to within one degree, and this is an accuracy very much in excess of that required for navigation in fog. Errors that occur are not due to the inaccuracy of the instrument, but to refraction or reflection of the wireless waves, similar to that which occurs in the well-known phenomena of the mirage. Where signals are received along a coast line an error of unknown quantity may occur, and at night errors have been noted due to the refraction or reflection in the upper atmosphere. On the whole, however, the readings are well within the limit of accuracy required in practice.

A number of direction-finding stations were erected on our coasts during the war, and most of these are now available for the use by merchant ships. These stations were admirably adapted for the purpose for which they were created, but there can be no doubt that for the navigation of ships in time of peace it is very much better to have the direction finder on board the ship. During the war it was desired to ascertain the position and course of certain vessels, but it was not desired to advise these vessels of the results of the observations. Where the direction-finding stations are on land, a ship requiring to ascertain its position must call up the control station, will probably have to wait its turn and, on receiving instructions, will send V's for direction finding, wait for a message giving its position and acknowledge receipt of same. Apart from the fact that this procedure takes considerably longer than is the case when the direction finder is fitted aboard ship, it involves an amount of unnecessary transmission, which may result in jamming, and has the important drawback that the master of the ship is asked to rely for navigation purposes upon a determination made by persons unknown to himself, and on whose reliability he has no check.

UNI-DIRECTIONAL TRANSMISSION.

A new and promising wireless development which may come into general use as an aid to navigation, but which is not yet commercially available, consists of a system of uni-directional transmission whereby telegraphic or telephonic communications may be sent out over a limited area and in one particular direction. The ordinary ships' wireless sends out signals which, for practical purposes, may be regarded as being equally strong in all directions. In the new system the electric waves are confined to a cone, which has its apex at the transmitter, much as in the case of a somewhat diffused searchlight beam. An important feature of this system is that it can be limited to comparatively short ranges, say, 5 to 10 miles, so that it is specially suitable for close-up work, and therefore for use in connection with the avoidance of collisions, and it would appear to be exactly what is required in crowded waters during foggy weather. The wave-length is exceptionally short, and the beam effect is obtained by means of reflectors. The use of this apparatus will in no way interfere with the ordinary wireless, to which it must be regarded as an auxiliary.

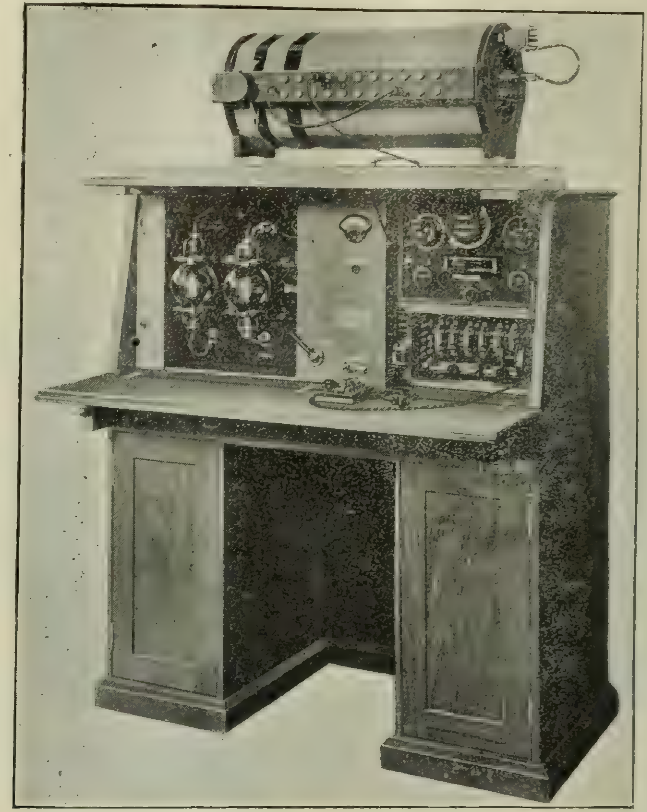


FIG. 6.—MARCONI 1½ KW. VALVE TRANSMITTER (CABINET TYPE) FOR C.W. TELEGRAPHY AND TELEPHONY.

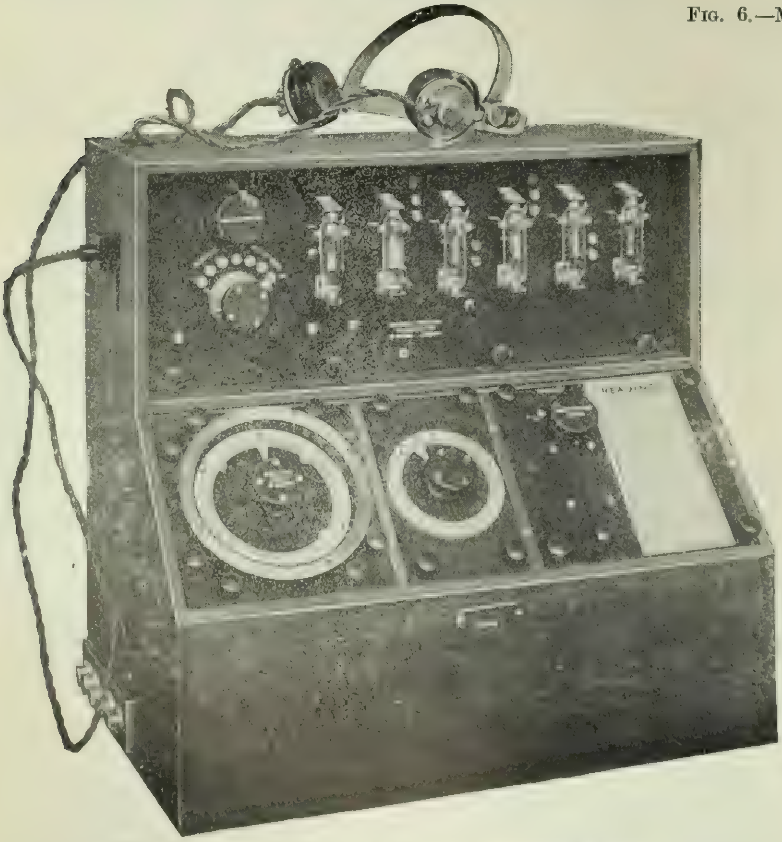


FIG. 5.—MARCONI MARINE PATTERN DIRECTION FINDER.

FUTURE DEVELOPMENTS.

Wireless in the Mercantile Marine would appear to be on the verge of a remarkable period of development and activity, in which the experience gained during the last few years will be utilised commercially. A great increase in efficiency may be expected, and with it a very considerable growth of traffic with ships, with the resulting benefit to shipowners who draw revenue from such traffic. In addition to the improved means of communication, wireless as an aid to navigation is becoming recognised and the direction finder at any rate, in its modern improved form, is likely to be very largely used. The wireless telephone and directional transmission are practical developments which, though not likely to be immediately adopted on a large scale, are available or will shortly be available should the demand arise.

Design of Dynamos and Motors for Marine Work.

By J. A. HUNN, O.B.E., A.M.I.E.E.

THE following remarks are intended to touch generally on the special design of electrical machinery for marine work to cope with the exacting requirements met with on board ship. There is no doubt in the past that the use of electrical machinery, especially for work such as steering gear, winches, windlass and compressors, has not made such rapid strides as it should have done, mainly due to the following causes: (1) Attempting to use the ordinary commercial machine as for land work; (2) the control gear being unable to cope with the onerous conditions obtained on board ship; (3) the higher initial cost on the electrical machinery. Owing to the increased numbers of oil engine driven ships, there are now signs that electrical machinery will play a more prominent part regarding auxiliary drives than in the past.

The firm with which the writer is connected (Messrs. Laurence, Scott & Company, Ltd., Norwich) have specialised in electrical machinery for marine work for many years, and the following details indicate the general methods employed. In the design of dynamos and motors for ship work it is always advisable to allow for a larger margin of power to meet with the varying conditions, such as heat and moisture. The insulation must be special—*i.e.*, micanite must be more liberally used than for ordinary commercial machines—and the impregnation must be more thorough.

DYNAMOS.

In many Diesel-driven ships generators of 100 kw. to 200 kw. capacity have been installed. As these machines are placed in the main engine room, where the atmosphere is permeated with oil vapour, special precautions must be taken regarding the insulation of the armature conductors and field windings. During the course of manufacture the coils are taped and impregnated with waterproof varnish before assembling in the machine, and afterwards thoroughly impregnated in a vacuum chamber and subsequently stoved.

ARMATURE CONSTRUCTION.

The armature is built up on a cast-iron quill, an extension of which forms the coupling, whilst an extension at the other end carries the commutator. By this means no torque is transmitted through the shaft, which simply serves to support the armature and bearing. The commutator is of heavy design, the sections being deeper and the steel cone rings of considerably larger section than is usual. The armature conductors are twisted on edge to form the back bend, thus obviating back joints.

We favour the use of "simple wave" windings as far as possible, owing to the difficulty in getting and maintaining the correct magnetic centre which is essential when using lap windings. The use of wave windings in large machines is limited, owing to the fact that a less number of commutator sections are required and the pitch of the slots in the armature core becomes unduly coarse.

FIELD WINDING AND VOLTAGE REGULATION.

Generators are preferably plain shunt wound with heavy series-wound interpoles. When running two or more similar machines in parallel there is no need of an equalising main. One of the chief disadvantages of running compound generators in parallel on light loads when driven by Diesel engines is the tendency for one machine to take all the load and motor the other set. The writer has seen a ship's electrician making abortive attempts to get satisfactory balancing of load between two compound generators under conditions above mentioned by working on the shunt regulators. One engine would slow down, and the operator promptly raised the field regulator on this set, forgetting that by so doing he was actually reducing the engine speed yet more. It invariably ended by getting a reversal and both machines coming off the board.

With the shunt interpole machine there is no danger of reversing the residual magnetism. Should one machine by accident send current back through another, it reverses only the magnetism of the interpoles, and any residual magnetism in the wrong direction left in these will not affect the building up of the shunt on the main poles when the generator is started up again. The best brush position for interpole generators is a slight lead in the opposite direction to that given in non-interpolar machines. This position gives the best commutation and best voltage regulation. When a compounded effect is required we proportion the strength of the interpole so that this negative lead may be increased. Messrs. Laurence, Scott are able, according to the position of the brushes, to get, with sparkless commutation, over, flat or under compounding effects. It should be noted that the generators will run better in parallel with a slightly dropping voltage curve.

MAGNETIC FLUX REGULATION FOR FANS.

A special system of magnetic flux regulation for ships' ventilating fans gives a considerable range of speed on the fan. The motors, being series wound, can be used without any starting resistances in the circuit. Series-wound motors are specially adaptable for centrifugal fans, as the area of delivery can be altered to any extent without overloading the motors, which is the danger when shunt machines are employed.

The machines are specially proportioned so that the speed may be reduced by increasing the magnetic flux. This system, however, increases the size of the machine; but the advantages gained by doing away with the line resistances outweigh the disadvantage of extra size of motor.

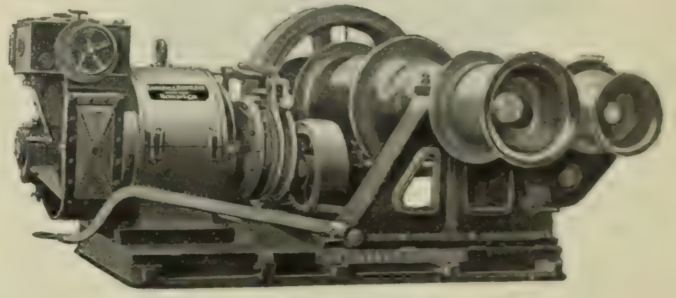


FIG. 1.—TYPICAL ELECTRICALLY DRIVEN WINCH.

In this system of regulation three separate series coils on each pole are generally used. The power taken by centrifugal fans varies between the square and the cube of the speed, so that for slow speeds a very small current is required. The first of the series are therefore wound with many turns of small wire. The second set of coils has fewer turns and larger wire, whilst the third set has thick conductors and only a few turns. For the lowest speed all three sets of coils are in series. For the intermediate speeds the first sets of coils are cut out, and for full speed the second set is also shorted. The starting and shorting of these coils is effected by a relay controller, which is mounted to the motor. The contactor is operated (from a distance) by a "master" switch. It is possible to fit regulating tabs on the last set of series coils (those that are always left in), so that the final speed can be adjusted to suit the length of the trunks, &c.

DECK WINCHES.

These machines have been designed so as to be similar in operation to a steam winch, it being understood that the gear is used by unskilled labour, and the treatment meted out is not of the gentlest nature. They have, therefore, to be not only foolproof, but rogue proof. The system used takes all consideration as regards the safety of the electrical equipment from the operator's hands, the control gear protecting the plant no matter how it is operated. The motor is series wound with limiting shunts. The latter protects the machine from getting up to a dangerous speed when running light. The master controller is mounted on top of the motor, and the contactor controller (which is ventilated) is fitted in a deck house, thus allowing attention or examination in all weathers. The parts of the control gear which are on deck are made thoroughly watertight, and consist of a barrel reverser, brake lever switch and isolator.

The method of operation is as follows :—

The control gear is operated by a single hand wheel, and the foot brake is arranged so that it can be operated at will by the man, whether the controller is in the " full on " position or not. If the man required to tease the motor for fixing slings, &c., he puts the controller on to the first step. This step is a slow speed one, and he can obtain his slow speed, lowering or hoisting, by teasing on his foot brake. The second step gives half speed with full load, and, of course, proportionately quicker speeds with lighter loads. If the man uses his foot brake on this step, the controller is returned to the " off " position and the motor is stopped. If he lifts his foot brake the motor starts up again.

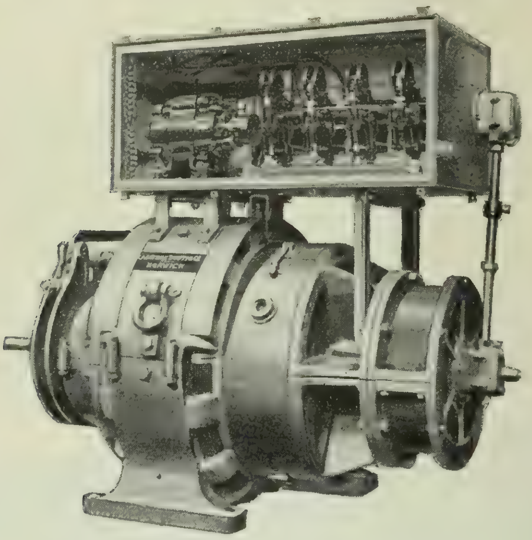


Fig. 2.—Controller Gear of Steering Gear.

The third step gives full speed on the motor—that is, the machine being series wound, it gives speed in accordance with the torque. The foot brake operates on this step in a similar manner to that on the second step. If the winch is required to run in the opposite direction, the controller is simply reversed, there being three steps on the reverse position also.

No harm is done if the operator goes straight from the " off " position to the third step, or if he goes from the third step in one diretion to the third step in the other, as the control gear simply follows up, starting the motor gradually. If the controller is left in the " full on " position and the voltage fails, the controller must be returned to the " off " position before it can be operated again.

A time overload is arranged to return the controller to the off position, but the controller again starts up the motor until the load again acts. This arrangement has the advantage that when using the winch for warping or when the load catches an obstruction the winch stops, but starts again without the operator having to come to the off position, and is therefore automatic.

The motor is fitted with a centrifugal brake to prevent excessive speeds in light loads, and is further provided with a magnetic brake, which holds the load when the controller is switched to the " off " position.

In place of a mechanical change speed gear, a specially-wound motor is used, the controller being fitted with a patented discriminating device which enables the speed to be increased in proportion to the load on the hook. For example, if the speed at 10 tons is 100 ft. per minute, the device will be set so that 5 tons is raised at 200 ft. per minute, taking the same horse-power for either loads. The above discriminating device comes into operation automatically. The speed cannot be increased if the load on the hook exceeds a predetermined amount, and it actually prevents an overload.

Steering Gear Equipment.

A special wound motor has been designed for this duty, The machine is series wound, but has two distinct windings, one having a great many turns of small conductor and the other a few turns of heavy winding.

These coils are connected in series, with also a certain amount of line resistance, by the first starting contact of the controller. It will be observed that, owing to the heavy excitation of the auxiliary series, the motor will start up with a very small current ; therefore, for slight adjustments of helm, the motor runs either in one direction or the other very slowly. If more helm is required, the resistance is gradually cut out and the motor speeds up. For maximum helm the resistance is cut out altogether, and the auxiliary series shorted, thus giving maximum speed.

The main motor, which is connected to the rudder quadrant through a gearing of 500 to 1 ratio, is electrically operated from the bridge, an electric telemotor system being used, which work on the Wheatstone bridge principle. A small servo-motor (whose field magnets act as the galvanometer of the Wheatstone bridge) operates the hunting gear in the controller, which is mounted on top of the main motor. The bridge rheostat and main motor rheostat forms the legs of the Wheatstone. The armature of the telemotor has practically a constant current flowing through it, and the strength and direction of the current passing through its field windings depends on the relative positions of the bridge and rudder rheostats. If the rheostats are in a balanced position, there will be no current flowing in the servo-motor field, and consequently the machine will be stationary. If the bridge wheel is now turned, the telemotor will rotate, its direction of rotation depending on which way the steering wheel has been turned. The telemotor will run until a balance has been restored between the two rheostats.

The telemotor also operates the master controller through one member of a mechanical differential gear. This starts up the main motor and keeps it running until the other member of the differential (which is driven by the main motor) switches it off again. The main motor on being switched off is at once brought to rest by a solenoid brake, and the rudder remains stationary until another fresh movement is made on the steering wheel. The movement of the rudder is thus exactly proportional to the movement of the wheel. It is obvious (when one considers the number of reversals which take place with steering gear) that the contactors for reversing and starting must be able to stand up to the work. From observations under actual conditions, it has been seen that as many as 300 reversals have taken place in an hour for keeping course, and this has been maintained for days together with most satisfactory results. The skeleton drawing (Fig. 3) readily shows the principle under which this equipment works.

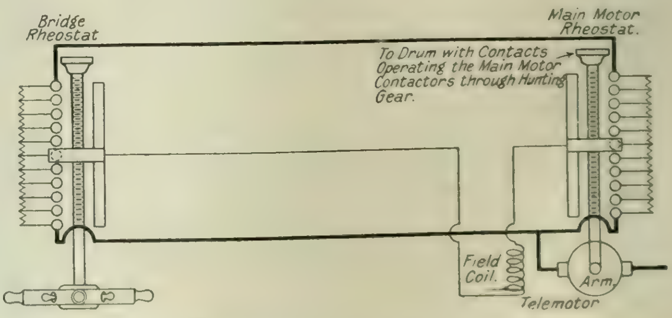

Bridge Rheostat
Main Motor Rheostat.
To Drum with Contacts Operating the Main Motor Contactors through Hunting Gear.
Field Coil.
Arm.
Telemotor

Fig. 3.—Diagram of Electric Telemotor Gear.

The Cost Question.

The initial cost of electrical machinery is often set up against that for steam with adverse results. When the cost and maintenance is considered on a three-year basis, there is no doubt the advantage is on the electrical side, and, judging by the number of ships now being fitted with all auxiliary gear electrically driven, the electrical engineer must feel that he has overcome the prejudice which undoubtedly existed in the past.

The Electrical Equipment of Fowey Harbour.

Handling China Clay by Modern Methods.

THE majority of the articles which we publish in this special issue of The Electrician deal with the application of electricity to some form of operation carried out on the ship itself, but there is also a phase in the employment of electricity in marine practice to which attention must be called. This phase may be well exemplified by describing an interesting installation of electrically driven conveying machinery and handling gear which has been in use for some time at the Great Western Railway's harbour at Fowey, Cornwall. By the methods there employed it has been possible to cut down man handling of material and so to reduce labour costs, while at the same time very large quantities of material can be more expeditiously dealt with in a given time.

Cornwall and China Clay.

The material handled electrically at Fowey is china clay. This material has for more than 150 years been one of Cornwall's chief exports, and to-day is put to many and varied uses for pottery work, as a dilutant and in the manufacture of paper and textiles. It is also used to a certain extent as an adulterant in foods of various kinds, though in itself it possesses but a small food value.

At Fowey both china clay and china stone are dealt with, the latter product still retaining its crystalline form and constituents of granite, although the felspar in it has been decomposed into clay. In the china clay itself all except the decomposed felspar has disappeared. These two Cornish products are shipped from Fowey to many European countries and to the United States. In connection with this trade the Great Western Railway act as carriers and handlers at Fowey, the clay and stone being brought down by them to the harbour over the Lostwithiel and Fowey railway from Lostwithiel or from St. Blazey over one of the old Cornwall mineral roads, which has now been modernised. These two railways together form the Fowey loop. To enable this to be done and to utilise the facilities of the harbour to the greatest extent it was necessary some years ago to build a special railway yard above Fowey station. This yard was partly hewn out of the rock and partly built up from the bed of Caffer-Mill-Pill which has been filled in. Three timber jetties were here built out into the river and were put into operation in 1874, while a fourth was added in 1890. Above the fourth jetty the river takes a bend westward and in the deep water harbour thus formed three more jetties were built in 1896. At the present time yet another jetty is being constructed, as will be seen in more detail below.

All these jetties, as will appear in the course of the article are practically entirely used for the export of china clay from the china clay beds in the neighbourhood and for the import of coal and timber, both of which commodities are largely used in the preparation of this material and in the manufacture of casks for transporting the higher grade clay to European and American countries.

The Growth of the Trade.

It is interesting to note that the tonnage arriving at the port of Fowey for these purposes since the time the jetties were first put into use has steadily expanded, and that the size of the ships has also increased, so that at the present time owing to the improvements made by the Harbour Commissioners in recent years it is possible for vessels of 400 ft. in length and 50 ft. beam, with a net register of 3,000 tons and carrying capacity of 7,000 tons of clay to work into and out of the Fowey Harbour.

Older Handling Methods.

The first four jetties were, however, only designed for vessels and steamers up to 300 tons register, and are still in fact used for vessels not exceeding this tonnage. Here the clay in casks and bags is loaded into the vessels by means of a steam crane at each jetty head while clay in bulk and china stone is tipped down a chute placed beside the crane. Each chute is telescopic so that a steamer not exceeding 300 tons register may be loaded at all states of the tide. The increasing demand for china clay and the consequent desirability of decreasing the handling and trans-shipping as much as possible, has, however, in recent years led to a reduction in the number of vessels of this size working into the port and an increasing tendency on the part of American traders especially to bring in large steamers which can not only carry a larger quantity of material but are suitable for working long voyages without trans-shipping being necessary. The main result of this particular expansion is however that the old jetties are of insufficient height to allow clay to be tipped into such ships except at low tide, and in consequence all the clay and stone has had to be shipped by crane, thus increasing the time taken to load the vessel and adding to the cost of handling

It should be mentioned that by means of the older system of working steamers and vessels not exceeding 300 tons register can be loaded by these methods at an average speed of from 500 to 550 tons of clay in ten working hours. This rate takes into account all loss of time in marshalling wagons, shifting the vessel for trimming purposes and for other similar work either on the quay side or in the hold. When tipping is being carried out uninterruptedly a rate of 120 tons per hour for small vessels is reached. But in the case of loading larger steamers the conditions mentioned above have cut down the amount of clay which can be loaded in a ten-hour shift to 150 tons. The necessity for modernising these somewhat rough and ready methods therefore became obvious.

Methods of Modernisation.

These considerations and the equal necessity of increasing the facilities of the port in order that its trade might not suffer led the Great Western Railway some 12 years ago to provide means for continuously loading any ship which could enter the port, with the result that one of the jetties was fitted with an electrically operated conveyor plant designed by the chief electrical engineer of the company, Mr. Roger T. Smith, and a number of electrically driven capstans were placed about the yard to replace the older system of horse haulage.

This plant, of which we give further details below, has been so successful that when in 1912 it was decided to build a special jetty higher up the river a very extensive conveying plant was designed, in the working of which electricity will be exclusively used. The outbreak of war stopped the completion of this improvement, but since the Armistice operations have been going ahead, and it is hoped before long that the work will be completed, and that the facilities of the port will be thereby considerably increased. There seem no reason why this should not be so. We also give below certain details of this plant. Before, however, going into particulars of the old and new conveying plant we may call attention to some of the more general features of the electrical equipment at Fowey.

The Generating Station.

All the electrical energy required is supplied from a generating station, views of which are given in Figs. 1 and 2. This was erected in 1909 to supply the electrical requirements of the port, which at that time consisted mainly of lighting, though shortly afterwards the equipment of No 4 jetty with an electrical conveyor and the elimination of horse operation of trucks by the installation of electric capstans, to which we have referred, was undertaken.

The generating plant now installed consists of four 38·5 kw. direct-current sets, with Willans' two-cylinder engines and Westminster Engineering Company's undertype dynamos. It is proposed to replace two of these small sets by two 170 kw. Bellis sets to provide the necessary energy for the additional electrical plant which will be installed in connection with the new jetty. The whole of the lighting and power at Fowey is operated on the continuous-current two-wire system at 220 volts. With the increase in the amount of plant installed it was at one time thought advisable to make arrangements for changing over the system to a three-wire system at 440 volts across the outers. This arrangement has been abandoned owing to increased capital costs which, it is considered, outweigh any advantages that might be obtained by the use of the higher voltage. It should be pointed out that the distances to be covered are not by any means great, and that the "copper" has been worked out, and to a large extent installed on the lower voltage.

The Coal Question.

As regards steam raising, coal is brought to the station over a special siding, which is connected to the railway by the somewhat excessive gradient of 1 in 8. The trucks are pushed up this incline by ordinary locomotives. The coal is unloaded from the wagons on to a special dump or may be passed direct into the boiler house through a corrugated iron shutter door.

It is interesting to note that this is one of the stations where Mr. Roger T. Smith has for some years adopted the practice of using anthracite grains for steam-raising purposes. There were two considerations which decided him to employ this form of fuel. In the first place he was able at the time the experiment was first made to obtain this fuel on good terms because there was only a small amount available and that was not being used industrially. The price paid inclusive of carriage was, therefore, only 4s. 3d. a ton. At the same time the use of this fuel enabled smokeless working to be obtained, and this at Fowey especially was a great advantage, owing to the close proximity of the station to the quay and the necessity of keeping china clay free from all impurities, especially black impurities, such as soot.

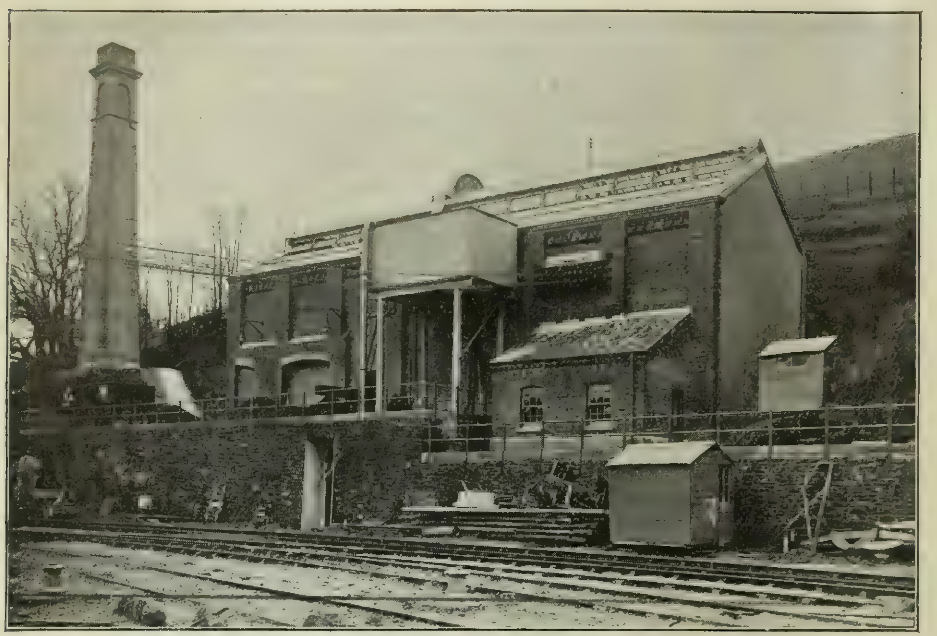


Fig. 1.—Exterior of Electric Power Station.

Another interesting financial point is that the generating sets, the main steam pipe work and two of the boilers were taken out of the company's Cardiff station at the time when it was decided to take the energy for working the electrical machinery in the latter town from the Corporation mains so that it was possible to erect the station at a very small capital expenditure.

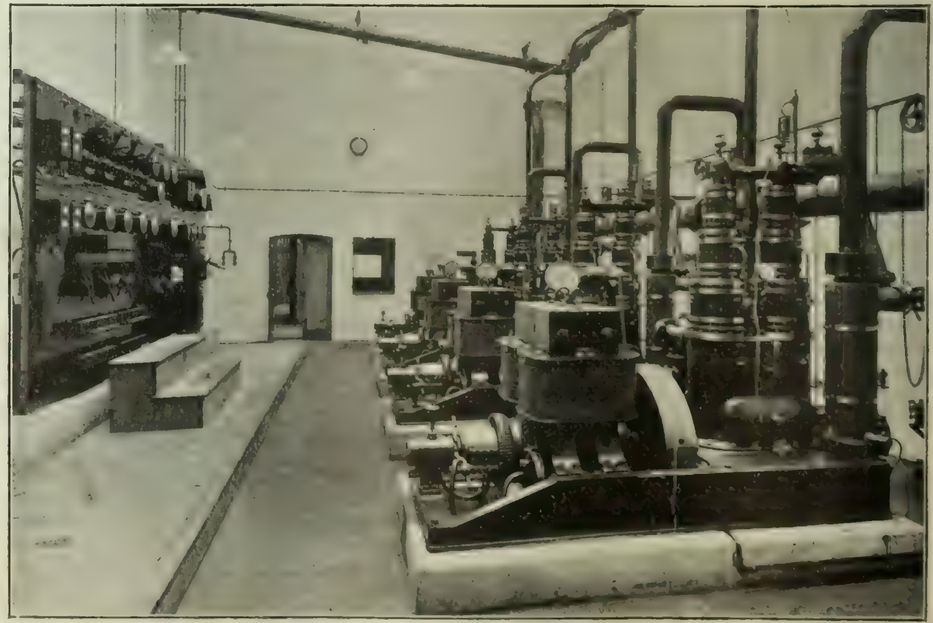


Fig. 2.—Interior of Electric Power Station.

Steam-Raising Plant.

The steam-raising plant consists of two 300 h.p. Babcock & Wilcox land type boilers. Each boiler is fitted with the Meldrum forced draught system. Worthington feed pumps with a capacity of 50 gallons per minute are provided for supplying these boilers, while all the coal used is weighed on a Pooley weighing machine for record purposes. Feed water is supplied from a 100,000-gallon tank, near Fowey Railway Station, whence it is pumped to a tank above the generating station by an electrically-driven Greenwood & Batley pump. This set is fitted with Bertram Thomas automatic gear to enable a proper level in the feed tank to be kept. This tank supplies not only the steam-raising plant in the station, but the boilers of the steam cranes which are still in use on some of the jetties.

A Körting condenser with a capacity of 3,000 lb. per hour is provided for each generating set, the necessary cooling water being obtained from the harbour by an electrically-driven pump installed on No. 2 jetty. This pump has a capacity of 500 gallons per minute. The condensing plant works normally at a vacuum of 29 in., an automatic valve being provided to change over to the atmosphere if the condenser should fail at any time.

A storage battery consisting of 113 Tudor cells with a capacity of 250 ampere-hours at the 10-hour discharge rate is provided for use in connection with the lighting and power work and to provide a current for the "week-end" lighting circuits. This battery has been in successful operation for over six years and has effected a saving of 10 per cent. in the coal consumed, owing to it being possible to close down the station altogether at week-ends and holiday times.

The various power and lighting circuits supplied from the station and the generating sets are controlled from a Spagnoletti board which possesses no special features. A small motor-generator set is installed for charging all the secondary batteries employed in the Western Division in the Great Western Railway in connection with the signalling track circuits.

The Capstan Installation.

We mentioned above that for some years the haulage of the trucks to the jetty heads and their various movements in the yard which could not well be effected by shunting locomotives, were performed by horses. In 1910, these horses were replaced by a very complete installation of Clyde electric capstans, the principal feature of which, as is well knonw to readers of The Electrician, consists in the use of a loose capstan barrel to which a flexible stranded steel wire rope is rigidly fixed. This barrel is normally free to rotate by itself, but it can be connected through gearing to an electric motor placed in a special chamber underneath by means of a clutch which is worked by a hand lever on the capstan level. The same movement of the lever which puts in the clutch also closes the motor circuit and enables the load to be hauled without any slip. In this way all the power used in the barrel is expended in hauling, and as a result the same engine power can be used for working twice as many Clyde-type capstans as the ordinary slipping rope capstan. At present there are 17 Clyde capstans installed, eight of which work at 150 ft. per min., and nine at 200 ft. per min. These capstans are installed at various strategical points about the yard, and are used in bringing up trucks of china clay to all the jetties which are now in operation. The motors operating them are erected in concrete chambers 9 in. thick, but these have not been altogether successful in keeping the water out, and in future cast-iron boxes will be used. Besides actually hauling the wagons these capstans are also employed for operating turn-tables, the rope being taken over a special stud on the latter. This has meant a great saving of labour.

For supplying current from the generating station to the various motors and lighting points overhead transmission is used throughout, as shown in Fig. 3, 32 ft. wooden poles embedded in concrete being employed. As far as lighting is concerned, arc lamps were extensively used before the war, but these have now been replaced by half-watt lamps, 37 of which are used about the yard, so that the clay can be loaded at all hours of the day and night. In addition, Fowey railway station and the signal boxes at the railway station and in the yard are also electrically lighted. The signal boxes are provided with electric hot plates, so that the signalmen can obtain a hot meal at any time.

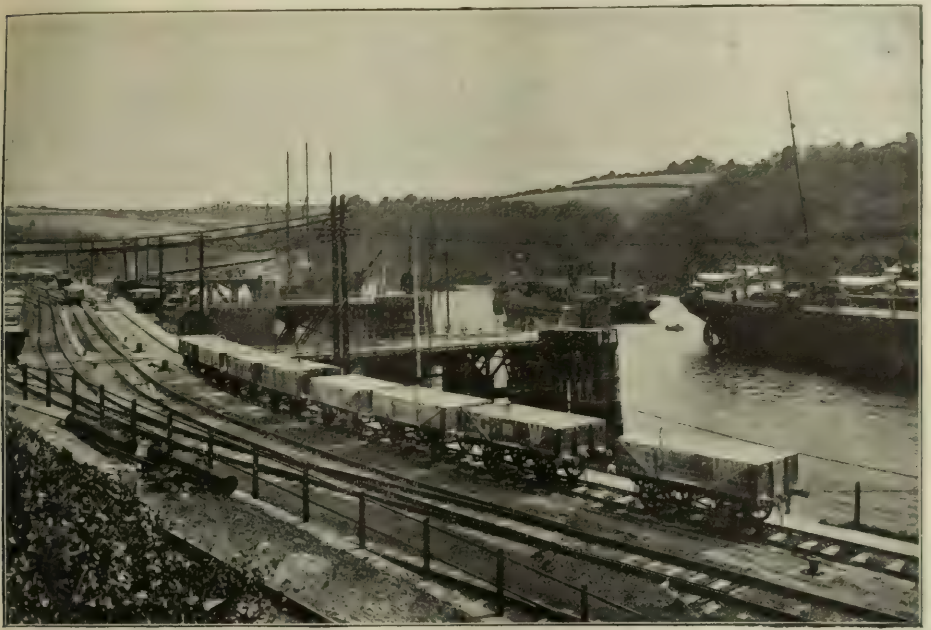


Fig. 3.—General View of Harbour.

Jetty No. 4.

In describing the electrical gear which is at present installed at Fowey, attention may be concentrated on the equipment of Jetty No. 4. The china clay loaded on this jetty is handled entirely electrically with the sole exception that the tipping table, which discharges the contents of the trucks on to the conveyor, is hydraulically operated. The electrical equipment on this jetty consists of a 2½-ton Muskers' luffing jib crane which is used for loading four ½-ton casks at one lift from the wagons to the jetty, for slewing a similar load over the hatch of the ship and lowering it into the hold. The use of this crane has considerably decreased the time taken in making bulkheads by walls of casks to separate different parcels of bulk clay.

The Conveying Plant.

The conveying plant, which was specially designed by Mr. Roger T. Smith, consists of a tipping frame and hopper, into which the hydraulic tipping table mentioned above discharges the contents of the wagons. This hopper is below the siding level and its spout is fitted with a valve which regulates the flow of the clay on to an endless conveyor belt. This belt, which is made of eight-ply cotton canvas, is 350 ft. long and 36 in. wide, and is troughed by means of inclined rollers. It runs on floating pulleys held in position by guides, and is automatically kept in tension by a weight of 1,000 lb. Its operating speed is between 120 ft. and 150 ft. per minute, and immediately after a truck has been tipped it invariably carries a nearly continuous stream of clay to the end of the jetty. As will be seen from our illustration (Fig. 4) the belt is protected both above and at the sides from the effects of the weather. This is important not only for its own good, but because china clay becomes sticky and difficult to deal with in wet weather. The conveyor is hinged at the shore end of the jetty just above the jetty level, the free end being hung from steel ropes which pass over sheaves fixed at the top of a lattice steel tower, thus enabling the head to be raised or lowered by means of a winch, and so to be run in any position between the horizontal and a height 35 ft. above the quay decking. This arrangement enables any ship up to a capacity of 3,000 tons register to be loaded at all states of the tide. A steel chute is hung from the end of the conveyor, the slope of which can be adjusted by ropes.

The end of this chute is furnished with a trimming nose which can be swung through a right angle in the vertical plane and can be slewed completely round the circle in the horizontal plane, being easily guided by two hand ropes fixed at the top of the nose. With all ships and vessels the nose can be set to deliver to any part of the hold, so that the labour of hand trimming and the time thus occupied is almost entirely saved. By altering the slope of the conveyor the head of the chute and the position and slope of the trimming nose together, the greater part of the hold of every ship and vessel now entering the port can be reached at all states of the tide.

This conveyor was designed to ship bulk clay at an average rate of 110 tons per hour and a maximum rate of 200 tons per hour. It should be pointed out that the time of belt working depends on three factors. First the number of different parcels of clay, each of which must be carefully separated from its neighbour. Secondly, the rate at which wagons can be brought up to be tipped; and thirdly, the number of hatches into which the clay has to be shot. In order to save a tide 360 tons has been shipped in an hour.

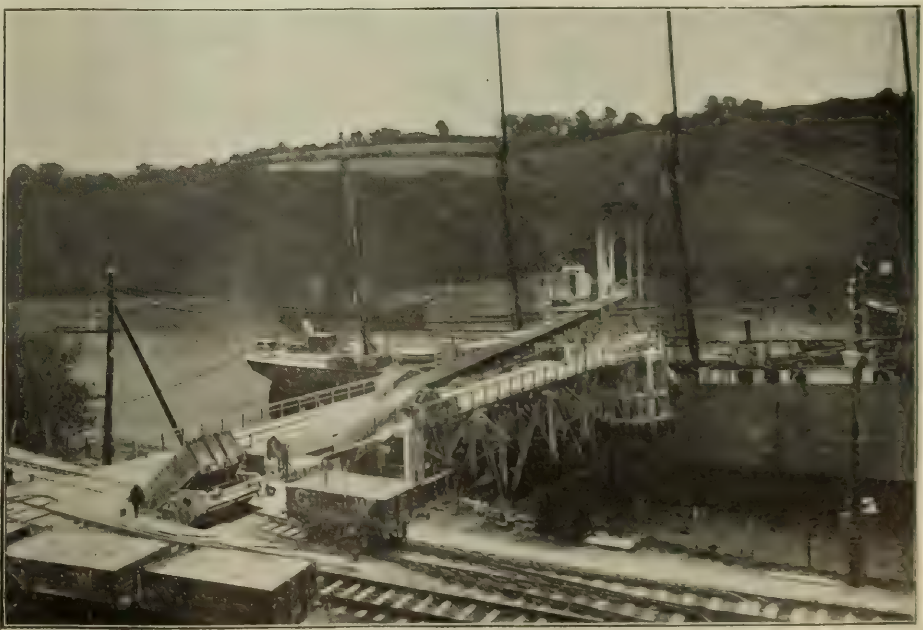


Fig. 4.—View showing Conveyor and Tipping Arrangements.

The Conveyor Operation.

The conveyor is driven by a 35-h.p. Laurence Scott motor, working at 220 volts and driving the band through cast steel gearing. The operation of the chute just mentioned above is effected by a small motor placed in a special house just below the chute.

The mechanical equipment in connection with this conveying plant was supplied by Messrs. Spencer & Company, of Melksham, while the principal contractors responsible for the electrical equipment have been mentioned in the body of the article.

Jetty No. 8.

The results obtained with the electrical equipment we have just described have been so satisfactory and the necessity for the expansion of the facilities for handling china clay at Fowey so great as to have led the directors of the Great Western Railway before the war to decide on the erection and electrical equipment of a further jetty known as Jetty No. 8. This jetty, which is situated further up the river than the others at a place called Carn Point where the bend in the river makes deep water available, is designed for dealing with the steamers and vessels of the largest size than are able to enter Fowey Harbour. Work on this jetty was commenced in 1912 and would have been completed ere now but for the war, which necessitated a temporary stoppage in its construction. After the Armistice, however, work was resumed, and it is hoped that it will be completed early next year. The general layout of the jetty and of the conveying machinery connected with it for the transportation of china clay is shown in the accompanying drawings (Figs. 5 and 6).

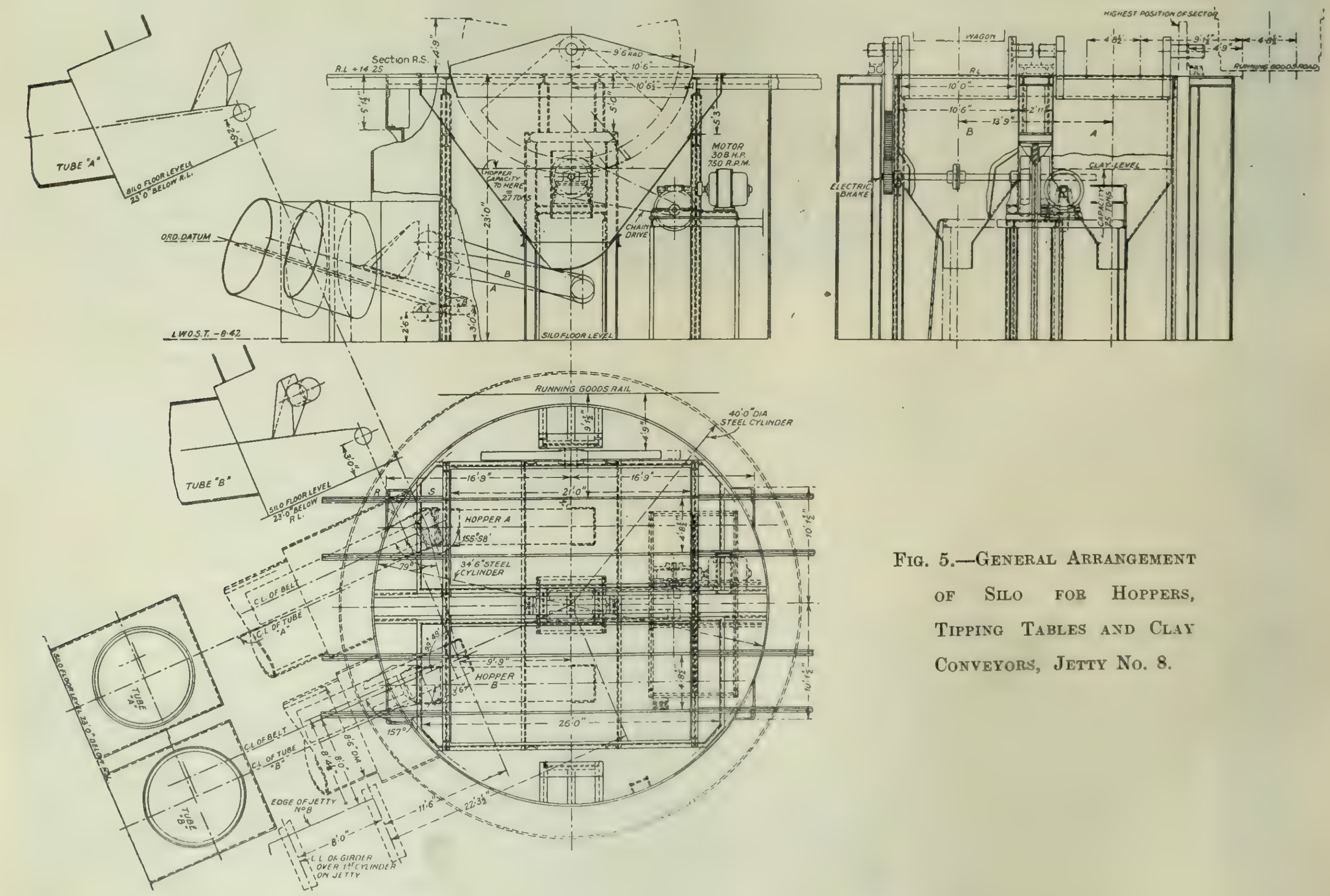


Fig. 5.—General Arrangement of Silo for Hoppers, Tipping Tables and Clay Conveyors, Jetty No. 8.

Generally speaking, this equipment comprises a double action wagon tipping table together with hoppers, conveyors in duplicate and a steel silo of special construction. In more detail from the upper end of two tubes in this silo a steel structure carries duplicate troughed inclined conveyors from below two feeding conveyors in the silo to a steel tower on the jetty. From either side of this steel tower a steel structure extends along the jetty, each wing of which is equipped with a horizontal distributing conveyor feeding into a portable hinged conveyor with swinging chute and trimming nose. This combination is designed for delivering bulk china clay either simultaneously into the two holds of one vessel or into one hold of each of two vessels moored alongside the jetty. The clay tipped into each hopper is delivered to its corresponding inclined belt by a plate conveyor. The inclined belts deliver by short cross-belts through a four-way valve on to either of two horizontal belts running parallel with and above the jetty. A travelling tipper, over which each horizontal belt runs, delivers the clay through the side of the galleries enclosing both horizontal belts on to one of two hinged belts carried on a steel portal structure travelling on the jetty. Each hinged belt is provided with a hinged chute, which chute is furnished with a trimming nose, the combination being suitable for delivering clay into any part of the holds of the vessels at any state of the tide. The whole of this combination of work is electrically driven. The number of motors in use for this purpose being 16.

Automatic Switchgear.

With the exception of the two tipping frame motors which have their own switchgear fixed above the silo, each motor is provided with automatic switchgear mounted on a switchboard within the central tower. This is controlled by electric interlocks to secure starting and stopping in proper sequence. The arrangement is shown in Fig. 7. The electric motors which operate the portal structure are controlled from switchgear in a motor house in the portal itself. When the clay is tipped into the hopper it is carried continuously by gravity to the plate conveyor passing beneath each hopper mouth. The capacity of each hopper is 550 cubic ft., and the sides are sloped at such an angle that the clay when dry is carried on to the hopper by gravity. It should be noted that all the rivets used in the construction of this hopper are countersunk, so that when the clay is damp it can be easily cleaned off the sides of the hopper by an ordinary scraper. The mouth of each hopper is provided with a plate valve working between a double row of wheels and operated by means of a pinion gearing from a capstan hand wheel. This wheel is so arranged that the flow of clay from the plate conveyor can be easily regulated by a man standing between each hopper.

The Tipping Table.

The tipping table is designed to be capable of completely emptying the contents of a 12-ton wagon and is large enough to take wagons with a wheel base up to 9 ft. 6 in. It is hung centrally and when fully tipped makes an angle of 50 deg. with the horizontal. It is held horizontally by means of two locking bolts worked by a lever. The wagon is secured to the tipping table by one of two pairs of hooked rods depending on which way the tipping table is to be revolved.

Each pair of hooks is carried on a shaft worked by a hand lever, and the weight of the hooks is counter-balanced, so that they are in a stable position both when right down and right up, holding the wagon in position. Each lever moving the hook-shaft is mechanically locked with the lever working the locking bolts and with a switch which opens or closes the electrical circuit, so that it is impossible for the tipping table to be moved unless the bolts are withdrawn and the wagon held in position, because the switch cannot be closed unless these conditions are fulfilled.

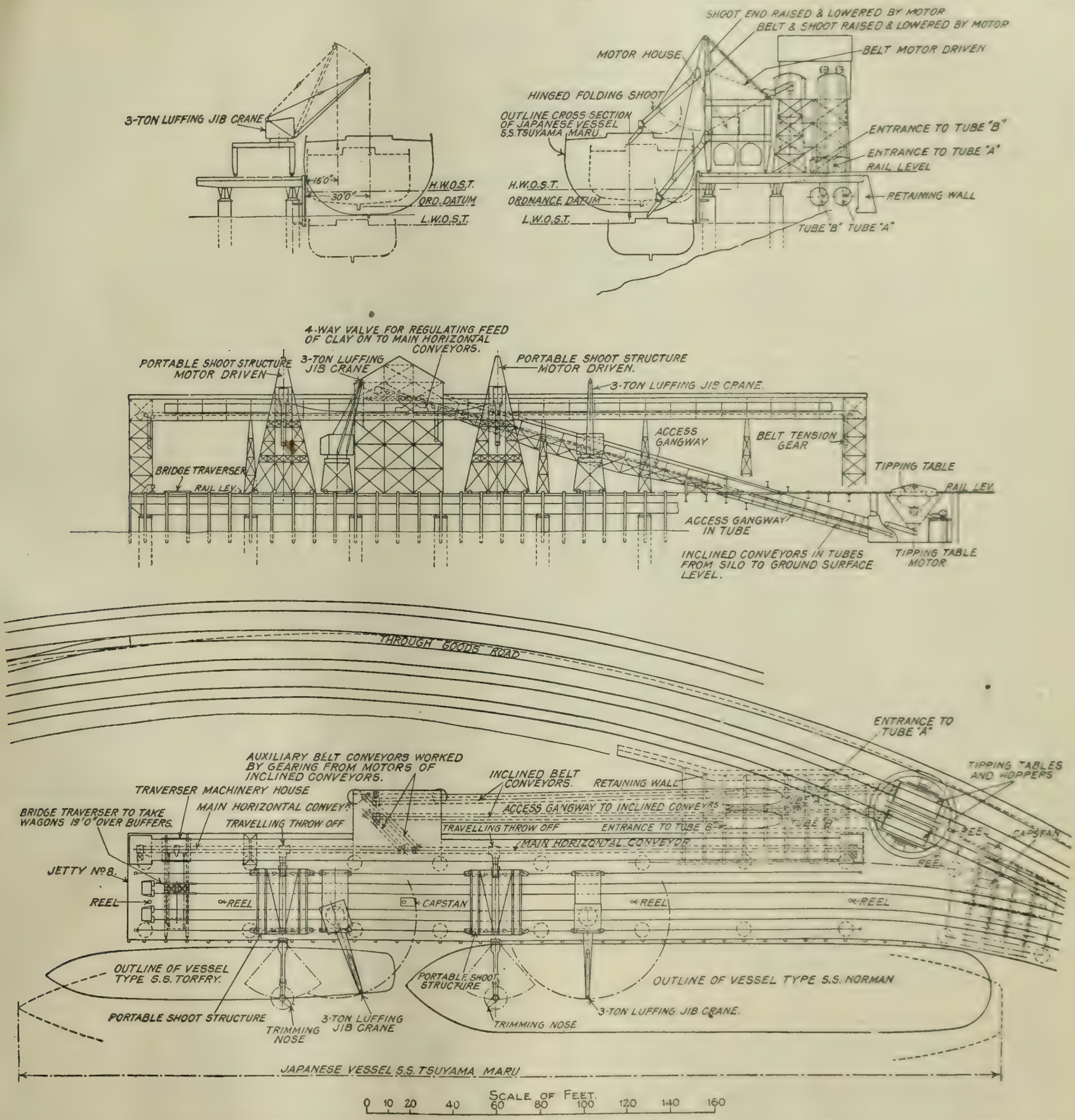


Fig. 6.—Plan and Elevations showing General Arrangement of Silo, Tipping Tables, Conveyors and Cranes, Carne Point, Jetty No. 8.

The table is driven by a 30-h.p. motor running at a speed of 750 revs. per min., and it takes 6 sec. to raise a 12-ton empty wagon from its extreme position to the horizontal.

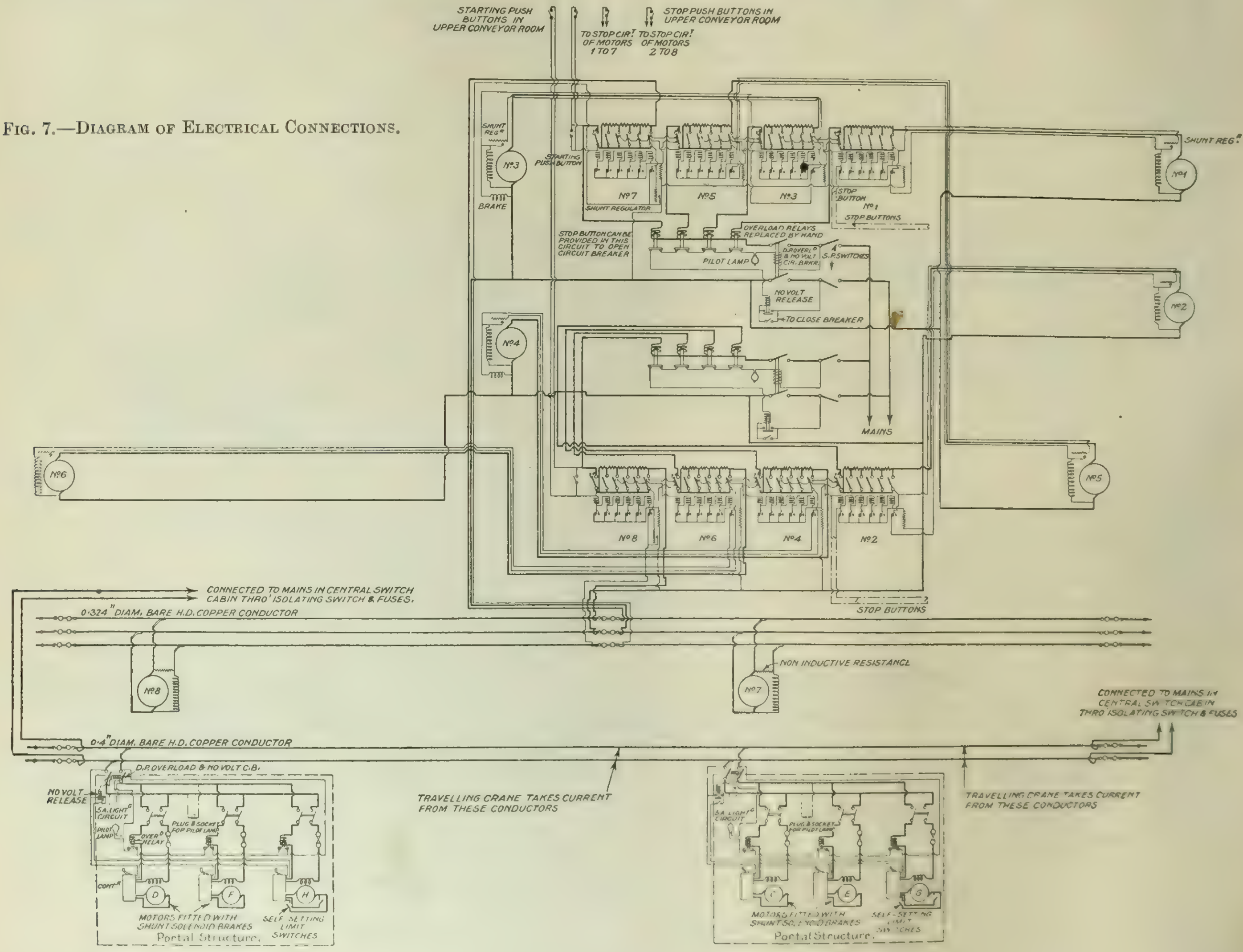
The Plate Conveyor and Inclined Belts.

The two inclined conveyor belts are fed with clay from the mouth of the corresponding hopper by a push plate conveyor constructed of overlapping steel plates, each of which is driven by an electric motor through worm gearing, and the speed of which can be altered by means of a shunt regulator. These plate conveyors are made of sufficient strength to withstand the shock of lumps of clay falling upon them when a wagon is tipped into the empty hopper, supposing the valve at the hopper mouth to be fully opened, and are also so arranged to prevent clay being spilled over the side of the conveyor.

The inclined conveyors each comprise a troughed belt inclined at an angle of 17 deg. with the horizontal, and are each driven by a shunt-wound motor through worm gearing. Each belt is carried by a steel bridge between the tower on Jetty No. 8 mentioned above and jetty rail level and communicates with the silo through two tubular extensions. The belts used are of eight-ply cotton, similar to those described above in connection with Jetty No. 4, and have an ultimate tensile strength of 4 tons. The working face of each belt is troughed by a system of inclined cast-iron rollers bushed with gunmetal, running on steel spindles and lubricated by means of Stauffer grease lubricators. The maximum rate of working each tipping table has been got out on the basis of one 10-ton wagon being tipped into each hopper every 2½ minutes. This means a maximum delivery of clay on to each conveyor of 240 tons per hour.

Cross Conveyor Belts.

The cross conveyor belts are driven through suitable gearing by the same motor which drives the corresponding inclined conveyor belt, the gearing being so arranged that the speed is slightly in excess of the inclined belt, so that no crowding of the clay takes place. At the delivery end of these belts a four-way hand-operated valve is provided, so that each inclined conveyor can deliver on to either one or the other horizontal conveyors, and thus allow a maximum of interchangeability. Each of the main horizontal conveyor belts is driven by a shunt-wound motor through worm gearing, the motor being provided with a field regulator, which enables a regulation of 20 per cent. up and 15 per cent. down from the normal speed to be obtained independently of the contactor switchgear. The belts are troughed in the manner described above, and are also fitted with travelling throw-off gear for delivering the clay on to the horizontal conveyor belt in the portal travelling structure. This throw-off gear is operated by hand.


STARTING PUSH BUTTONS IN UPPER CONVEYOR ROOM
TO STOP CIR.T OF MOTORS 1 TO 7
TO STOP CIR.T OF MOTORS 2 TO 8
STOP PUSH BUTTONS IN UPPER CONVEYOR ROOM
SHUNT REG.R
No.3
BRAKE
STARTING PUSH BUTTON
No.7
No.5
No.3
SHUNT REGULATOR
STOP BUTTON
No.1
STOP BUTTONS
SHUNT REG.R
No.1
STOP BUTTON CAN BE PROVIDED IN THIS CIRCUIT TO OPEN CIRCUIT BREAKER
OVERLOAD RELAYS REPLACED BY HAND
PILOT LAMP
D.P. OVERL.D & NO VOLT CIR. BRKR.
S.P. SWITCHES
NO VOLT RELEASE
TO CLOSE BREAKER
No.2
No.4
MAINS
No.6
No.5
No.8
No.6
No.4
No.2
CONNECTED TO MAINS IN CENTRAL SWITCH CABIN THRO' ISOLATING SWITCH & FUSES.
0·324" DIAM. BARE H.D. COPPER CONDUCTOR
STOP BUTTONS
No.8
NON INDUCTIVE RESISTANCE
No.7
CONNECTED TO MAINS IN CENTRAL SWITCH CABIN THRO' ISOLATING SWITCH & FUSES
0·4" DIAM. BARE H.D. COPPER CONDUCTOR
D.P. OVERLOAD & NO VOLT C.B.
NO VOLT RELEASE
S.A. LIGHT.G CIRCUIT
PILOT LAMP
OVER.D RELAY
PLUG & SOCKET FOR PILOT LAMP
CONT.R
D
F
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MOTORS FITTED WITH SHUNT SOLENOID BRAKES
SELF SETTING LIMIT SWITCHES
Portal Structure.
TRAVELLING CRANE TAKES CURRENT FROM THESE CONDUCTORS
S.A. LIGHT.G CIRCUIT
PLUG & SOCKET FOR PILOT LAMP
C
E
G
MOTORS FITTED WITH SHUNT SOLENOID BRAKES
SELF-SETTING LIMIT SWITCHES
Portal Structure.
TRAVELLING CRANE TAKES CURRENT FROM THESE CONDUCTORS

Fig. 7.—Diagram of Electrical Connections.

The Travelling Portal Structure.

A telescopic arrangement is provided for connecting the spout of the throw-off gear to a spout on the travelling portal structure, so as to secure continuous delivery on to the hinged belts, which are carried on the portal structure. The effect of this latter arrangement is to allow china clay to be delivered into any part of the hold of the vessel irrespective of its position alongside the quay, the portal being driven by a special series motor at a maximum speed of 20 ft. per minute. Current for the motors in the portal structure is supplied from two trolley wires carried below the horizontal conveyor galleries. Each conveyor belt on the portal structure is driven by a shunt-wound motor through worm gearing, each motor being fitted with a shunt field regulator, which is fixed on the contactor switchboard in the switch cabin.

A non-inductive resistance of the same value as that of the shunt field regulator is fitted across the shunt field winding of the belt motors as a safety path for any dangerously high rise of voltage that might occur in the field circuits owing to possible imperfect contact between shunt field collector and the trolley wire. Each belt hinged at one end is capable of being raised and lowered at the other end, and of delivering its clay into a hinged chute similar to that described in connection with Jetty No. 4. The head of each conveyor, together with the head of the chute with its trimming hose, can be raised or lowered by means of a reversible series-wound motor fitted in the motor house of the portal structure. The end of each chute is controlled just above the chute hinge by a steel rope, which is also driven by a series-wound motor, enabling it to swing through a total horizontal angle of about 80 deg.

The whole of this conveyor system is designed to deal with 480 tons of china clay per hour, or 240 tons on each half of the system, under all conditions of wind and weather. As is the case on Jetty No. 4, tightening gear of the automatic type is provided on all conveyors. The upper part of the central tower mentioned above is enclosed with corrugated galvanised sheeting to provide a room, whence easy access to all working parts of the conveyors is obtainable, and underneath this room is a cabin containing the contactor switchgear which controls the conveyor belts and motors.

The table on the next page summarises the electrical motors provided for operating this equipment. All motors work on the direct-current system at 220 volts.

Control Gear.

The control gear is of special interest. Each series of motors is started and stopped by push-button switches in the tower conveyor room above the switch cabin, the push buttons being so placed that a view of the tipping tables can be obtained when operating them. Each series of conveyor belt motors is started in the order shown on the diagram, and is stopped in the reverse order—*i.e.*, each motor is started by six contactor switches, the closing of the third contactor for each motor also closing the first contactor for the motors in the next order of sequence. Each motor of a sequence is provided

Table Showing Motors Employed on Conveyor System on Jetty No. 8, Fowey Harbour.

No. in use.	Employment.	Rating.	Winding.	Direction.	Approx. H.P.	Protection.
2	Tipping tables	Intermittent	Series	Reversible	30	Totally enclosed.
2	Plate conveyors	Continuous	Shunt	Single	7½	Totally enclosed.
2	Inclined conveyors and cross conveyors	Continuous	Shunt	Single	40	Protected.
2	Horizontal conveyor	Continuous	Shunt	Single	30	Protected.
2	Hinged conveyor	Continuous	Shunt	Single	15	Protected.
2	Raising and lowering hinged conveyor and shoot	Intermittent	Series	Reversible	7½	Protected.
2	Raising and lowering shoot end	Intermittent	Series	Reversible	7½	Protected.
2	Travelling portal structures	Intermittent	Series	Reversible	7½	Protected.

with a shunt-regulating resistance, so that its speed may be increased by 20 per cent. from the rated speed or decreased by 15 per cent. Each sequence of four shunt motors is protected by one double-pole overload circuit-breaker, with a separate overload coil for each motor, which is adjusted to operate at an overload of 150 per cent. in any coil of the sequence of motors, thereby stopping the whole four motors. When a relay opens on overload it has to be replaced by hand. This overload circuit-breaker is also provided with a no-volt coil, which trips the circuit-breaker when there are "no volts" on the switchboard. Provision is made for effecting a release at various points by means of a push-button circuit in case of accident or other emergency. In addition to this, each motor can be started and stopped from the switchboard independently of any other motor. It should be noted that the motors and starting gear, which have all been provided by Messrs. Laurence Scott & Company, are fitted with resistances made in that firm's well-known chimney draught pattern, which is formed of enamel steel tubes and micanite sleeves, on which the resistance strip is wound, and finally served with an asbestos bedding. All connections within the motor are made of stiff copper rod or insulated cable, sweating sockets being provided for each terminal, to which the cable is soldered. The whole of the mechanical part of the conveyor described, together with the steel structures, was supplied by Messrs. Spencer & Company, of Melksham.

NEW CRANES.

The conveying plant which we have just been describing deals, as mentioned earlier in the article, with the loose china clay which is brought down from the mines around St. Austell and elsewhere. In addition to this, china clay of the finer qualities is also shipped in casks, and, to deal with this class of goods, two electrically-operated portal luffing jib travelling cranes, each with a capacity of 3 tons, are provided on the new jetty, and operate on rails about 80 yds. long running the whole length of the quay. In addition to the ordinary movements, luffing gear is provided inside the driver's cabin, which is so arranged that the loaded jib may be raised or lowered to give a minimum radius of 15 ft. and a maximum radius of 30 ft. between the rope, as plumbed from the centre of the jib head and the side of the jetty. This luffing motion is worked by a series-wound motor through worm reduction gear. Each crane has a lifting speed of 80 ft. per minute when fully loaded, and a lifting speed of 120 ft. per minute when lifting a load of 1 ton. The jib and luffing gear is so constructed as to be able to raise and lower the jib with a load of 3 tons suspended in the hook through the angle between the maximum and minimum jib head radii. Each jib is constructed to slew through about 290 deg. by means of spur gearing through a series-wound motor and worm reduction gear. The speed of slewing is 2 revs. per min.—*i.e.*, an angle of 290 deg. is passed through in 25 seconds. Treadle type limit switches are provided in such positions beside the track as to ensure the supply being cut off and a brake applied to the jib before it can be slewed into the conveyor structure. The position of the striker supplied with these switches is, of course, adjustable, so that the necessary limits may be altered and fixed as required.

It is interesting to note that each crane cabin is provided with a 500-watt electric heater, in order that the driver may be comfortably housed when operating at night or in cold weather. Each motion of the crane is, of course, driven by a separate electric motor, and each motor is fitted with an electric solenoid brake of the usual type.

ELECTRICALLY-OPERATED TRAVERSER.

To facilitate the shunting of the trucks by carrying them from one track to another on the jetty, an electrically-operated bridge traverser is provided. This traverser, which enables wagons to be transferred from one road to another on the jetty, has a capacity of 12 tons, and operates at a speed of 20 ft. per minute. It is provided with one standard gauge track for carrying the wagons, the rails being formed of steel bars shaped in the tread as for 70 lb. bridge rails, and rivetted to special angles. The level of these rails is kept as low as possible, so that the head of the ramps between them and the running rails may be as small as possible. The top of the transverser is covered by chequer plating, which is so arranged that all the wheels and rope attachments may be readily got at by lifting one or more plates. The traverser is driven by duplicate flexible steel ropes passing over grooved pulleys and fixed to drums, which are driven through gearing by an electric motor. Each wheel is fitted with a spring pawl and ratchet handle, so that each wire rope can be kept properly tight and take its half share of the haul.

The winding gear, together with the electric motor driving it, is mounted in a special pit, and consists of two drums driven by the motor through a combination of worm and spur gearing. The electric motor is of the series type and of 10 H.P. It is protected by a double-pole overload circuit-breaker, which is also used as a main switch. This circuit-breaker is enclosed in a cast-iron box with a hinged cover. Two limit switches are fixed at each end of the run, and are operated mechanically by the traverser and electrically connected to the controller. One switch at each end is arranged so that it gradually reduces the speed of the traverser before the limits of its travel are reached, and the second switch is so fixed as to cut off the supply when tripped by the traverser at a point where the rails in the traverser register with the rails on the jetty. Each switch is of the quick-break type, and is enclosed in a weatherproof cast-iron box. Each limit switch for cutting off the supply to the motor is so connected that when one is tripped the other will permit of the traverser being driven in the reverse direction by reversing the control. This reverse movement of the traverser sets the first trip switch in working position again. The motor spindle is fitted with a solenoid brake of the usual type. The control of this traverser is effected on the push-button system by means of solenoids. These push buttons are arranged in sets of three, one of which operates the traverser in each direction and a third is used for emergency stopping.

We have to thank Mr. Roger T. Smith, chief electrical engineer of the Great Western Railway, for giving us facilities for inspecting this interesting installation and providing us with the drawings and photographs which illustrate the article, and his assistant, Major G. H. Spittle, for spending a great deal of his time with our representative in explaining the details of the installation.

Electric Propulsion on the s.s. "Wulsty Castle."

The steamship "Wulsty Castle" has the proud distinction of being the only British electrically propelled sea-going ship in commission. It belongs to the Chambers Castle Line and trades between the South United States ports and Europe, being capable of carrying some 6,000 tons of cargo. Two turbo-alternators are used, situated on each side of the 30 ft. by 45 ft. engine room. The alternators run in parallel and supply power to the two main driving induction motors situated amidships, which, in turn, transmit power through double helical single reduction gearing to the single low speed propeller shaft. Ljungström turbines are used. The two alternators are permanently connected in parallel with their fields in series. As the turbine runs up to speed they come into synchronism automatically. Each is capable of delivering 625 kw. when running at 3,600 r.p.m. Excitation can be effected from the lighting dynamo of the ship should necessity arise. The two main induction motors are of the wound rotor type, and are fitted with the usual design of brush-lifting and short-circuiting gear. They are rated at 785 h.p., and, on test, gave an efficiency of 95 per cent. with a power factor of 0·875.

Geared Turbines for Marine Work.

By R. J. WALKER, C.B.E.

PROGRESS in the engine-power of warships fitted with direct-coupled turbines has been very rapid during the last fifteen years. Similarly the development of reduction gear has been remarkable since mechanical gearing was tried experimentally in the cargo steamer "Vespasian" eleven years ago. The first application by the Admiralty was in 1910, when part gearing for the machinery of the torpedo-boat destroyers "Badger" and "Beaver" was introduced for the high-pressure turbines of these vessels (the low-pressure turbines being direct-coupled). In 1912 gearing was adopted for the whole of the propelling engines of the torpedo-boat destroyers "Leonidas" and "Lucifer," of 22,500 H.P. on two shafts, and subsequently to the transmission of 40,000 H.P. on two shafts of H.M.S. "Champion," During the war mechanical gearing was universally adopted by the Admiralty for patrol boats, torpedo-boat destroyers, light cruisers and battle cruisers of the highest powers, and for the last four years practically no direct-coupled turbines have been fitted in warships. At the time of the signing of the Armistice the total horse-power of geared turbines completed and under construction for war vessels for Great Britain and its Allies was over 16 millions.

The curves shown in Fig. 1 represent (*a*) the output at the end of each year in shaft-horse-power with direct-coupled turbines, and (*b*) the output with geared turbines.

As is well known, one of the chief difficulties in the use of turbines for marine work arose from the fact that, for highest efficiency, a turbine should run at a high speed, whereas for maximum propeller efficiency much lower speeds are desirable. Initially this difficulty was overcome mainly by judicious compromise giving a satisfactory combined efficiency for turbine and propeller. Direct application of turbines was first solved satisfactorily for vessels of about 18 knots and upwards, but up to the year 1909 the steam turbine had not been applied to vessels of slow and intermediate speeds (except, in a few instances, when low-pressure turbines were combined with reciprocating engines). But it was only with the advent of satisfactory methods of gearing that the problem was completely solved.

Forms of Reduction Gearing.

Several forms of reduction gearing between the turbine and the propeller have been proposed—*i.e.*, electrical, mechanical and hydraulic. Electrical and hydraulic transmission gears have been fitted in a few ships, but the great majority of vessels have been fitted with mechanical gearing, which enables an efficiency of 98½ per cent. with single reduction, and over 97 per cent. with double reduction to be obtained. There is practically no limit to the ratio of reduction that can be introduced between the turbine and the propeller. The maximum efficiency of electrical gearing probably does not exceed 90 to 92 per cent., and the weight of the installation appears to be greater than with mechanical gearing. With hydraulic gearing the maximum efficiency is below 90 per cent., and the ratio of reduction at present cannot exceed about 7 to 1. Within the last three or four years the introduction of double reduction gearing has had further good results, notably in permitting larger ratios of reduction without gear wheels of excessive size, so that even slow-going vessels can have turbines running at speeds yielding maximum efficiency. With high speed war-vessels, however, the adoption of double reduction is doubtful, owing to limitations as regards size of propeller.

At the outbreak of war a total of over 260,000 H.P. of geared turbines was in use in the mercantile marine. Further developments in this field were naturally retarded throughout the war. During the last three or four years the adoption of double reduction gearing, for the reasons explained above, has been an important factor in this field of work. When the question of the type of machinery to be employed in standard ships first arose, preference was given to firms which had specialised in cargo carrying vessels, speed in building being the main factor; moreover, most of the leading turbine makers were fully occupied with the equipment of war vessels. But in the later standard ships of the fabricated type geared turbines were adopted. It may be of interest to give some particulars of the machinery employed in the "Danier," the first of this type of vessel, which has a gross tonnage of 6,500, a dead-weight of 10,500 tons, and develops a shaft-horse power of 2,300, with a sea-speed of 10½ knots.

Machinery:—

Revolutions of high and low pressure turbines	3,479
Revolutions of propeller	78
Revolutions of first reduction wheel	440
Pitch of teeth in first reduction	0·68 in.
Pitch of teeth in second reduction	1·15 in.
Helical angle	30 deg.

At the present time the total horse-power of geared turbines for vessels for war and commercial purposes completed and under construction is about 18 millions.

Varieties of Turbines Used.

There are several varieties of turbines in use, but those running in association with gearing may be divided roughly into two classes—"impulse" and "reaction," The former, in general, uses a two- or three-row wheel of the Curtis type at the initial end of the high-pressure turbine, followed by a series of single-row wheels in separate chambers. The reaction type of turbine consists of a number of turbines on a drum in series, with small pressure drops at each turbine, the expansion of steam taking place both in the fixed and moving blades. In some cases a combination of the two types has been favoured. However, the reaction turbine is the only system which has been tried over a long period in mercantile vessels. With ordinary care the economy of the reaction turbine is fully maintained after years of running. This is due largely to the low steam velocity employed. High steam velocities, on the other hand, tend to cause erosion of the blades, though the effect is reduced by the use of superheated steam.

As regards the life of gearing there is also no reason why this should not be considerable, provided that ordinary precautions are taken in the manufacture and cutting of teeth, and efficient lubrication is provided. It may be mentioned that the gearing of the "Vespasian," referred to above, shows practically no sign of wear. Similar favourable experience is recorded of other vessels among the earliest to be fitted with geared turbines.

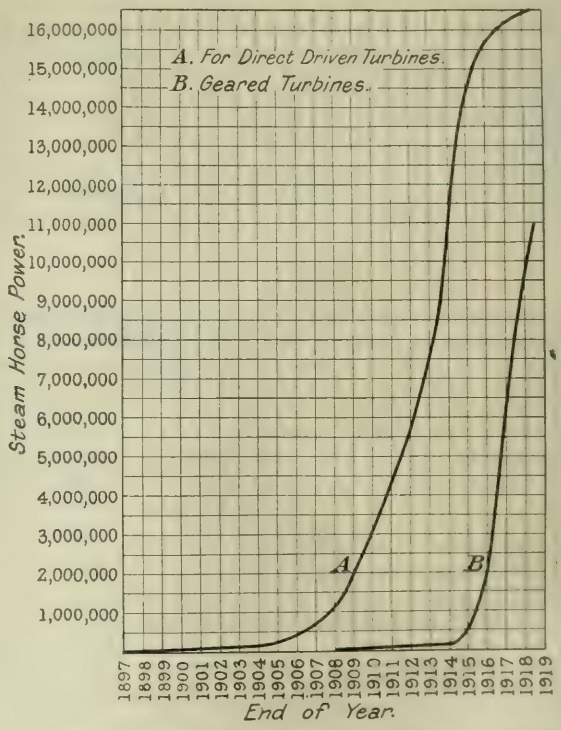

Fig. 1. Curve of Progress in the use of Direct Driven and Geared Turbines.

Since its introduction there has been a steady advance in the efficiency of the steam turbine. Originally turbines in vessels worked at about 15-16 lb. per shaft-horse-power. Later, with direct-coupled turbines, less than 12 lb. per shaft-horse-power was obtained, whereas at the present time with double reduction gearing a steam consumption under 10 lb. per shaft-horse-power (turbines only) can be secured with saturated steam, and under 8 lb. per shaft-horse-power with superheat at 200°F. The introduction of gearing has had a marked influence on the combined efficiency of the installation. For in direct-coupled turbines of the reaction type, and even in some single-reduction geared turbines, the velocity ratio (*i.e.*, the ratio of blade-speed to steam-speed corresponding to maximum blade efficiency) could not be obtained owing to the compromise necessary between desirable speeds of turbine and propeller. The adoption of double-reduction gearing had a favourable influence in this respect, as it not only permitted higher blade efficiency corresponding to a higher velocity ratio, but also eliminated steam losses due to omission of dummies, and occasioned a slight reduction of the tip leakage losses owing to the smaller diameter of the rotor and consequent higher blade heights.

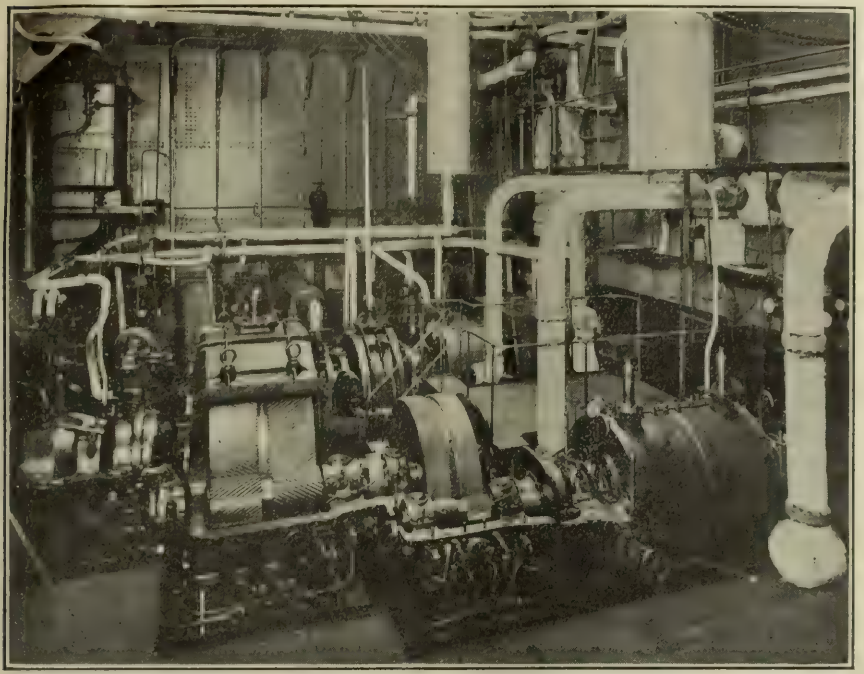

FIG. 2.—VIEW OF ENGINE ROOM OF S.S. "DANIER."

INITIAL PROBLEMS.

In the initial stages of the design of gearing for marine work many problems had to be considered in order to ensure certainty of success. Amongst the most important of these was the behaviour of the gearing in a heavy seaway. Naturally no experience on this point was available, and accordingly very heavy allowances had to be made with regard to tooth-pressures. But, as remarked above, experience has enabled gearing to be so designed as to have an extremely long life, even when undergoing the roughest weather conditions. In the case of single reduction-gearing troubles have occasionally been experienced owing to the breaking of the pinion teeth at the ends, or through excessive wear. Such troubles have generally been traced to defective material, faulty workmanship (including cutting of teeth) or inferior lubrication. There is an impression abroad that the tooth pressures adopted in double reduction gears are too high, the assumption being based on the pressure per inch of face. The author, however, believes, that pressure per inch of tooth face alone is an insufficient criterion, and that other factors need to be taken into account. The load per inch of face can increase with the diameter of the pinion, with gears of similar ratio, because of the difference in curvature of tooth surface. For large pinions the load per inch may be allowed to increase proportionately to the diameter of the pinion, or on a somewhat more conservative view with the square root of the diameter. There is no experience available to suggest that pressures adopted in double reduction would warrant. It is true that this experience has been obtained mainly with war vessels, and that in merchant ships a greater margin of safety is needed, owing to the fact that the gear is kept running more continuously. However, during the war the demands on many types of war-vessels, torpedo-boat destroyers and light cruisers in particular, were very severe, and it has nevertheless been found that the gearing is one of the most reliable pieces of machinery in the ship. In designing gears for mercantile work lower values for the load factor (either L/d or $L/\sqrt{d}$, where L=load per inch and d=diameter of pinion) have been taken than are usual in warships.

DESIRABLE PRECAUTIONS.

As regards precautions to be taken in the design and manufacture of gears, the cutting of the teeth and true alignment are of primary importance. One of the chief objections originally advanced against the use of gearing was the anticipation of noise. With a view to obtaining as silent running as possible fine pitch teeth with an angle of 45 deg. were adopted, the pitch of the tooth being 7/12 in. In later designs, with improved methods of cutting, the spiral angle has been reduced to 30 deg., which permits of considerable increase of tooth pressure without reduction of the margin of safety. Noise has been found to be due mainly to slight inaccuracies in the pitch of teeth. An improved method of cutting gear wheels and pinions, the so-called "creeping" mechanism, was described by Sir Charles Parsons, in a Paper before the Institution of Naval Architects in 1913, and at the present time quite 75 per cent. of the total horse-power of gears in use were cut by machinery fitted with "creeping" tables. The chief effect of this method is to distribute uniformly round the wheel any errors that may arise. It is essential that machines for cutting should be frequently checked for wear in the driving worms, and also the alignment, as any such error in the machine would be reproduced in the work.

LUBRICATING ARRANGEMENTS.

As regards lubrication the quality of the oil and the method of application to the gearing are both important. On the other hand, any good type of mineral oil which fulfills the Admiralty specification should prove satisfactory. Separate lubricating systems for the gearing and bearings have been advocated by some, the idea being to secure oil of higher viscosity for the gearing, but it is clearly a drawback to have to deal with two grades of oil, and in any case it is difficult to separate the systems entirely, inasmuch as the oil from the pinion bearings drains into the gear case, and the two oils become mixed. With a view to delivering oil at a lower temperature to the gearing, and consequently at a higher viscosity, a second cooler may be used for the oil supplied to sprayers for the gearing; in this way we obtain for the gearing oil as thick as possible, without increasing the losses in the high-speed bearings, and without the complication of using two grades of oil.

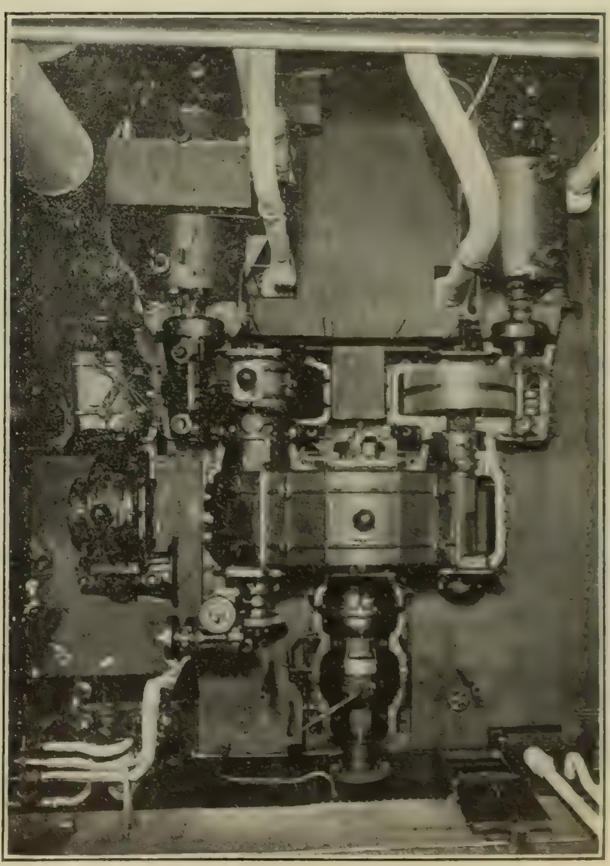

FIG. 3.—ANOTHER VIEW OF ENGINE ROOM OF S.S. "DANIER."

Differences of opinion exist regarding the relative merits of pressure and gravity lubrication. In Admiralty work lubrication of the bearings on the pressure system is exclusively employed. In mercantile work a gravity system has sometimes been preferred, so as to ensure a supply of oil in the event of one of the pumps stopping. On the other hand, the pressure system ensures better control of the pressure required for the bearings, and also more uniform pressure.

As regards material, ductile material is essential for the gearing, nickel steel being commonly adopted for the pinions of the first and second reduction gears, and 31-35 tons tensile for the primary and secondary reduction wheel rims.

The saving in coal consumption to be effected by substituting geared turbines for reciprocating engines is considerable. Thus, in the case of sister vessels a saving of 17·05 has been determined in favour of geared turbine ships. Results for the "Vespasian," "Cairnross," "Mahanada," and other vessels have led to computed savings of 15-29·2 per cent. Assuming on an average a saving of 20 per cent. in coal consumption, it is evident that the change would be very beneficial at present day prices for fuel.

The article has dealt primarily with the use of geared turbines for marine work, but it may be mentioned that on land geared turbines have also found a number of applications, notably in connection with the generation of electricity. Here the introduction of gearing has made it possible for a turbine operating a direct-current machine to work at the speed corresponding with maximum efficiency, while that of the dynamo is kept within moderate limits, corresponding with the exigencies of dynamo design. Otherwise it would be necessary for the turbine to work, in some cases, at only half its efficient speed. The use of gearing in such cases has effected economies of the order of 15 per cent. In the case of alternators of fair size the permissible speeds are such that direct-coupled turbines can usually be employed. Gearing has also opened up a new field for the turbine in the driving of cotton, jute, paper and other mills. A number of mills, both in Great Britain and the Colonies, have adopted this method of driving with satisfactory results.

The Electrical Equipment of a Dundee Shipyard.

THE following article, which describes briefly the methods adopted at the shipyards of the Caledon Shipbuilding and Engineering Company, Dundee, should be of more than usual interest as the installation is designed to overcome troubles peculiar to shipyard work.

The Caledon Company have two shipyards on the Tay, separated by a distance of about half a mile. Their position from an electrical point of view is ideal, in view of the fact that they are situated on either side of Dundee Corporation's main generating station at Carolina Port. The methods of distribution adopted in these two yards are entirely dissimilar. The old yard situated on the West, like many other industrial concerns has grown to its present size from a very small beginning. As this growth has been more or less spasmodic, it was very difficult to keep the electrical system abreast of the yard requirements. The system that was deemed efficient ten or even five years ago developed into a patch-work arrangement as time went on. The advent of the war brought things to a crisis, and it was determined in 1917 to proceed with an entirely new layout on the most modern lines, at the same time taking care that there should be ample room for further extension without departing from the original scheme. With this end in view, arrangements were made with the Corporation of Dundee for a bulk supply at 6,600 volts three-phase 50 periods.

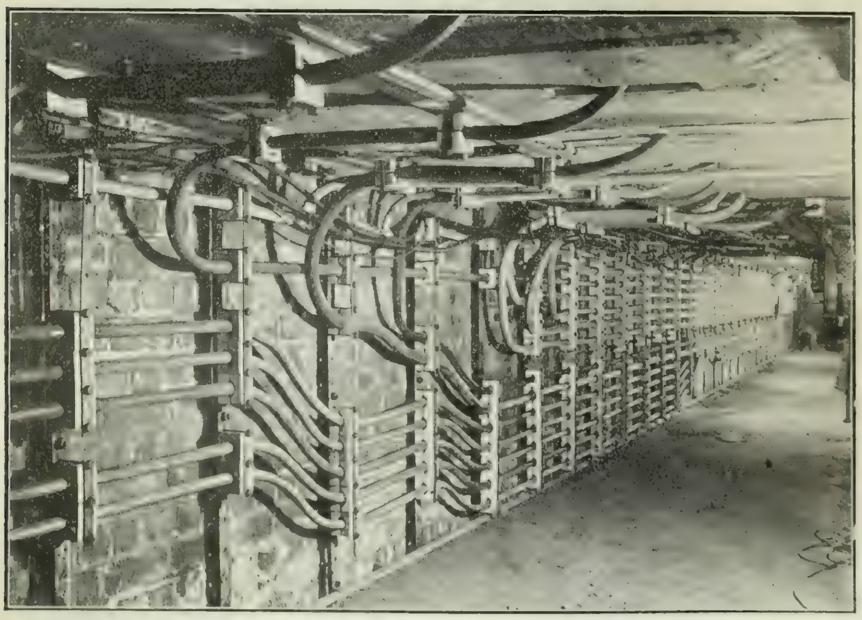

Fig. 1.—Cable Passage, West Yard.

Sub-Station at the Old Yard.

As this arrangement necessitated a sub-station in the shipyard, and as there was, at that time, no permanent compressor house, it was deemed advisable to lodge the compressor and sub-station plant in one building. This building is of brick and is of dimensions ample enough to house all the plant necessary for present, or, within reasonable limits, future requirements. A prominent feature is the cable passage, an illustration of which is shown in Fig. 1. This passage, which measures 4 ft. 6 in. × 6 ft. 9 in. extends right round the station, under the floor level. Access to it is gained from two manholes, one at either end of the station. Insulator racks are provided for the cables on the outside wall. This has proved to be an ideal method of wiring for this class of work, as every cable is accessible. There are four transformers in this station as follows: two 500 kilo-volt amperes and two 550 kilo-volt amperes. The first two supply all the three-phase 440 volts circuits, and in addition have special tappings brought out at 205 and 215 volts for supplying all permanent yard lighting. The 550 kilo-volt ampere transformers work in conjunction with two 500 kw. rotary converters which supply direct current at 400 volts to a three-wire system. The transformers and rotary converters were constructed by Messrs. Metropolitan-Vickers, Ltd.

Compressor Equipment.

The compressor equipment, which occupies a position of great importance in every modern shipyard is in this case of special interest. The compressor plant which comprises one compressor of 300 h.p. one of 115 h.p., two of 100 h.p. and one of 80 h.p. is designed either to run continuously or to be automatically started and stopped by an air pressure switch on the container as described below. This arrangement is very satisfactory, as all conditions of load can be dealt with at the high efficiency which comes from running any unit on full load. Of the foregoing machines, the first two operate on alternating current and the latter three on direct current.

Special interest attaches to the 300 h.p. compressor equipment. This compressor, which is by Alley & McLellan, Glasgow, is driven by a 300 h.p. synchronous motor running at 333 revs. per min., the exciter being direct-coupled and mounted on an extension of the bed plate. This synchronous motor which was constructed by the Metropolitan-Vickers Company is self-synchronising and is automatically controlled by contactor gear operated by an air pressure switch. The operation is as follows:—When the pressure in the container falls to 90 lb. the air pressure switch moves to the "on" position. This closes the stator contactor, the rotor circuit in the meantime having full resistance in circuit. As the rotor accelerates, and the current consequently diminishes, several successive units of resistance are cut out by rotor contactors until the motor attains full speed, as an induction motor, with its secondary short-circuited. On the closing of the last rotor contactor, a time limit relay comes into operation, which allows a few seconds to elapse before synchronisation takes place. When the time relay operates it breaks one phase of the rotor, immediately afterwards inserting the exciter across the break. The motor then pulls into synchronism. It should be observed that the closing of the synchronising contactor also closes the unloading value, which is open during the starting period and allows the motor to take up the load.

Owing to the fact that it was primarily installed for power factor correction it is desirable to keep this motor running during the whole time that there is any considerable load on the electric plant; for this purpose an auxiliary contactor was fitted to vary the field excitation so that the motor gives a constant leading wattless current at either full or light loads. In these circumstances the automatic starting feature described above is not generally in use.

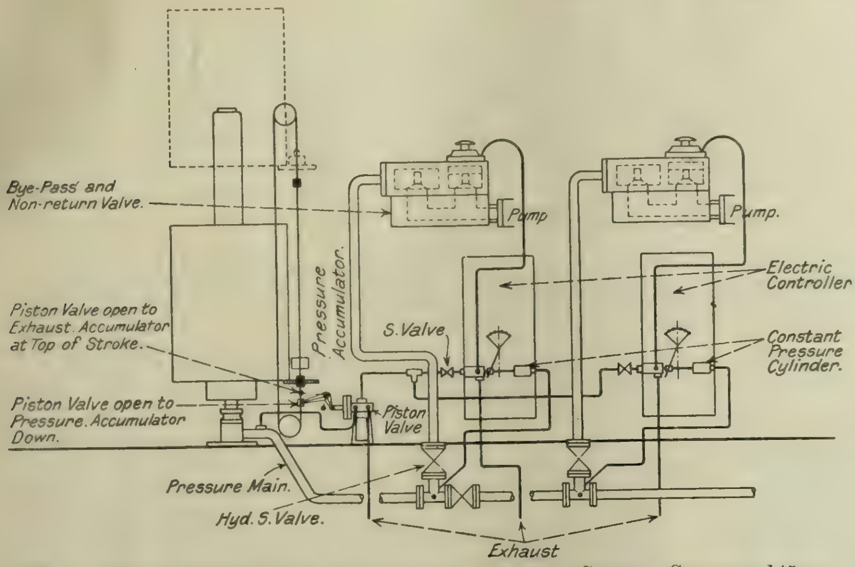
Bye-Pass and Non-return Valve.
Pump
Pump.
Pressure Accumulator.
Electric Controller
Piston Valve open to Exhaust. Accumulator at Top of Stroke.
S. Valve
Constant Pressure Cylinder.
Piston Valve open to Pressure. Accumulator Down.
Piston Valve
Pressure Main.
Hyd. S. Valve.
Exhaust

Fig. 2.—Diagrammatic Sketch Showing Arrangement of Control Gear for 145 h.p. and 62 h.p. Hyd. Pumps in Power House (not to scale).

Hydraulic Pumps.

Two sets of hydraulic pumps are also included in the station equipment, one of 62 h.p. driven by an alternating-current motor, and the other of 145 h.p. driven by a direct-current motor. The pumps are by Fullerton, Hodgarth & Barclay of Paisley, and the motors by the Metropolitan-Vickers, and Electromotors respectively. The hydraulic system is so arranged that the pumps can operate on two separate accumulators, or when running on light load one pump can operate both accumulators. Both pumps are controlled by Messrs. Fullerton, Hodgarth & Barclay's system of pressure control working in conjunction with contactor gear supplied by Messrs. Electric Control, Glasgow. Fig. 2 shows the arrangement of this control. Fig. 3 shows the station.

Switchgear.

The switchboards are four in number. The high-tension board, which comprises seven sheet steel cubicles, was constructed by Messrs. Ferguson, Pailin & Company. Separate potential transformers for the meters of both Corporation and consumer are mounted on top of the main cubicles. The usual overload and earth protection devices are fitted together with the necessary instruments for each cubicle. The low-tension alternating-current board is also of the sheet steel cubicle type and was constructed by Messrs. Metropolitan-Vickers. The mains are carried on racks in the cable passage and pass through bushes in the floor into trifurcating boxes in the bottom of the cubicle. This arrangement also holds good in the case of the other two boards, which were both constructed by Messrs. W. C. Martin & Company, the contractors for the installation. These boards, which are for lighting and direct-current power, are constructed of polished slate mounted on a steel framework. The breakers on the power board are by Messrs. Whipp & Bourne, and the oil switches on the lighting board by Messrs. Ferranti.

Power Distribution.

In order to utilise the original direct-current motors that were part of the old scheme, it was at first decided to instal rotary plant and carry out the new scheme at 400 volts three-wire direct-current. Owing, however, to the difficulty of obtaining this class of plant in the early part of 1918 the original direct-current scheme was abandoned, and a modified alternating-current scheme substituted. This appeared unfortunate at the time, as a portion of the plant was already under construction, but may prove to be a blessing in disguise. The new arrangement is much more flexible, as a choice of both systems is provided at any part of the shipyard, and an alternating-current or a direct-current motor may be used giving the characteristics most suitable for the work involved. The installation when completed was proportioned as follows:—

1,650 h.p. at 400 volts direct-current three-wire.

900 h.p. at 440 volts alternating-current three phase 50 period.

In addition to the above-mentioned systems, it was decided to add a low-voltage direct-current system for use on board ship during construction and whilst fitting out. One 50 kw. 440 volt. alternating-current to 110 volt direct-current motor generator was installed at the head of the berths to supply the ships under construction. Additional motor generators will be installed in a like manner, where and when the occasion demands. There is a diversity of opinion in shipyards as to the best voltage for temporary work, but it may be stated that 110 volts direct current has many advantages, owing to its safety and economy in operation. Practically all the temporary fittings can be constructed in the yard as Home Office patterns are not required at this voltage. A considerable saving is also effected in lamps owing to the greater filament strength of the 110 volt lamp and also to the fact that dishonest people cannot find much use outside the shipyard for a lamp of this voltage.

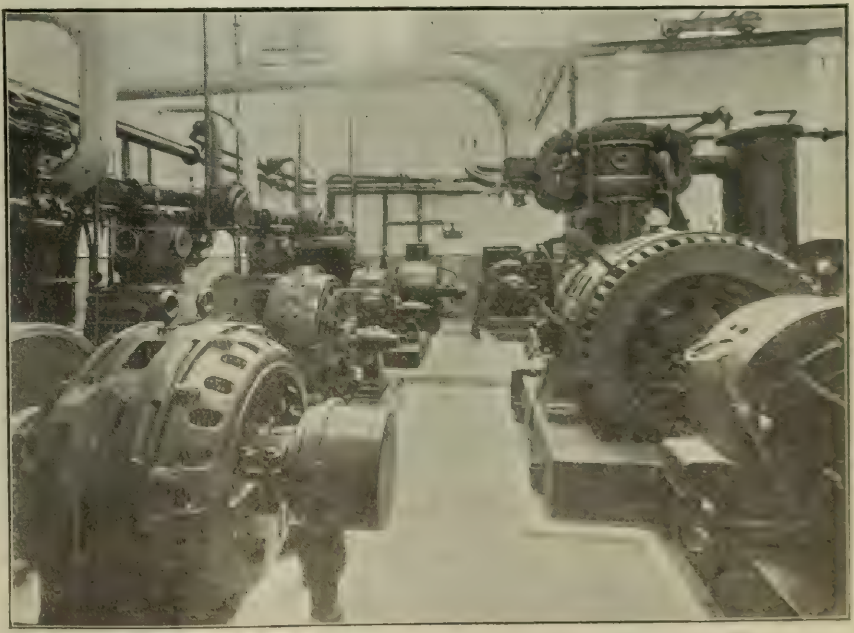

Fig. 3.—West Yard Sub-Station showing Compressor Plant.

Cabling.

Distribution throughout the yard was carried out entirely with paper insulated and lead covered cable, pulled through earthenware ducts of the multiple pattern. These ducts had from three ways to nine ways and were laid in trenches which at any point gave a covering to the ducts of 3 ft. 6 in. Where these ducts pass under roadways or parts of the shipyard where iron, &c., is being stored, they are buried in solid concrete. Brick manholes with locked covers are arranged at suitable points and provision is made for draining these manholes into the nearest waste pipe, or providing them with a sump where a waste was not available. As the ducts were given a "fall" of from 3 in. to 9 in. between manholes, it is impossible for water to lie in any part of the system. The cables were carefully arranged before pulling in, to give the minimum amount of crosses, insulator racks being provided in the manholes to keep everything rigid. All main cables terminate in a disconnecting link box. This greatly facilitates cable testing, and removes the necessity of stripping a distribution board of fuses should a fault arise. These boxes, which were constructed by the contractors for the installation, were of robust design with a portable handle inside the cover. For power distribution, Parmitter Hope & Sugden's "Fluvent" type distribution board was standardised. Where a number of these boards were grouped together, as in the plater's sheds or berth heads, small brick distribution houses were constructed over manholes. This provides a distribution centre inaccessible to unauthorised people, and one at the same time which was free from dirt or chance of damage. The necessity of these precautions cannot be emphasised too strongly in shipyard work. Circuits radiating from these distribution houses and when running to isolated machines such as punches, winches, &c., were of paper insulated, lead covered and served cable and were laid solid in earthenware troughs. A square trifurcating box was standardised for the outlying end of these cables, split earthing glands being used at either end to ensure an efficient earth. Whenever it was possible, however, power wiring was carried out in V.I.R. cable run in galvanised steel tube. This method was adopted throughout the new boiler shop, which has been built adjacent to the shipyard. Motors to the extent of 475 h.p. were installed in this shop, the distribution being carried out in precisely the same manner as for the the shipyard.

(*To be concluded.*)

The Present State of Electric Arc Welding.

[FROM A CORRESPONDENT.]

THE application of electric arc welding to iron and steel work of great variety extended to large proportions during the war under conditions which were in many respects artificial and uncommercial. It proved its value under those conditions, and it is satisfactory to be able to say that considerable progress has been made since the cessation of hostilities.

The most important recent advances in the use of arc welding have been in its application to constructional work as distinguished from repair work. A good start was made in this direction during the war, the best known example perhaps being the electrically-welded barge built at Richborough by the Admiralty, but a good deal of other work was also successfully carried out, such as the making of mine casings. The experience gained was such as to engender confidence, and now such work as the building up and erection of roof trusses and the welding of large structures is undertaken by at least one firm. Another line in which work has been recently done is the welding of the steel skeleton for reinforced concrete. These applications to building are evidently only a beginning. The extension of welding to the fastenings of all kinds of steel structures is certain to follow.

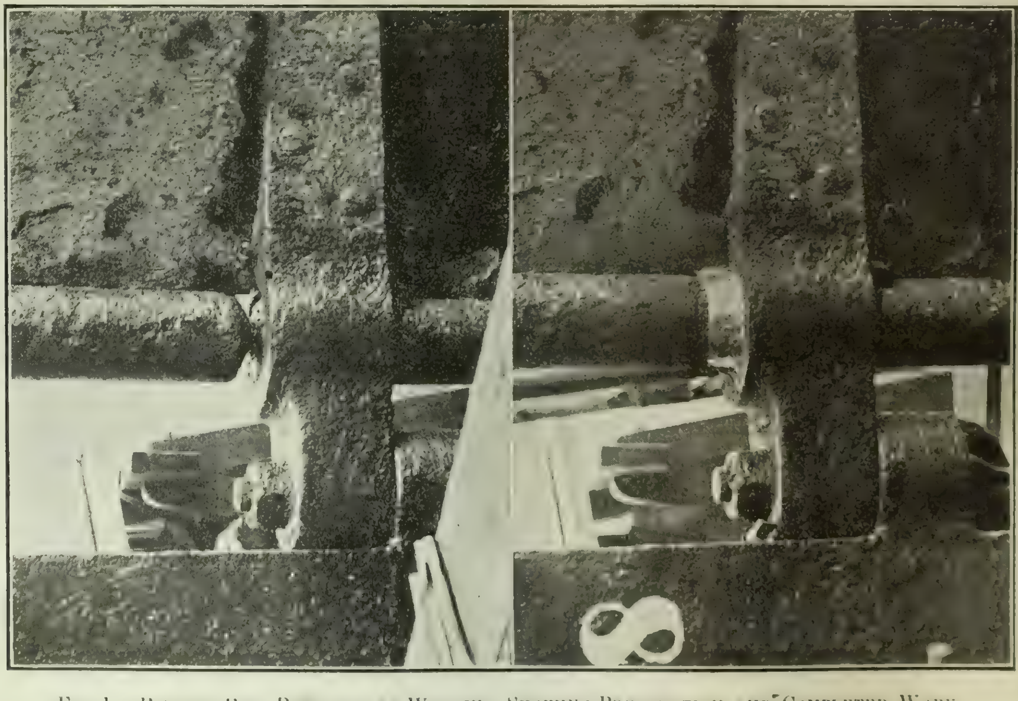

FIG. 1.—RUDDER POST REPAIRED BY WELDING, SHOWING PREPARATION AND COMPLETED WORK.

SHIPBUILDING.

With respect to shipbuilding progress is being made in a cautious manner. Since the construction of the "All Welded" barge at Richborough, Messrs. Cammell Laird & Company have built a 500-ton coasting steamer by means of electric welding, largely as an experiment, and other shipbuilding firms in this country and abroad have made arrangements to construct all-welded small craft and oil tankers. The welding of oil tanks, both for fuel and bulk cargoes, has been practised extensively. Naturally enough the substitution of welding for riveting in the construction of large vessels will not come about suddenly. Experience will show how far the method is applicable to shell and frame construction, and no other experience will be acceptable to shipowners than that gained in service. But it has already proved its value for an immense variety of detail work, especially in making knees, angle collars and similar fitments, attaching fittings to bulkheads and desks, and making watertight joints of many kinds.

Before the close of the war the United States Shipping Board made arrangements for the building of a number of 10,000-ton ships in which welding was to replace riveting almost entirely. Apparently these arrangements were brought to a stop by the armistice and the lack of suitable electric welding materials, but the fact shows that a responsible body was sufficiently convinced of the utility and economy of the method to venture on a large scale experiment. One very important advantage of welded joints for oil and watertight structures is that a welded joint is tight up to its breaking point, whereas riveting and caulked joints are liable to leak badly on stressing up to 25 per cent. of their ultimate strength.

A somewhat remarkable application of welding was recently carried out by an electric lighting company in the United States. It was desired to run a 12 in. steam main underground, between two electric power companies' stations, 1,600 ft. apart. The steam pressure is 250 lb. per square inch, superheat 225°F. Steel tubing was used and jointed up by arc welding with no threaded connections, and the only flange points at expansion joints and elbows. The steam main stood rigorous tests, and has been in satisfactory use for some time. In view of the strong reasons for increasing the pressure and temperature of steam, this successful example of making pipe joints, shows that the jointing difficulty can be vanquished and erection thereby facilitated.

SHIP AND BOILER REPAIRS.

Ship and marine boiler repairs figure largely in the work done, and have not involved anything very novel. Some of the work is, however, noteworthy, as showing the confidence which has been gained in respect to the repair of parts exposed to severe and complex stresses. Special emphasis is laid on complex stresses, because the strength of welds against such stresses has been the subject of doubt.

These repairs have included propellor shaft brackets, rudder gudgeons, stem frames, tall end shafts, stems, and windlasses. Two are illustrated in Figs. 1 and 2. Many of such repairs have been made on large masses of metal, and have saved many hundreds of pounds on each job, besides time and earning power of perhaps greater money value.

Arc welding for boiler repairs became firmly established during the war, and may now be considered as the standard method for making good worn landing edges, wasted plates, tube plates, and cracks in fire boxes. It has proved itself thoroughly reliable for such things. Fig. 3 shows some work done in this direction.

WELDING OF SPECIAL STEELS AND CAST IRON.

The most notable extension of the process has been in its application to qualities of iron and steel which had been considered beyond its scope. This has been a direct consequence of the urgent demands for repairs of machinery, vehicles, &c., which have been as pronounced since the armistice. Great successes have been achieved in these directions. Cast iron, cast steel, special steels of various kinds and in many forms have been successfully welded, though two or three years ago the effective welding of such materials with the arc was not considered to be practicable. Among the cast-iron parts joined together by the writer may be mentioned centrifugal pump casings, machine tool bedplates, tramway gear cases and new teeth in spur wheels.

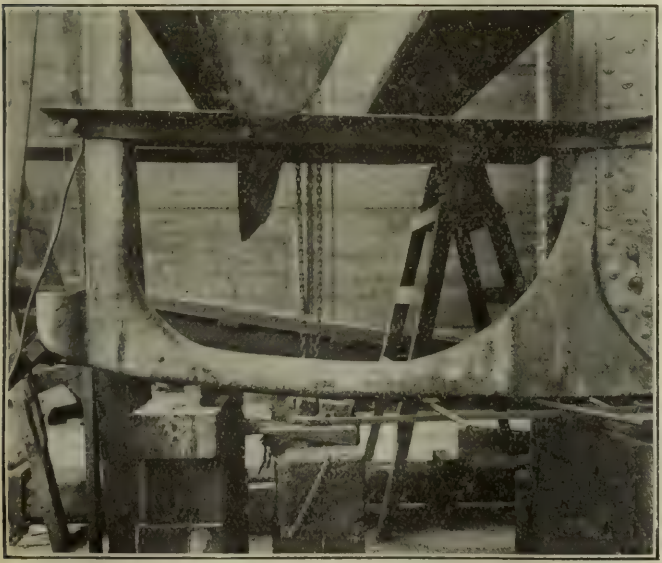

FIG. 2.—STERN FRAME, WELDED REPAIR.

Other welded cast-steel parts include such things as the side frames of tramway bogies, motor frames, broken gear wheels, tramway special work, some of this of manganese steel. Tramway undertakings have indeed been among the largest users of arc welding for repair work, as they were among those hardest hit by the difficulty of repair and maintenance during the war. Figs. 4 and 5 show some such repairs.

The building up of worn shafts and journals is not novel in itself, but the application of the process to such things as rolling mill wobblers shows the extent to which confidence has been earned where very heavy stresses are involved. Similar remarks apply to the welding of broken spokes in locomotive driving wheels, and the building up of worn flanges on such wheels. With reference to special steels, motor-car engines, crank shafts, cylinders, crank and gear cases, gear wheels, frames stub axles, and clutch dogs have been successfully repaired in large numbers.

One application of considerable utility is the depositing of high-speed steel tips on to mild steel shanks for use in machine tools. This has been applied to a considerable extent by means of electric and gas welding processes with the A.W.P. process, and is certain to be more extensively used ere long.

TECHNICAL ADVANCES.

On the technical side there has been very considerable advance, otherwise some of the work above enumerated would not have been attempted. This is particularly the case in respect to the welding of cast iron and special steels. No doubt the demand for such work stimulated the experimental efforts needed to meet it with success.

It has been generally stated that the metal deposited from an iron electrode is nearly fine iron, that such elements as carbon, silicon, &c., are consumed in passing through the arc and go off in dust or are absorbed by the slag. It has also been said very definitely that it is useless to try to modify the composition of the deposited metal by special fluxing composition, or by using electrodes of special composition. These affirmations are not supported by the most recent experience. It is quite certain, for example, that welding metal can be deposited from an electrode of suitable composition properly fluxed, which presents all the characteristics of a typical cast iron.

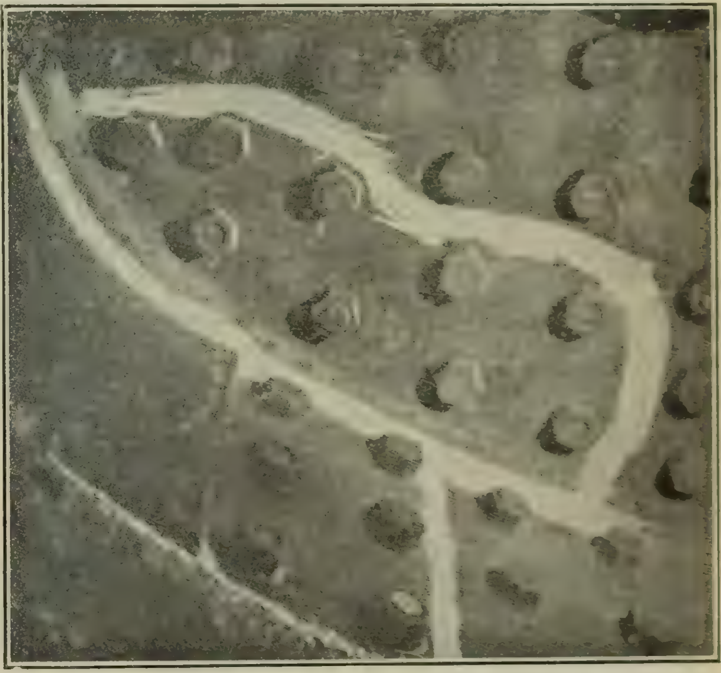

FIG. 3.—COMBUSTION-CHAMBER BACK PLATE AND PART OF WRAPPER SIDE RENEWED AND WELDED.

Much the same thing can be said in respect to at least some special steels. The weld metal can be made to match the original material very closely. These results are obtained by the composition of both the electrode metal and the fluxing coating. It is inevitable in the present state of the art that the research work which has led to them has not been published. No doubt some of this work has been conducted on "trial and error" methods (hardly any other was available at the start) but the confidence with which some of the workers will undertake to make electrodes for welding any kind of steel indicates that they have arrived at some trustworthy working principles, whether they have or have not been able to formulate them in physical and chemical terms. Considering the commercial value of the knowledge gained, early publication is not to be expected.

ELECTRICAL CONDITIONS.

Another direction in which there has been some practical advance is the utilisation of alternating currents for arc welding. There have been those who consider continuous current very definitely superior, and others of a contrary opinion. It seems quite safe to say now that arc welding can be done equally well with either. It is all a question of the operator's training and ability, provided that the outfit permits him to obtain suitable pressure and current. Some operators will do equally good work with either. An intelligent operator who has been trained to use either will soon adapt himself to the other. An unintelligent one will not adapt himself so readily.

The Physics of the Iron Arc.

It must be confessed that very little is known about the physics of the iron arc. The fact that good welding can be done with either polarity of electrode, and with alternating current, seems to prove that the transfer of metal is not directional in respect to either potential or current. Dr. J. H. Paterson read a Paper on the subject before the Newcastle Branch of the Engineering and Shipbuilding Draughtsmen in February, 1919, in which he described some experimental work done on the subject. With continuous current and iron electrodes of equal size he showed that the anode or positive was much the hotter of the two, that a globe of fused material formed at its end, and a crater or hollow at the end of the negative electrode. Examination of the fused globule on the positive showed that it consisted mainly of iron and oxygen in combination, and that some of the iron had come across the arc from the cathode. This transferred iron was oxidised, and within the limits of the current tried—a maximum of 15 amperes—a quantity of 0·0013 grams of iron per ampere per minute was carried across the arc and deposited on the positive as oxide. It will be noted that this transfer of metal is in the opposite direction to that of the transfer of carbon across a carbon arc, and also to that of the transfer of a metallic ion across an electrolyte. No doubt can be thrown on the accuracy of such an accomplished observer, but the facts revealed do not seem reconcilable with what happens in iron arc welding. There is some other effect which is not noticeable with the small current used. In welding the electrode is generally much hotter than the work, whatever the relative polarity, and the metal passes from the hotter electrode to the cooler work. Dr Paterson himself, in the Paper mentioned, observes that the amount of metal deposited in the weld is greatly in excess of the amount (*i.e.*, 0·0013 gram per ampere minute) carried normally by the current, a fact well within his knowledge as technical supervisor of welding in a shipyard. He gave curves showing weights of deposited metal with various current strengths which indicate that between 60 and 140 amperes the deposit from a No. 6 gauge wire is at the rate of 0·157 gram per ampere minute, and a little less with a No. 10 gauge wire. In both cases the arc voltage was 18, the wire was negative to the work and uncoated. There is a point of maximum deposition for each size of electrode, *e.g.*, about 160 amperes for the No. 6 and 145 amperes for the No. 10 wire, beyond which current strengths the amount of deposition falls off. Dr. Paterson thinks that the deposited metal falls across the arc by gravity in the form of minute particles.

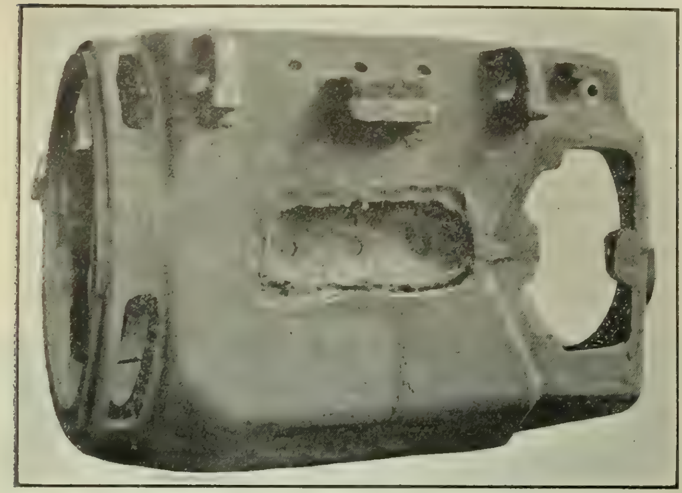

Fig. 4.—Defective Steel Motor Casting.

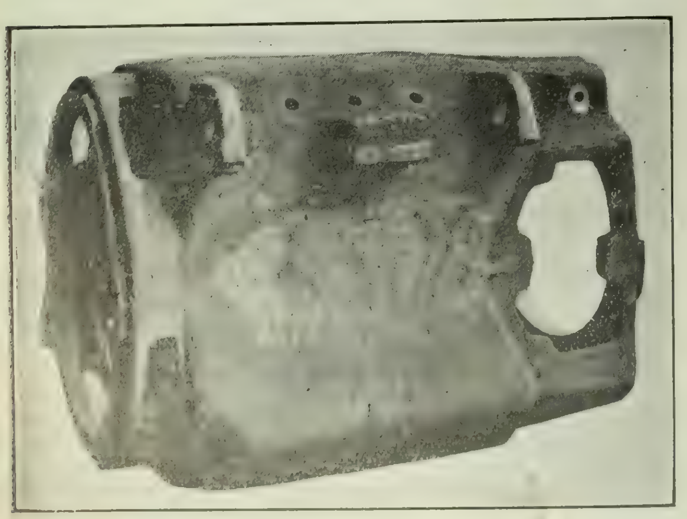

Fig. 5.—New Portion Welded into Casting in Fig. 4.

Room for More Investigation.

This seems to be the only piece of research work on the iron arc which has been published, and clearly there is room for much more investigation. The gravity explanation of the transfer of the deposited metal does not square with the fact of overhead welding, when the electrode is below the work. It is useless to dogmatise about the nature of the force which projects the metal, in this case against gravity, but it can hardly be denied that the action occurs, and there must be something to account for it. Dr. Paterson's Paper contains some valuable observations upon the composition of weld metal, its strength and cognate subjects making it a contribution to the science and art which should be consulted by anyone wishing to embark on further investigations.

Flux Covered Electrodes.

When one comes to the more complex conditions introduced by covering electrodes with fluxing coatings it can hardly be said that anything is known, except by a limited number of men. Certainly, some of them have shown that it is possible to modify the character of the deposited metal by the combined action of the flux coating and electrode composition, although these matters have not been publicly elucidated in a scientific manner.

"Magicoal" Fires for Marine Work.

One of the problems which faces those whose business it is to provide passenger accommodation on our large liners is how best to ensure proper heating of the quarters. At first sight this would

An Artistic "Magical" Fire

seem to be best and most easily done by equipping the saloons, cabins and other similar places with some form of central heating. This, of course, is so, but it has long been realised that something more is required owing to the peculiar psychology of human nature, which prefers not only to feel heat but to see it, if we may so express it. Another point of some importance in this connection which applies equally, of course, in dwellings on shore as on shipboard, is that it is very desirable to provide some means of peak load heating, so that when a person goes into a room at a moderate temperature from a freezing atmosphere outside, he may obtain the necessary additional warmth he requires without the delay that would be necessary if some auxiliary apparatus of this kind were not available. Both these conditions are met by the installation of the well-known "Magicoal" fire, designed and made by Messrs. Berry's Electric, Ltd. Our illustration shows the way in which a fire of this kind can be adapted to old fire places of artistic design; and it is interesting to note that similar artistic fire-places are to be met on many of our large liners and that the combination of these fire-places with a "Magicoal" electric fire provides an equipment of just the kind that is required on board ship. For instance, the "Olympic," the "Aquitania," and many other vessels on the Canadian Pacific, Cunard, and other large liners have been fitted with these fires.

"Falco" Cooking Gear for Marine Work.

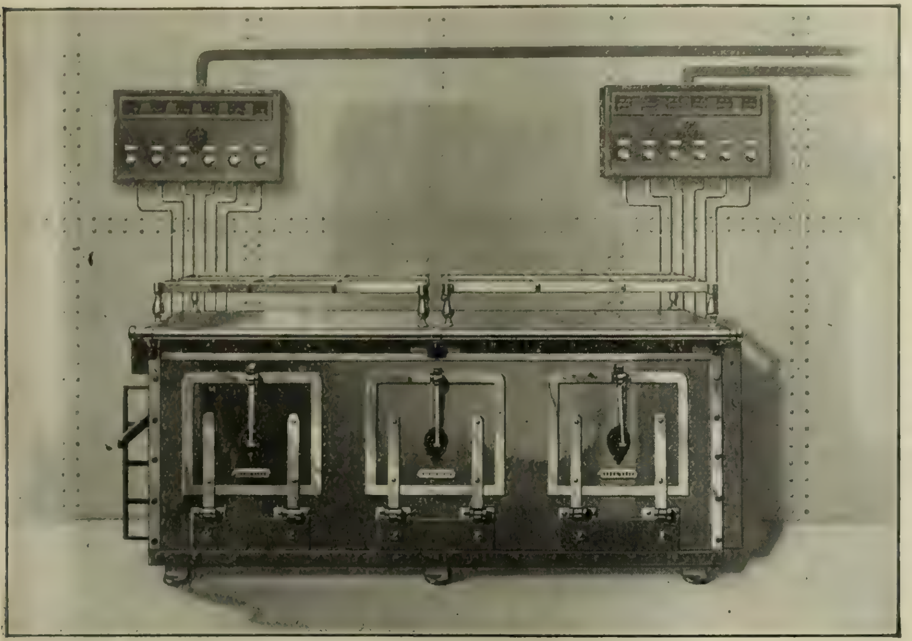

Fig. 1.—View of the Galley Electric Range on s.s. "Antwerp."

Within the last few months the Great Eastern Railway Company have made further important improvements in their Continental services, so that it is now possible to arrive at Berlin in 34 hours, at Hamburg in 36 hours, at Leipsig in 37 hours, and Dresden in 39 hours, after leaving London in the evening, whilst the principal Belgian towns can be reached in the afternoon. This development is due to a great extent to the magnificent new fleet of steamers which the company now have on this service.

Galley Ranges.

The chief item in the equipment of these galleys is, of course, the range. This consists of a treble oven bulkhead range in each case, the overall dimensions of which are 8 ft by 3 ft. by 2 ft. 8 in., excluding guard rails, racks, door handles, &c. The range is constructed of heavy mild steel plate throughout, and is most efficiently lagged. The main connections are of solid drawn bus-bars which are well anchored to avoid vibration troubles, and exceptionally strong terminal connections are fitted throughout. The hot plates surmounting the ovens carry solid rectangular plates rated at 2·5 kw. each, and the hotplate itself is hinged so that it can be raised to allow of inspection of the elements for renewals when necessary. All the electrical parts can be opened out for inspection and are instantly accessible should occasion arise.

The maximum rating of these ranges is 28·5 kw. each when full on, but the actual working load under ordinary conditions, assuming all parts to be in use, works out at about half this. In use the ovens attain a temperature of 480° F. in 30 minutes, and 600° F. in 45 minutes, starting from all cold. If the current is switched off at the end of this period the cooking temperature is maintained, assuming the doors to be kept shut, for a period of over two hours, whilst at the end of 12 hours it is found that the internal temperature of the ovens is approximately 45° F. above atmospheric temperature.

The whole of the heating elements both in the ovens and in the hotplates are controlled by rotary heat-regulating indicating switches which, along with the fuses and pilot lights, are mounted on strong ironclad switchboards which are fixed to the bulkheads. The tests taken on these ranges were very exacting and included, amongst others, a high-tension flash test of 2,000 volts when hot and also when cold.

Hot Presses.

The hot presses were also constructed mostly of mild steel plates and measured approximately 4 ft. by 2 ft. 9 in. by 2 ft. 6 in., the tops being finished off in thick block tin. There are two carving recesses. The interior of the hot presses are fitted with plate creels and shelves which are constructed of galvanised steel throughout. The

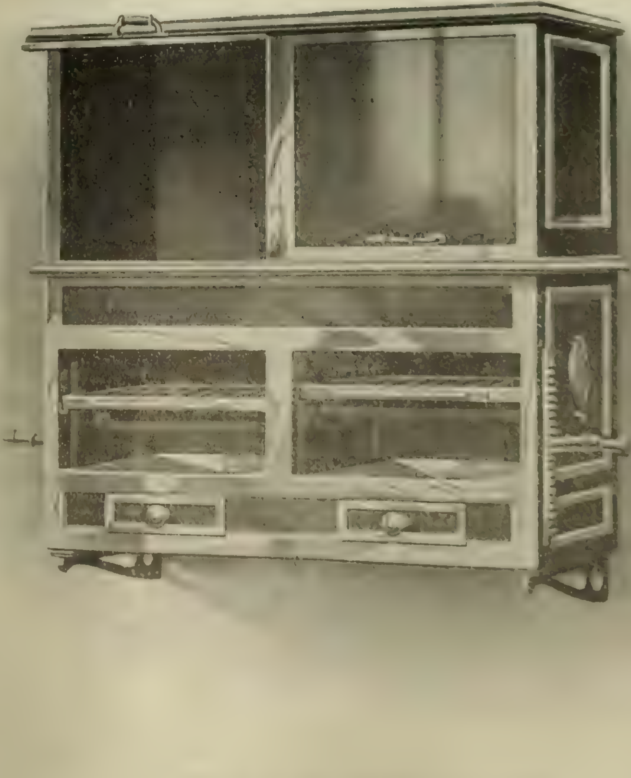

Fig. 2.—The Electric Hot Press.

doors are of mild steel and slide in machine-cut grooves which work with a minimum of friction.

The heat elements are situated in the bottom of the hot press and also underneath the hob and carving wells. These are accessible for inspection and renewals, are all interchangeable, and running at a very low temperature should have a long life. The maximum rating of these hot cupboards was 3·5 kw. with an average working rate under ordinary conditions of about half this amount. The heat regulation of the elements was obtained in precisely the same manner, by the use of similar gear to that used with the ranges. Similar tests were taken on these hot presses to those on the ranges.

Grills and Toasters.

The grills, although built from existing patterns, have been fitted with many modifications to adapt them for sea-going conditions. They are rated at 8 kw. and are arranged for regulation as in the other apparatus. This type of "Falco" grill embodies in its construction the patented arrangement for raising and lowering the grid by means of a handle fixed on the side which, through a projection on it, engages with a rack, thus holding the grid in any desired position. The grid itself and gravy drawer are locked in position to prevent them being thrown out by the movement of the vessel, but they can be removed instantly from the locking device when necessary.

We are interested to learn that the owners of the vessel state that they are very pleased with the results obtained from this "Falco" apparatus, but we are not surprised.

Commercial Topics.

South American Electric Plant Tenders.

The "Monthly Review" of the London and River Plate Bank contains some particulars of the tenders recently submitted for hydro-electric plant in Chili. The amounts quoted by the respective firms and the time required for delivery by British firms were much higher than those of the American firm who secured the contract. It was proposed to erect two hydro-electric stations on the River Maipo, south of Santiago. Messrs. Vickers (Limited) quoted £20,000 for the turbines and £44,000 for the generators, with delivery in 15 months; Messrs. Boving & Co. (with the Swedish General Electric Company) quoted for Swedish made turbines £19,425, delivery eight months, and generators £33,600, delivery 17 months. The American Pelton Wheel Company and the Westinghouse Electric Company quoted $157,000 U.S. gold (in £39,250) for the turbines and generators, with delivery in nine months.

* * * *

Electrical Progress in Holland.

In a report to the Department of Overseas Trade by the Commercial Secretary to H.M. Legation at The Hague, it is stated that, owing to the increased price of coal in Holland appeals are being made to householders to use electricity wherever possible, instead of gas. In view of the coal scarcity, industry generally is advised to spare the use of gas and to extend that of electricity. The power stations produce 50 per cent. more electricity than last year, which was also an increase over 1918. in spite of rationing. Though the shortage of plant and electric cables retards the extensions of electricity in factories, this fact need not affect street lighting, &c. The Hague and Amsterdam have set the example in making the change from gas to electricity by adapting the street gas lamps, but other towns have been slow to follow this course. At the instigation of the Coal Distribution Bureau, the municipality of Rotterdam voted 40,000 florins to convert 800 street lanterns.

* * * *

Electricity Meters for New Zealand.

A recent communication from H.M. Trade Commissioner (Mr. R. Dalton) deals with the types of meter suitable for the New Zealand market. The information is based on particulars obtained from the Chief Electrical Engineer of the Public Works Department at Wellington. It is stated that the maximum demand system is very suitable for hyro-electric power systems, and would have been used more widely if a cheaper and more accurate instrument were available. So far the only reasonably cheap types are wanting in accuracy; the clockwork types are too expensive. A good serviceable maximum demand indicator, costing, say, £2 to £4 without wattmeter, or £3 to £6 with wattmeter dial as well as maximum demand dial, would find a ready sale. A satisfactory commercial maximum k.v.a. meter suitable for service on demands of 5 up to 500 k.v.a. graduated for 400 volts, 3,300 volts and 11,000 volts is required. So far no suitable instrument for measuring maximum k.v.a. has been available, and consequently it is necessary to take the maximum kilowatts averaged over half an hour and deduce therefrom the maximum k.v.a. from the power factor observed during heavy loads. This system is obviously unsatisfactory if a suitable maximum k.v.a. or maximum current measuring instrument is available. The standard frequency for New Zealand is 50 cycles. It appears that there are four systems of charging in vogue, viz., rate A, a fixed rate for domestic and farm service; rate B, a two-rate system for domestic purposes; rate C, meter rate for general purposes; and rate D, maximum demand for general purposes. Of the wholesale rates the most popular is rate D based on maximum k.v.a. demand, and a large number of consumers will adopt this rate in the Canterbury and Waikato districts.

Electricity Supply.

An inquiry has been held at Mansfield into the application by the Corporation for sanction to borrow £1,800 for the purchase of an electric tipping wagon.

The London district Committee of the Electrical Trades' Union has instructed its members to refuse to connect up work carried out by non-union labour.

Owing to the breakdown of a generating set at Llandudno electricity works consumers have been asked to reduce their consumption. Negotiations are proceeding with the North Wales Power and Traction Company for a bulk supply, and in order to facilitate matters the Urban Councils of Llandudno and Colwyn Bay have asked for power to borrow money for the erection of the overhead transmission line from the company's power station to the two towns. The line will, it is hoped, be the main transmission line for North Wales.

In the Return recently published by the London County Council interesting statistics relating to the position of electric supply undertakings in the London and the Extra-London areas are given. For local authorities the figures relate to the year ended March 31, 1918, and for supply companies to Dec. 31, 1917. The figures relating to tariffs and revenue are out of date, but there is much interesting information as to the authorised distributors, date of obtaining powers (including a list of those having authority to supply in bulk), date of commencement of supply and extent of area, population and assessable value, details of plant capacity and output, total connections, number of consumers, units sold, analyses of capital expended, working expenses, revenue, &c. Curves show the units sold by companies and local authorities from 1898 to date of Return, the load factor, and the average prices obtained for private supply. There are also two good maps showing the supply areas of the various undertakings, and there are useful notes as to purchase rights, the transfer of provisional orders and other matters.

From the Return we see that the total plant capacity of the London boroughs (excluding transformers and motor generators used for bulk supply, was 131,766 kw., the maximum load 86,596 kw., and the total number of consumers was 57,324 (including 11,006 in Marylebone), the total connections being 243,583 kw. For the companies the corresponding figures were 218,715 kw., 125,493 kw., 118,836 consumers (14,658 of City of London, 27,998 of County of London, 16,308 of Metropolitan and 11,813 of Westminster Companies), and 377,706 kw. In the extra-London area the plant capacity of the local authorities was 72,086 kw., the maximum load 45,969 kw., consumers numbered 62,266 (including 7,460 in Wimbledon, 6,174 in Ealing, 5,992 in Croydon, and 5,555 in Ilford), and the total connections were 139,822 kw. The totals of the companies are not complete but the capacity is returned at 12,614 kw., maximum load 13,381 kw., consumers 25,414 and the total connections 52,265 kw. The London Borough Councils sold 198,194,693 units, of which 153,246,950 were for power and heat; the London Companies sold 253,790,270 units, including 166,669,499 for power and heat. The average load factor of the London Councils was 28·5 and of the companies 21·5 per cent. In the extra-London area the local authorities sold 110,548,900 and the companies 65,078,748 units, but separate figures for power supply are not given.

Electric Traction.

There was a cessation of work on Saturday last on the part of the skilled men employed by the Sunderland Electricity and Highways Departments on account of the refusal of the Council to grant them seven days' annual holiday with pay. About 500 men will be affected.

During the year ended March 25, the Sheffield tramways department carried 151,667,534 passengers, compared with 163,799,188 the previous year, but the revenue was £824,268, against £653,325. The percentage of working expenses to income was 82 per cent., against 76 in 1919, and 60 in 1916. The total working expenses of the tramways section were £679,127 and gross profits £159,018. After meeting repayment of loans, interest, &c., the balance is £57,412, a decreaseof £5,805.

A further increase of fares is recommended by the Manchester Tramways Committee. A revised scale of charges was adopted on July 4 last, but as the undertaking is still losing money it is proposed to reduce the length of the penny stages from $1\frac{1}{2}$ to $1\frac{1}{4}$ miles and to make other charges.

In a statement prepared by the general manager (Mr. J. M. McElroy) it is pointed out that from April 1 to June 29 there was an actual loss of £16,485 (without renewals fund or the payment to the City Fund), and he estimates that on the present basis of fares from June 30, 1920, to March 31, 1921, there would be an income of £1,382,800, and an expenditure of £1,310,308, leaving £72,494, but from this must be deducted £16,485, the deficit from April 1 to June 29, and the net financial results for the year would, therefore, be as follows: Amount required for City Fund, £115,260; provision for renewals, £246,600; a total of £361,860. Towards this only £56,009 is available, showing a deficit for the year of £305,851. Even should the new proposals be adopted, the summer months, which form the best part of the year for traffic, will have gone. It is estimated, therefore, that from June 30 to Sept. 30, the receipts, with the existing fares, will be £461,590, and from Oct. 1 to March 31, at $1\frac{1}{4}$ miles for a penny, £1,051,625. These sums, with miscellaneous revenue (£7,800), give a total of £1,520,925, against an expenditure of £1,311,000. Deducting the deficit of £16,485 from April 1 to June 29 the available surplus would be £193,440, which would be considerably short of the amount required to meet the payment to the City Fund and to make provision for renewals. Unless wages and other costs are further increased, the fares on the basis of $1\frac{1}{4}$ miles for a penny for a whole year ought to be sufficient to provide the necessary revenue.

Miscellaneous.

An announcement has been made by Mr. Chas. M. Schwab, chairman of the Bethlehem Steel Company (Pa., U.S.A.) that his company has perfected a new two-cycle marine Diesel Engine which produces the same horse-power as a four-cycle engine twice its size, and effects a saving of two-thirds of the fuel expense as compared with a steam-driven oil-fired vessel. It is represented as a greater advance over oil-burning steamships than is the latter over coal-fired steamships.

We learn with pleasure that the dispute regarding the Wages of Wireless Operators at sea has now been settled. The men demanded an increase of wages 177 per cent. over pre-war rates, and the result of the settlement is the granting of an average increase of 156 per cent. The question of examinations which the wireless companies desired to institute has been waived, the association contending that the three examinations required by the Government were sufficient to secure efficiency.

Though the pre-war activities of the wireless telegraph amateur have been restricted by the Postmaster-General's regulations the growth of amateur wireless clubs has greatly increased. There are now 41 clubs in the United Kingdom with a membership of over 1,500, and the Post Office authorities are receiving fresh applications for licences every day. The restrictions on amateur installations are imposed in order to obviate interference with Government stations. In certain cases special permission is granted for the use of the thermionic valve for the reception of signals.

Institution Notes.

The Council of the Physical Society announces that, as a result of replies received in response to a questionnaire recently circulated with reference to time of science meetings, it has arranged to hold meetings during the coming session at 5 p.m. on the second and fourth Fridays of the month.

The Birmingham Electric Club commences its winter session on the 11th inst., when Mr. R. Gregory will read a Paper on "Some Considerations in regard to Low-Tension Switchgear." The meetings are held on the second Saturday in each month, at the Grand Hotel, Colmore Row, at 7 o'clock.

A report issued by the British Engineering Standards Association deals with the standardisation of test pieces for the notched bar test, now so widely coming into use. The report commences with a short description of the usual methods adopted for fracturing the test piece, useful notes and data being given of the principal machines used in these tests. The actual form of notch is dealt with and this is followed by the dimensions recommended for the British standard test pieces and for subsidiary standard test pieces of smaller cross-section for use when the former cannot conveniently be obtained. The report concludes with a valuable series of plates illustrating to scale the various test pieces dealt with, the direction and point of impact of the pendulum or falling weight of the testing machine and grips for holding the test pieces. The report can be obtained from the Secretary of the B.E.S.A., 28, Victoria-street, S.W.1, price 1s. 2d. post free.

Imperial and Foreign Notes.

Blackall (Queensland) Council has decided to erect an electric supply station and a contract has been placed for a 70-h.p. Kynoch suction gas engine, a 40-kw. generator, a storage battery and distribution cables

It is announced that Rai Badahur Ganga Ram has obtained from the Government a lease of about 50,000 acres of land on the lower Bari Doab canal of the Punjab for the erection of hydro-electric plant for irrigation purposes.

Electric power has recently been installed at Bangalore (India) water supply pumping station and current is taken from the Cauvery Falls power undertaking. The new plant cost R. 75,000, but it is stated that it saves R. 400 per day.

The "Industrial Australian" announces that the Australian Commonwealth Postmaster-General (Mr. Wise) is prepared to grant concessions for country telephone systems. In cases where the proposed system is estimated to yield within seven years revenue equal to the cost of operation plus 10 per cent. of the capital outlay, the Government will provide for 75 per cent. of any deficit during the first seven years.

H.M. Commissioner in the Baltic States reports that 150 miles of good light field telephone wire are required in Lithuania.

We learn from "Engineering" that the French Railway Commissions, which have been studying the subject of railway electrification for over two years, estimate that the total cost of the electrification of the Orleans system will amount to 760 millions of francs, of the Paris, Lyons and Mediterranean lines 1,190 millions of francs, and of the Midi (Southern Company's system) 740 millions of francs. The three railway systems which cover about 8,000 kilometres (4,800 miles) can be electrified for a total outlay of £107,600,000.

According to an American electric railway authority the coal used by the United States Railways in 1918 was 175,000,000 tons, and he calculates that if all the steam lines were converted to electric traction, using power generated by large steam generating stations only 53,500,000 tons of coal would be required, so that railway electrification would save 122,500,000 tons of coal a year. The estimate is based on the assumption that the ton-miles worked on the U.S. railways are 1,215,000 millions. There would also be a large saving on nonrevenue-producing haulage, opening up the possibility of a 20 per cent. increase in revenue-producing tonnage without additional expense by the elimination of tenders, &c.

Tenders Invited and Accepted.

Manchester Tramways Committee require tenders by Sept. 14 for steel girder tram rails and special track work. Specifications from the General Manager, 55, Piccadilly, Manchester.

Tenders are required by Sept. 13 for six months' supply of electrical goods, &c., to the Cheshire County Asylum, Parkside, Macclesfield. Forms of tender from the Clerk.

Tenders are invited (by Sept. 20) for steam, exhaust, circulating water and other pipes work at Ipswich Corporation electricity works. Specifications from Mr. F. Ayton, Chief Engineer and Manager.

Lochgelly Corporation require tenders by Sept. 11 for electrical installation work in connection with the erection of 66 and 40 houses. Specifications from the Town House, Lochgelly.

Croydon Corporation invite tenders for the supply and installation of a new feeder cable for the tramways department. Specifications from the Tramways Manager, and tenders to the town clerk (Mr. J. N. Newnham) by 11 a.m. Sept. 8.

Bradford Corporation invite tenders for the supply and erection of Boiler House Equipment, including Buildings, Water-tube Boilers, Economisers, Induced Draught Plant, Feed Pumps. Specifications from city electrical engineer, Mr. T. Roles, and tenders to the town clerk, by Sept. 9.

The Municipal Board of Agra (India) require tenders for four Diese engines and h.t. alternators, h.t. and l.t. switchgear, transformers and sub-station equipment; 15 miles of underground h.t. cables, 28 mills of overhead l.t. mains, &c. Specifications from Messrs. Handcock & Dykes, 11, Victoria-street, S.W. 1, to whom tenders by Oct. 22

The following tenders have been accepted by the Marylebone (London) Borough Council: Aiton & Company, boiler and high-pressure steam piping, £7,737; Whessoe Foundry & Engineering Company, two boiler feed tanks, and two hot well tanks, £3,133.

The New Zealand Government have accepted the tender of the English Electric Company for the conversion of the Arthur's Pass section of the main line railway. The section includes a tunnel of 5¼ miles in length, and the steepest gradient is one in thirty.

Personal and Appointments.

Mr. Alex. Spencer has been elected a director of Vickers, Limited to fill the position recently vacated by Mr. F. Dudley Docker.

The Right Hon. W. C. Bridgeman, M.P., has been appointed Secretary of Mines, and Major Sir Philip Lloyd-Graeme, K.B.E., M.C., M.P. mentary Secretary to the Board of Trade.

Darwen Electricity Committee recommend that the salary of the borough electrical engineer (Mr. F. M. Fletcher) be increased from £430 to 500 per year.

Mr. Lascelles Parrington, A.M.I.E.E., Collins House, 360-366, Collins-street, Melbourne, has been appointed sole agent in Australia for Wild-Barfield electric furnaces.

Colne Corporation have appointed Mr. J. Thompson, borough electrical engineer, as manager of the tramways in succession to Mr. Richardson. Mr. Thompson will combine the two positions, at a salary of £700 a year.

We learn that Ipswich Corporation has now decided to increase the salary of the borough electrical engineer and tramways manager, Mr. F. Ayton, from £850 to £1,000. We referred to this matter in a recent issue and we welcome the changed attitude of the Corporation.

The Rt. Hon. G. H. Roberts, M.P., has joined the board of Messrs. Scholey & Company, Ltd., electrical and mechanical engineers, of 56, Victoria-street, S.W.

Mr. S. L. Pearce, manager of the Manchester Corporation Electricity Dept., and Ald. Dagnall, chairman of the Electricity Committee, are about to set out on a tour of the United States and Canada, in order to inspect typical electricity supply works, &c.

A silver salver has been presented to Mr. William G. Turner, A.M.I.E.E., chief assistant engineer to the Newcastle & District Electric Lighting Company, Ltd., by the officials and staff upon the occasion of his leaving the company after 15 years service to take up the position of borough electrical engineer to Southampton Corporation.

Out of 129 applicants, Mr. G. Douglas Coe, assistant electrical engineer at Blackburn electricity works, has been appointed borough electrical engineer of Wrexham. He has been with the Blackburn Corporation 16 years, and served through the war with the R.G.A., securing the rank of Major. Mr. Coe commences his new duties on Oct. 1.

Bankruptcies and Liquidations.

A meeting of the creditors of the Commercial Electrical Accessories Company, Ltd., will be held at the Hall of the Institute of Chartered Accountants, Moorgate-place, E.C. 2, on the 10th inst., at 12.30.

The statement of affairs submitted at the meeting of creditors of Arthur Kershaw and Chas. Herbert Wood, electrical engineers, 9, Bradford-road, Dewsbury, last week, showed gross liabilities £4,521, of which £4,484 was expected to rank for dividend. Assets are estimated at £2,828. Mr. Kershaw started the business in April, 1919, and Mr. Wood became a partner in the following month. The trading account for the year ended March last gave the turnover as £4,674 and the loss on trading as £833. Unsecured creditors include 52 claims for cables, lamps, conduits, &c., amounting to £3,281. Mr. Chas. Turner, C.A., Sheffield, was appointed trustee, with a committee of inspection.

Companies' Reports, &c.

BENN BROTHERS, LTD.

The 24th annual general meeting was held at the offices of the company on Friday last, Sir John Benn, Bart., D.L., J.P., L.C.C., presiding.

In moving the adoption of the report and accounts, the chairman congratulated the shareholders on the strong position of the company and the continued growth of the business. It was a remarkable tribute to the skill and energy of their most efficient staff to be able to report that their revenues from advertisements and subscriptions had risen during the year by some £70,000. Almost the whole of that large sum had been absorbed in increased expenditure, the greater part of it going directly to the printers and paper makers. Personally he did not complain of. the increases which had taken place in the wages of printers' operatives Having regard to the exceptional skill necessitated in the art and practice of printing, he still thought that many members of that craft cou'd not be regarded as overpaid. Indeed, if the present level of wages for unskilled labour was to be regarded as permanent, there would, in his judgment, be a need for a further advance in the rates paid to several classes of their workers. Since the war began their printing charges had increased nearly two-and-a-half times, while payments to their shareholders had remained stationary. If they were successful in still further building up their revenues, they hoped to be able to do better both for their shareholders and for their workpeople, but on those figures it was surely the turn of the shareholders to claim that they might enjoy the next advance that might be possible. They were paying a dividend which was twice as large as the return obtainable from British Government stock, but it could not be pretended that that was adequate, having regard to the risks associated with a business whose chief asset was that intangible thing known as "goodwill." Printing wages had leapt ahead, and so had printers' prices, and printers' profits had kept well up in the race. He thought that master printers should now reconsider their position with a view to seeing how far they could secure the profits they desired out of increased turnover rather than out of higher prices. The well-being of this country depended upon cheap printing, and there was a vast mass of new thought and information which was now, alas ! denied to the public by reason of the prohibitive level of present printing prices. Then again, the question of paper had caused the directors no little anxiety. Unlike printing, paper was an international problem, and there could be little hope of easement until the world generally settled down to work. They had, he thought, seen the end of profiteering by outside speculators, but they were still faced with the unfortunate determination of many of the largest mill proprietors to take full advantage of the present shortage. The directors were basing their calculations for the current year upon their belief that the present position could not last.

INTRINSIC STRENGTH OF BRITISH TRADE.

Publishing as they did a dozen representative journals, touching every corner of British industry, their business constituted a very reliable barometer of the state of trade generally. There were happening to-day a score of things any of which in normal times would have been regarded as fatal to our commercial position. After referring to the signs of unrest at home and abroad, Sir John said that notwithstanding all these disquieting portents, he had to report that the company's business was now four times as large as it was before the war, and if their claim to be a barometer of trade as a whole was good, he thought they might well take courage. As trade paper proprietors they could claim to have done their share in building up that great position, and if only they all continued, both labour and capital, employers and employed, to keep their heads and do their best, he for one had no fear of the future.

THE TRADE PRESS AS A NATIONAL ASSET.

"Passing from what I may call the selfish side of my task," the Chairman said, "may I invite you to extend your purview to the place of the trade and technical press in our national welfare ? When the Great War came upon us it seemed for a time, as if the trade paper was no longer wanted. The relentless hand of war closed our factories and scattered our craftsmen. Why advertise ? Why trouble about trade ? But far-seeing business men wisely kept their flags flying or their signboards swinging. They recognised that the only thing which could save the country after a devastating war was the well-equipped and up-to-date workshop—with increased production—and so the trade press became, in a sense, the arsenal of the munitions of peace. Little is heard among millions of consumers of those trade and technical papers. We do not happen to live on head lines or sensational articles, but we do provide a storehouse for the best brains and hands of the arts and crafts. In our pafes the able scientist can get a hearing, and the clever designer or inventor, or the man with an idea, an early reward for his talents. Such mundane things as business and workshop management, efficient accountancy and a thousand other topics, are discussed in our pages, and still our industrial public 'ask for more.' This is, I think the best evidence of our claim to be classed as a national asset."

SHAREHOLDER EMPLOYEES.

"It is with great pleasure I call your attention to the gratifying response made by the staff to the offer of the directors whereby they are enabled to become shareholders in the company. We hope to see this movement grow still further, and indeed I should be glad if a large proportion of the additional capital which you will presently be asked to authorise found its way into the hands of those who serve us so well and so loyally. We ask our employees to join us as shareholders on level terms with ourselves." Sir John concluded by moving the adoption of the reports and accounts and the payment of a dividend at the rate of £15 per cent. per annum, less tax. The motion having been seconded and carried at a subsequent extraordinary general meeting a resolution was passed increasing the capital of the company from £100,000 to £150,000.

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 4, 1880.)

PERSONAL.—Mr. Jamieson, of the Eastern Company's electrical staff, has, we understand, accepted an educational appointment in Glasgow [The author of the well-known pocket book.—ED. *E.*].

DR. C. W. SIEMENS.—The "Universal Engineer" (Manchester) has published a biographical notice of C. W. Siemens, D.C.L., LL.D., F.R.S., in which contributions to science of this hard-working physicist are referred to with due appreciation.

ANOTHER TELEPHONE OUTRAGE.—Jones (telephoning wife): "My dear, Mr. Skid will be with us at dinner to-day." (To Skid)—"Now, Skid, you can converse with my wife through the telephone, if you wish." Mr. Skid approaches the instrument, when both hear very distinctly:—"You tell old Skid that we don't keep a hotel on washdays." Mr. Skid dined at a restaurant.—"The Operator."

GAS CARBON FOR ELECTRODES.—It is not generally known that the first to find out the exceptional advantages of carbon cut from the retorts of a gasworks in producing the electric light was Mr. Golding Bird. In a letter to the "Philosophical Magazine" for January, 1838, describing his new induction coil, he expressly states that he gets the most brilliant sparks from electrodes of this material.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—"Liners and Aircraft"; "A Suggestion"; "Captain Geoffrey de Haviland (with portrait)"; and "Screw Propellers," by M. A. S. Riach.

"The Cabinet Maker":—"Colour and Form: The Sense of Touch"; "Cane Furniture for a Club"; and "The Trade Press and the National Welfare."

"The Chemical Age":—"Possible Sources of Home-Produced Motor Spirit," by E. de Barry Barnett, B.Sc., F.I.C.; "Silica Glass"; and concluding Reports of the British Association Meeting at Cardiff.

"The Fruit-Grower":—"Intensive Cultivation," by Prof. F. Keeble; "Laying Out a Rose Garden"; and "Railway Charges and Service."

"Gas World":—Special Section dealing with By-Product Coking; Presidential Address before the North British Association of Gas Managers; Valuation of Scottish Gas Works.

"Hardware Trade Journal":—"Casting Temperatures in the Brassfoundry"; "Export Field for Leather Goods"; and "The Design of Fire Grates."

"Ways and Means":—"Effects on Output of a Change in Hours of Work" (II.), by Dr. H. M. Vernon (Investigator to the Industrial Research Board); "Officials and Reaction in China," by the well-known authority, Richard Oliver; and "British Trade with Bulgaria," by Miss E. Chivers Davies.

Prices of Metals, Chemicals, &c.

TUESDAY, Aug. 31.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£107 0 0	—	—
Electro Wirebars...	„	£117 0 0	—	£1 0 0
H.C. wire basis......	per lb.	1s. 4 7/16d.	—	⅛d.
Sheet.................	„	1s. 5⅞d.	—	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	„	1s. 9 7/16d.	—	⅛d.
Brass 60/40—				
Rod, basis	„	0s. 10¾d.	—	—
Sheet, basis	„	1s. 4½d.	—	—
Wire, basis	„	1s. 3⅞d.	—	—
Iron—				
Cleveland Warrants	per ton	£11 10 0	—	—
Galvanised steel wire, basis 8 SWG	„	£51 0 0	—	—
Lead Pig—				
English	„	£38 10 0	—	—
Foreign or Colonial	„	36 10 0	10s. 0d.	—
Tin—Ingot	„	273 0 0	£5 0 0	—
Wire, basis	per lb.	0 3 5¼	⅝d.	—

Salammoniac.—Per cwt. 110s.-105s.
Sulphur (Flowers).—Ton £18 5s.
„ (Roll Brimstone).—Per ton £18 5s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.
Copper Sulphate.—Per ton £41.
Boric Acid (Crystals).—Per ton £74.
Sodium Bichromate.—Per lb. 1s. 7d.
Sodium Chlorate.—Per lb. 5¼d.
Rubber.—Para fine, 1s. 9¼d.; plantation 1st. latex, 1s. 9¼d. per lb.
Shellac.—T.N. Orange, 675s.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd

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Notes.

Glasgow Electricity Supply.

WITH the official opening of the new Dalmarnock station of the Glasgow Corporation the era of capital stations may be said to have been inaugurated. It is only fair to add that this is more by chance than by design. For the site on which this station is built was purchased by the Corporation as long ago as 1910, and had it not been for the war the plant installed would doubtless have been in full operation ere now. Dalmarnock also falls short of our idea of a capital station in another way. It was originally designed, and for the present will be used for the supply of one municipal area. This, however, is not likely to be more than temporary, and before long we shall no doubt be seeing it playing its part in adequately supplying the electrical needs of the district. This it is well qualified to do. As will be seen from the detailed description which we give on another page of this issue, the lay-out is modern; ample provision has been made for coal and water supply, the generating units will be of a rating of 25,000 H.P., and the ultimate capacity of the site is 150,000 H.P.

Some Interesting Switchgear.

THE two most striking features of the station, however, are the arrangements made for coal storage, and the switchgear employed. A storage ground with a capacity of 75,000 tons is provided fully equipped with handling gear of a capacity of 100 tons per hour, so that ample insurance against stoppage of supply is made, whilst, in addition, the boiler house silos are of sufficient capacity to hold the fuel consumed in about 20 hours. The switchgear is entirely ironclad, on the principle now made familiar by Messrs. Reyrolle & Company, and, as will be seen from the illustrations we give on another page of this issue, has an appearance which is entirely characteristic. It is interesting to follow the development of this class of apparatus from a time when thin metal sheets were used, more as a covering than a protection, to the present time when boiler plates tested under pressure are employed to resist the stresses set up when the modern switch is called upon to deal with the loads now occurring on our extensive networks. The design combines simplicity with compactness and utility; factors which may well be given first place in modern power station practice. The Glasgow Corporation are to be congratulated on the possession of such a station, and upon the employment of engineers with enterprise sufficient to make such a project possible.

The Threatened Coal Miners' Strike.

THE menace of a coal miners' strike is now very real, but as serious efforts are being made to effect a settlement, we are withholding our comments until our next issue. The result of a strike would be so disastrous to every trade and industry that we hesitate to believe in a stoppage of work by the miners. It is the duty of everyone to refrain from doing or saying anything that would aggravate a delicate position or might prejudice the negotiations. We welcome, therefore, the letter issued by Mr. Peter Rylands, president of the Federation of British Industries, and Sir Allan Smith, M.P., chairman of the National Confederation of Employers' Organisations, condemning the suggestion that a coal strike should be met by employers with a general lock-out. We believe this would be a disastrous policy. Threats of this sort do much harm, for they prejudice negotiations for peace, and they might be taken as a declaration of a general war between Capital and Labour.

The Electricians' Lock-Out.

WE regret, therefore, that the efforts made to prevent the threatened lock-out of the members of the Electrical Trades Union were unsuccessful, and the notices given by the Engineering Employers' Federation took effect on Monday. The dispute arose over a foreman at the Penistone works of Messrs. Cammell, Laird & Company. On his appointment the foreman resigned his membership of the E.T.U., and the latter then attempted to coerce him and his employers by calling a strike which lasted over seven weeks. The strike was unauthorised at first, but ultimately the National Executive of the E.T.U. recognised it, and issued strike pay, thus turning a small local dispute into a national affair. To this high-handed and unjustifiable action the Employers' Federation responded by issuing lock-out notices, and unless prompt and effective steps are taken to settle the matter serious loss will be caused not only to the engineering industry, but to the country as a whole. There are some 3,000 firms in the Employers Federation, and about 10,000 or 11,000 of the 55,000 members of the E.T.U. will be directly affected at once, but as electric power is now so extensively used in engineering works it is estimated that over 500,000 other engineering workers will also be involved, while if the lock-out lasts for any length of time 1,500,000 men will be directly or indirectly prejudiced. Arrangements have, however, been made to prevent widespread dislocation, and for some little time to come all the works will be kept going as far as possible. The E.T.U. continues its militant action, and has called out all foremen and apprentices employed by the federated engineering firms. In addition, threats have been made to bring out the men employed on the electric railway, tramway and municipal undertakings as a counter-stroke to the lock-out. There is clear evidence that these attempts to widen the dispute are strongly resented, for many of the men have already resigned membership of the union, and joined other trade union organisations.

Action of Ministry of Labour.

We cannot congratulate the Ministry of Labour upon the time or method of its intervention. It should have intervened long ago, and made a serious effort either to settle or to localise the dispute. We think the employers are fully justified in insisting upon their right to appoint whom they please as foremen, but we also believe that their position will not be prejudiced by the proposal of the Ministry to refer the whole dispute to a Court of Inquiry to be set up under the Industrial Courts Act of 1919. This is the first time the Minister has, upon his own initiative, acted upon the powers given him by this Act, and it would be interesting to see the result of the inquiry. If the Act is to be of any use in labour troubles surely the present is a suitable opportunity to test it? Though the E.T.U. has undoubtedly been the aggressor we should like, in view of the wide interests involved, and the very serious menace to trade and industry, to give the new arbitration machinery an opportunity of establishing its utility, and of becoming, as we hope, the normal method of settling industrial disputes. It must be remembered that the Court will have no power to make an award; it can only investigate the facts and make recommendations, which would, no doubt, have great weight with both parties to the dispute.

Payment for Experience.

Following on some criticism we recently made regarding the payment of chief engineers of municipal electricity undertakings, an interesting correspondence has been taking place in our columns with the view of laying down rules for the salaries of the engineering officials in a manufacturing concern. "Enquirer," in reply received to his request for information has, however, no very definite answer, mainly, we think, because no definite answer can be given. It is doubtless very anomalous that because such officials possess no trade organisation they have received little increase in salary to counteract the new conditions, and that there is an increasing tendency, especially in the case of foremen, for the remuneration actually to fall as promotion occurs. Against this, however, must be placed the greater security in position in the higher ranks and the possession of privileges such as holidays, greater freedom from control, etc. The disease is evident, but the remedy is not so certain, though we feel sure it does not lie in Trades Unionism as at present understood. Appointment to and retention of the more important positions in any money-making undertaking depend mainly upon personal qualities. It therefore follows that the introduction of scales of pay and other levelling devices retard the advancement of the better qualified men without doing much to assist those who are less qualified. The best that can be done in such cases is to fix a minimum and leave the rest to personal effort.

An Unnecessary Subsidy.

Though the Electricity Commissioners have made progress with the re-organisation of the electric supply industry and the provisional determination of electricity districts, their task will be by no means ended when this portion of their work is completed. Complicated questions are likely to arise as to which are the most suitable of the existing stations to be extended, which of the present undertakers are to be permitted to give a temporary supply to the urban and rural authorities in an electricity district at present without electricity works, and who is to bear the cost of these extensions of plant and mains. For instance, we notice that Woolwich Borough Council, which is in the London and Home Counties Electricity District, has been authorised to extend its plant from 10,000 kw. to 25,000 kw., and as an inducement to do so, the Commissioners have offered "to grant maximum periods for the repayment of loans, and to permit the capitalisation of interest for three years, which ought to cover the time taken to complete the proposed extensions." The extension is to meet the needs of Woolwich and adjacent areas., and though we do not question the wisdom of putting down additional plant, we think that the proposal to suspend the payment of interest for three years is open to question. If there should be a fall in the price of plant and cables by the end of that time the Council will have to pay interest on an inflated capital, raised partly for the supply of adjoining areas. With new undertakings it is a common practice to postpone the payment of interest and the provision of a sinking fund, but the Woolwich undertaking is a successful and old-established one, and the real effect will be to extend the periods for the repayment of loans by three years. In such cases some of the added financial burdens and risk should be borne by the joint electricity authority, if one should be formed, or by the Government under the provisions of the new Electricity Supply Bill.

Difficulties of the Interregnum.

A difficulty of a different character has arisen in the North Wales District. There are generating stations at Llandudno and Colwyn Bay, which it is undesirable to extend, and negotiations have been proceeding for some time for a bulk supply from the North Wales Power & Traction Company. Though the electricity district has been provisionally defined, it will be some time before a joint authority is formed or a definite scheme is settled. In the meantime both towns are in urgent need of an additional supply of electrical energy, and in order to induce the company to give it the Council have agreed to co-operate in getting sanction to borrow capital for the erection of an overhead line, which would be the main transmission line for the whole of North Wales. We applaud the decision of the Councils, but as other local authorities on the route are likely to benefit the cost should be borne by the joint authority, or *pro rata* by the Councils affected.

Ampere-Hour Meters for Electric Vehicles.

The increasing use of electric vehicles makes it necessary that every care should be taken in the design and construction of the instruments employed, so that the driver may firstly be taught to trust their indications, and, secondly, that their indications may be sufficiently accurate to afford the desired protection to the battery. It is obvious, for instance, that the instrument should not be affected in its operation by vibration, and, further, that it should be capable of recording temporary overloads, say, up to 300 per cent. for five minutes without injury. These are necessary criteria in present-day conditions of working. Further, while the instrument should record accurately on discharge and 30 per cent. slow on charge, and should read uniformly in divisions of 1, 5 or 10, it also should be made so that it is inaccessible to the driver, and so that it cannot be tampered with.

Some Other Desiderata.

In view of the fact that batteries lose their charge at the rate of about 1 per cent. per day when standing, and that most ampere-hour meters, as at present arranged for electric vehicles, do not take this into account, it would be highly advantageous to introduce a compensating feature into these instruments, such, for instance, as a light coil spring, which would be "wound up" by the meter itself during charge, but which would permit of the indicating needle being returned to "zero" at the rate of 3 per cent. per day, whether the battery was in use or not. An alternative, and possibly superior, way of effecting this would be to have a voltage coil taking an insignificant current, but sufficient to operate the meter motor in the reverse direction to the current coil, so that in the event of the battery standing it would creep back to "zero" at the rate of about 5 per cent. in 24 hours. It is hardly necessary to add that the instruments should be soundly constructed and in metal cases, and that the binding posts being particularly solid, unless instrument is of the shunt type. They should be British built and the price should be moderate. These are ideals which our present-day makers should work for, and which they will no doubt reach.

The Machine Tool Exhibition.

This Exhibition, which was opened at Olympia on Sept. 3, whilst primarily a mechanical engineers' exhibition, has some features of first-rate importance. Following the growing custom of engineering exhibitions the present display is made by the trade for the trade; it is organised by the Machine Tool Trades' Association, and is not a private speculator's venture. The underlying motive of the organisers is primarily to demonstrate to manufacturers in other industries that there are ways of carrying out their operations which they have never heard of before. Success in this direction, of course, necessarily carries with it the sale of machine tools, but we welcome this outlook of the functions of an exhibition as one which carries with it a truer conception of the duty of the organisers of exhibitions towards the general public than has been manifested hitherto. Owing to the war there has not been a machine tool exhibition for eight years, and this period has undoubtedly been a most momentous one in the history of the industry. One advantage which the machine tool trade had over, at any rate many others, was that its war activities not only involved little change in the normal cycle of operations, but it created a much greater demand for its products. It also resulted in a demand for new types of tool of the single purpose variety, thus arousing an incentive to mass production. Perhaps the value of this is reflected in the present fine display. There are over 200 exhibitors, the whole of the available space has been let and it is beyond question that the collection of machine tools on view excels both in magnitude and in interest all previous achievements. Moreover, we have seldom, if ever, seen an exhibition so ready on the opening day. A private view on the previous evening suggested an unusual state of affairs in this respect, and on the opening day the visitor found waiting for him an exhibition complete in every respect, with scarcely a nut or a bolt to be put into place.

Electrical Features.

There are two aspects of the exhibition from the electrical point of view, which we shall deal with descriptively in an early issue. One relates to the application of the electric drive to machine tools, and the other to the auxiliary electrical apparatus which, of necessity, finds a place in any engineering workshop. Everything is aimed at reducing idle time, both of operator and machine, to the irreducible minimum, and an important factor in this connection is the recent developments in push-button electric control. Apart from the advantages of this electrically, this method of control favours the object in view inasmuch as the push button apparatus can be placed in such a position that only the minimum of effort on the part of the operator is necessary to work it. There are, of course, several types of electric drive, especially for the heavier machines, or, perhaps, it should be said that there are several methods of applying the electric motor to the machine, and these will be dealt with in some detail later. The continually advancing costs of labour have made it imperative to employ machine tools of the most efficient type on a constantly increasing scale, and to pay greater and still greater attention to obtaining from them the last ounce of output. To the electrical manufacturing industry this is no less important than to other industries, and it is for that reason we recommend, to all who can conveniently arrange it, a visit to Olympia during the next three weeks.

Engineering Training.

As the outcome of a gathering of leading engineers, educationists and Government officials, which took place at the Institution of Civil Engineers in October, 1917, there was formed a representative committee for the purpose of creating a central organisation for the improvement and better co-ordination of engineering training. It was felt that, though there was not anything very wrong with our higher technical training, the position was very far from satisfactory so far as the rank and file of those engaged in our engineering industries were concerned. The future of our industries and the trade supremacy of the country required a more careful and a more systematic training of apprentices and youthful workers, and one of the principal objects of the new organisation was the improvement of existing methods and the better co-ordination of engineering training generally. At the time we welcomed the new movement, but we felt that a good deal would depend upon the support given by engineering firms and manufacturers. Unfortunately, we now learn from the first report of the Executive of the Engineering Training Organisation that, owing to lack of funds, it will be impossible to go on with the good work which was inaugurated under such favourable auspices. Apart from the financial assistance given by the three leading engineering institutions very little help has been given by engineering firms. A great deal of valuable information has, however, been collected and printed, many young men have been assisted and other useful services performed, mainly owing to the unselfish efforts of the chairman of the executive (Mr. C. H. Wordingham, C.B.E.), and of Mr. A. E. Berriman, C.B.E., and Mr. A. P. Fleming, C.B.E. Another reason for the lack of success is that it was found the original scope of the scheme was too limited, and could not efficiently deal with the question. It turned out that instead of being in difficulty as regards apprentices after the war, the various works were blocked three or four deep with applications from apprentices. It is to be hoped that the F.B.I. or the Engineering and National Employers' Federation will now be able to take over and continue the organisation.

The Cycle of Electrical Ignition.

In discussing the design and requirements of the electrical apparatus used on motor cars for lighting and starting, in a recent issue of The Electrician, Mr. C. A. Stephenson omitted to make mention of the third use to which electricity is put on these vehicles—*i.e.*, ignition. The design, output and reliability of the battery used for the dual purposes of lighting and starting have, however, a very important influence on the system of ignition employed. For, curiously enough, practice and fashion have made a complete cycle in this respect. For the unreliable coil and interrupter of the early days, whose idiosyncracies were increased by the pleasing habit of the battery running down at the most critical moments and at places where it could not be charged, we passed to the magneto, which, though an improvement, was not ideal in either design or operation. The provision of this equipment was, moveover, mainly in foreign hands, and it was not until the war made a virtue of necessity that the manufacture was developed in this country. But by this time the equipment of many cars with a "lighting-starting" dynamo had removed the charging difficulty, while the design of both coil and interrupter has been improved. It would, therefore, seem that a very pretty battle of the systems may soon be joined, and there are not wanting those who assert that the magneto is doomed. We think this view is exaggerated. It is admitted that the magneto is not a perfect machine, but it is constantly being improved, and it will continue certainly to find a use on commercial vehicles, cycles and stationary engines which are not fitted with large reliable batteries and charging apparatus, and where the shortcomings of the coil system of ignition mentioned above are still evident. Even where the coil is used in connection with the lighting battery it is advisable to carry an auxiliary dry battery to use on the ignition circuit should the main battery fail or be over-discharged, as is not unlikely to happen with an electric starter. On the other hand, the magneto is now an exceedingly reliable piece of apparatus, and its chief disadvantage has been its failure to give a good spark at low engine speed, though this has been overcome in the most modern designs. It is, therefore, obvious that there is plenty of room for both systems, and we shall expect to see them develop side by side.

Developments in High-Tension Insulators.

The foundation of successful operation in electrical machinery or apparatus is insulation. This is equally true whether we consider the turbo-alternator or the telegraphic recorder, though the problems that have to be solved in the two cases are very different. In the first case good insulation has to be combined with considerable mechanical strength. In the second good insulation has to be combined with non-hygroscopic and damp-resisting qualities. Somewhere midway between these two in both sets of qualities came the high-tension insulators for transmission line work, which is likely to receive an increasing employment as large power schemes develop in this country. A great deal of work has been done on this question in recent years in the United States, where things are going forward more quickly in this direction than in this country, particularly in refining the methods of manufacture and assembly, and as a result it is hoped that their life and reliability will both be increased. According to Mr. A. I. Austin, of the Ohio Insulator Company, the losses in the field during the past four or five years have been a small fraction of 1 per cent. This is in itself a tribute to the work of investigators who have been trying to discover how the life of the insulator might best be prolonged. At the same time it has been possible to increase the mechanical stresses used and to reduce the cost of manufacture, so that a line with a voltage of 200 kv. will shortly be installed. Indeed, according to Mr. Austin, the problem is not one of insulation, but of regulation, and in this country, where an intensive population take a great interest in such engineering phenomena as transmission lines and insulators, both problems are likely to force themselves on the attention of the operating engineer.

Private Generating Stations.

We had hoped that with the advent of joint electricity authorities there would be little need for the erection of private generating stations, for it is obvious that any considerable increase in the number of these stations will militate against the re-organisation and co-ordination of the supply systems of the country. Of course, there may be isolated cases, such as iron and steel works, where there is an abundance of blast furnace gas available, or large factories some distance from existing electricity works where it would be economical to erect an independent station to supply energy for power and lighting, but in the large majority of cases this will not apply. It should be noted that Sec. 11 of the Electricity (Supply) Act of 1919, which imposes restrictions upon the establishment of new generating stations, does not affect private electricity works, except that "the owner thereof shall comply with any regulations made by the Electricity Commissioners as to the type of current, frequency and pressure to be used; but such regulations shall be so framed as not to interfere with the economical and efficient working of the business for which the supply is generated." We understand that up to the present only a few cases have been dealt with by the Commissioners and no general regulations have so far been framed, the conditions as to the type of current, frequency and pressure being embodied in a letter addressed by the Commissioners to the owner of the station, and being drawn, we presume, with reference to the developments that may subsequently be expected in the district.

Equipment and Control of Heavy Floating Cranes.

Many of the large floating cranes that have been constructed during recent years are self-propelling, and the power dynamo is either coupled to the main engine by means of a disconnecting clutch or is driven by a separate engine. The engine-room is usually below deck in the pontoon; the crane operator's cabin is located at the top of the revolving tower near the foot of the jib, and the machinery house is situated near the base of the revolving tower, and is at rest relatively to the operator's cabin. Irrespective of the system of control the motors and control gear have a rotatory motion with respect to the source of power, and the connection must, therefore, be made by means of slip rings. These rings are usually located at the top of the stationary tower, and are near the operator's cabin.

Motor Details.

The motors to be controlled may be as many as seven in number, namely: Main lifting, auxiliary lifting, derricking, slewing; two for the movable counterweights, and one for driving the pressure-oil pump. Of these, the first four are usually of fairly large output, 70 h.p. to 100 h.p., the counterweight motors are each of 15 H.P. to 25 H.P. output, and the pump motor is a small high-speed machine. The supply is direct current, at 220 or 440 volts, preferably the former. As far as possible the motors should be alike and interchangeable. Moreover, all first reductions, which are usually worm gears, should be interchangeable. By keeping to a single size of motor for the principal motions, the brake-releasing electromagnets, brake rigging and drums are alike, as also are the couplings, first reductions and resistance grids. Furthermore, there is only one size of cable for the main wiring, and many of the controller parts are interchangeable.

CONTROL ARRANGEMENTS.

As the rheostatic system of control is undoubtedly the correct one to use for the counterweight motors, the control of the motors for the four principal motions may be dealt with successively. The three systems to be considered are: Drum rheostatic control, contactor rheostatic control and Ward Leonard control. Drum rheostatic control is the least complicated electrically and, as far as the control gear is concerned, it costs less than either of the other systems; but the heavy wiring between the operator's cabin and the machinery house is an expensive item. In addition the system implies drum controllers sufficiently robust to give satisfactory service for outputs which are near the maximum for controllers of this type. An objection to this system is that the controllers are of considerable size and take up a large floor area, and it may be necessary to operate them by means of levers, cranks and rods in order that the driver may have an uninterrupted view of the hook. Assuming that well-designed and suitably-rated drum controllers are available there is no reason why rheostatic drum control should not give satisfactory service.

CONTACTOR RHEOSTATIC CONTROL.

With the exception that there is no heavy wiring between the cabins and machinery house, and that the other limitations mentioned above do not apply, contactor rheostatic control is identical with drum rheostatic control. Contactor control consists essentially of three elements, namely: A number of magnetically-operated switches, or contactors, placed near the motor to be controlled; a master controller arranged so as to operate the contactors in correct sequence; and a multi-core cable connecting the contactors and master controller. In comparison with the motor current, the current required for operating the contactors is small, and since it is this current with which the master controller has to deal, it follows that the controller is of small size and that the multi-core cable is composed of small wires. The several master controllers may therefore be readily grouped about the operator's stand, and the provision of the necessary control wires between the cabin and machinery house is not costly.

WARD LEONARD SYSTEM.

As is well known, in the Ward Leonard system of control, the motor has a field of constant strength, and the armature is connected to a variable-voltage dynamo. Any speed, forwards or backwards, is obtained by altering the excitation and polarity of the exciting dynamo; in other words, the speed is controlled without the dissipation of energy in series resistances characteristic of rheostatic control. In a machine working to a definite cycle of operations, where the time taken to reach full speed represents a large percentage of the running time, and where the driving motors are of considerable size, this saving of energy is important. In the case of a crane, however, the total energy consumption, irrespective of the system of control, is relatively small, and a considerable saving on a small item makes little difference to the total expenditure.

The fact that the position of the controller handle gives a positive indication of the speed of the motor, irrespective of the load, is claimed as an advantage by advocates of the system. Under certain conditions this may be of some weight; but for crane driving it is desirable that the motor should automatically run at higher speeds on light loads. To enable a motor controlled on the Ward-Leonard system to do this, weakening of the motor field has been proposed. From the electrical standpoint this must be regarded as a vicious expedient, because in the hands of a careless operator it is likely to result in a serious overload on the motor.

THE DISADVANTAGES OF THE SYSTEM.

With the object of being able to operate several motions simultaneously it is usual to provide a crane with one motor for each motion. The advantage of being able to work more than one motion at a time is generally admitted and need not, therefore, be emphasised. In the case of the Ward Leonard system, unless there is a separate control dynamo for each motor, not more than one motor can be operated at a time.

Since not more than one motor can be working at a time in the case of the simple Ward Leonard system, it follows that several motors have to be connected in circuit by means of a selector switch, and, although the latter has not to break a live circuit, it has, nevertheless, to be rated to carry the maximum motor current. In other words, the design of a satisfactory selector switch presents the same difficulties as that of a drum-type controller. This selector switch is mounted in the operator's cabin near to and is interlocked with the Ward Leonard controller. Heavy wiring is necessary between the cabin and machinery house for connecting the several motors to the selector switch, and in addition there is a good deal of lighter wiring for connecting up the motor fields and brake magnets to this switch.

ELECTRIC BRAKING.

Although it is advisable to provide a mechanical load brake of the Weston or hydraulic type on the lifting mechanism, no matter which system of control is adopted, electric braking is nevertheless much more reliable with rheostatic control than with Ward Leonard control because the loading back method used with the Ward Leonard system implies the existence of something to load back upon. In the case of a floating crane the load takes the form of a grid resistance which is connected across the 'bus-bars on the exciting dynamo by means of a centrifugal switch should the speed of the prime mover increase by 4 or 5 per cent. If this load is insufficient to check the descending crane hook, a second centrifugal switch comes into action in case of 20 per cent. overspeed and the mechanical holding brake is brought into operation.

As far as braking is concerned, therefore, in the Ward Leonard system reliance is placed on centrifugal switches and, when the speed is becoming dangerous, on a mechanism which may, or may not, be suitable for checking the speed, namely, a holding brake. Centrifugal switches do not commend themselves to practical engineers, nor do the holding brakes one comes across appear to be capable of dissipating the heat-equivalent of the energy stored in a heavy weight moving at high speed.

Elsewhere in this issue will be found a description of the electrical equipment of the 250-ton floating cranes at Panama. From this it will be seen that the Ward Leonard system of control is used, and to admit of two motions being operated simultaneously there are two independent control dynamos. It is interesting to note that after the crane was put into service, on account of the humidity of the Isthmus, the voltage was altered from 220 to 110 volts for the lighting circuits, in order to obtain greater working security.

Ward Leonard Control Applied to Heavy Cranes.*

By H. H. BROUGHTON.

Some time ago† the author described in these columns the two 250-ton floating cranes that had been provided for the Panama Canal. The electrical equipment, which is novel in some respects, will be dealt with in the present article. For convenience the electrical equipment is divided into three separate groups, namely: (1) Power house on the pontoon, (2) motor house on the rotating portion, (3) operator's cabin, also on the rotating portion. The wiring diagram, Fig. 1, shows the electrical connections of all the electrical equipment on the cranes. In the following sections a description is given of each of the sub-divisions referred to above.

POWER HOUSE.

The power plant consists of the following machines: One compound steam engine operating at 250 revs. per min., equipped with two flywheels, direct connected to two shunt-wound generators of 116 kW. and 58 kW. respectively. The two generators are arranged on either side of the steam engine, the flywheels being mounted between them. In addition to this main generating equipment, which is intended to operate the motors of the crane on the Ward Leonard system, there is a second steam-driven unit consisting of a two-cylinder steam engine of 28 H.P. to 34 H.P. at 450 revs. per min., and direct connected to a compound-wound exciter having a rated output of 17 kW. For lighting purposes, the Panama Canal authorities installed a further steam-driven set direct coupled to a 110-volt shunt-wound dynamo.

MAIN GENERATOR UNIT.

The main generator unit is intended to drive two motors having a total output of 132 H.P., and also two other motors having a combined output of 66 H.P. Both sets of motors are operated on the Ward Leonard system and are capable of maintaining their output under the rigid temperature conditions laid down in the specifications. The small generator set, having a rated capacity of 17 kW., is intended to serve as an exciter for the motors and the large generators mentioned above. It was also originally intended that this 17 kW. set should furnish the current required for illuminating purposes, but it was found that 220 volts for general illumination was too high a voltage for the complete safety of the men operating the crane, and it was thought advisable to instal a small unit operating at 110 volts for illuminating purposes only.

The small exciter set for supplying the field current to the main generators is equipped with a field regulator for maintaining constant voltage. In the event of the small exciter set being damaged or out of commission, the crane has been arranged so that the 58 kW. unit can be used as an exciter for the 116 kW. generator; and to admit of this method of operation, a field regulator has been provided for the 58 kW. machine, but this is ordinarily cut out of the circuit. The main generator unit is provided with a centrifugal limit switch, which can be regulated, so as to protect the machine from excessive speeds due to wide variations of load.

SWITCHBOARD.

The switchboard in the power plant room consists of five panels, a double 'bus system being provided. The instruments on the switchboard are all of the flush type and are embedded in the slate panels. The instruments are also especially protected against moisture, it being assumed in the design of the switchboards and generating equipment that the humidity on the Isthmus is 100 per cent.

Each generator circuit is provided with an ammeter, a voltmeter and an insulation tester. The generators are also protected by overload circuit breakers and time limit relays. The automatic relay on the circuit breaker is arranged to open at double the full load current on the generator. Each of the two sets of automatic circuit breakers are provided with a common time-limit relay, so that when the breaker on one unit opens, the breaker of the remaining generator will also be released from load. Under normal conditions the main control circuit is closed through a set of contacts on the circuit breakers, and when, as a result of overloading, one of the circuit breakers opens, the whole plant is brought to a standstill through the opening of the main control circuit. The auxiliary contacts of the circuit breakers are connected in series.

In case of emergency the steam engine generator equipment possesses the following possibilities:—

As already mentioned, the 58 kW. generator can supply the energy for excitation in case the small exciter unit is out of service; furthermore, the 116 kW. generator is capable of supplying energy for full load service of the whole plant. On the other hand, the smaller generator (58 kW.) can supply the main hoist gear and the luffing gear on half full load speed of operation, and all other motions on full load.

When either of the main generators is disconnected the overload circuit breakers, nevertheless, remain in the circuit, as otherwise the control circuit from the tower would be interrupted.

COLLECTOR RINGS.

Between the power house and the rotating portion of the crane is provided a sliding contact collector ring system, consisting of 20 slip rings, each 16 ft. 5 in. in diameter. Sixteen of these rings are for use in connection with the motor control, two in connection with the lighting circuits on the rotating portion of the crane and two of the rings are for the telephone leads.

MOTOR HOUSE.

The motor house contains two main hoist motors and two auxiliary hoist motors. The two slewing motors are not placed in the motor house, but are mounted on the pontoon. Wherever it has been feasible, two similar motors are arranged to work in parallel so that in the event of one of them being damaged the other will always be available for carrying on the work, provided the load on the crane is not excessive.

The crane is equipped with two main hoist motors of 66 H.P. each, on a one-hour rating at 220 volts and 400 revs. per min. The motors, which are of the totally-enclosed type, have been furnished with a special insulation to guard against the humidity upon the Isthmus. Two smaller motors of 36 H.P. each, on a one-hour rating at 500 revs. per min., are used for operating the auxiliary hoist.

Both sets of these motors operate part of the time as compound-wound motors, and at higher loads they operate as shunt-wound motors; the change-over from compound to shunt being entirely automatic in connection with the control. Contactors are provided for switching over the compound windings, and these contactors are equipped with auxiliary contacts to which the control circuit is connected. If through any cause a contactor is released, thus disconnecting the main motor circuit, the relay control circuit is also switched out and all of the machines are brought to rest. In this way protection is obtained against the possibility of the load running away during a lifting or lowering operation due to the absence of braking force on the drums, for if the armature circuit between the generator and motor is interrupted the load produces no braking action on the generator.

CONTROL EQUIPMENT.

In accordance with the specifications of the Canal Authorities, the control equipment has been arranged so that it is possible to operate either of the main hoist or auxiliary hoist motors for either motion (hoisting or luffing). In order that the motors may be switched over for this purpose, a second switchboard, fitted with the necessary knife switches, is provided in the motor house. In the case of the slewing mechanism no independent operation of the motors is required, so that an additional switchboard has not been installed.

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† THE ELECTRICIAN, Vol. LXXVIII., p. 174.

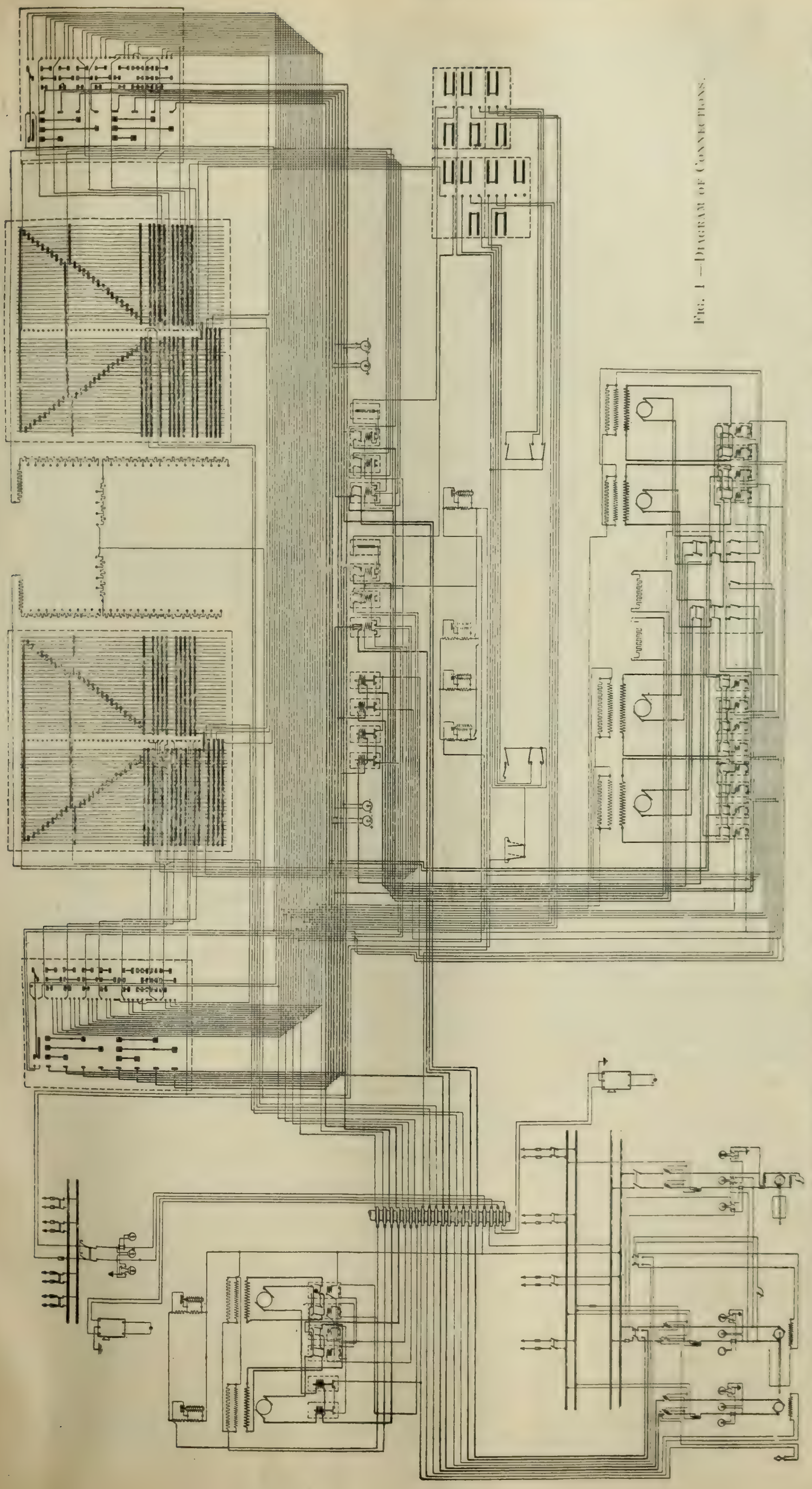

FIG. 1.—DIAGRAM OF CONNECTIONS.

An emergency switch has also been included in the switchgear by means of which the control for the main and auxiliary hoist motors can be switched off in case of emergency. This device is for the use of the attendant in the engine room in the event of a defect in the driving gear, such as the breakage of gear teeth or trouble with the mechanical equipment, which cannot be observed by the operator in the control cabin.

The main and auxiliary hoist motors and the slewing motors are equipped with electro-mechanical brakes. The drive of the main hoist is divided in such a way that each motor works through a separate gear and drives a separate drum, and these two main hoist rope drums can be coupled or uncoupled mechanically. The mechanical braking of the two separate drums is effected by means of the two solenoid brakes mentioned above.

SAFETY ARRANGEMENTS.

In the event of either one of the hoisting gears being uncoupled and out of commission, arrangements have been made to provide an automatic switch which will prevent the operation of the solenoid brake on the idle drum, the drum in action being operated by the main controller circuit as usual. Two limit switches are provided for the highest position of the hoist gear, one for each of the drums, both switches being connected in series in the control circuit. The lowest position of the hook for the main hoist is not limited. The main hoist is arranged for two different speeds by means of a sliding pinion which engages the two toothed wheels of the gear. Between the two positions there is an intermediate position in which the pinion engages with neither of the toothed gears. When the pinion is in this position the current might be accidentally switched on, in which case the load would fall without check.

In order to avoid this

possibility of an accident, two automatic switches are mechanically connected to the above-mentioned pinion and are so arranged that the control circuit of the crane cannot be energised except when the driving pinion is in one or the other of its running positions.

The luffing motion is driven by the main hoist motors and is provided with limit switches at both ends of its travel. The motors are changed over from the main hoist to the luffing mechanism by means of a mechanical connection between the operator's cabin and the engine room. The auxiliary hoist equipment on the crane is operated in a similar manner to that of the main hoist, that is, limit switches are provided in the control circuits which operate when the hoist reaches the upper end of its travel, the lateral movement of the auxiliary hoist crab being limited at both ends of its travel.

Each limit switch is mounted in a moisture proof cast-iron case and is insulated throughout with mica. The switches themselves are arranged for quick break and automatic return. As already mentioned, the main hoist motors are used for luffing as well as hoisting. The auxiliary hoist motors also have dual operations to perform, namely, auxiliary hoisting and the racking of the auxiliary hoist crab.

Limit Switch Connections.

In order to obtain the right relationship between the various limit switches, special switches are arranged in the operator's cabin to connect the limit switches in the control circuit. These take the form of two change-over switches of the controller type. They are operated on changing the motors from the main hoist to the luffing gear, or from the auxiliary hoist to the racking motion. In addition to the contacts for switching over the relay circuit limit switches, these change-over switches are also provided with additional contacts to provide the correct switching of the ballast resistance as described below in the section dealing with the operator's cabin. The contactors for switching over the compound windings of the slewing motors, and also the overload circuit breakers, the solenoid brakes and field discharge resistances, are mounted in the immediate vicinity of the slewing motors.

Operator's Cabin.

All manually-operated control equipment for the direct supervision of all operations of the crane is brought together in a cabin mounted on the rotating portion of the crane immediately under the jib. Two main controllers are provided, with additional equipment consisting of relay circuit switches, overload relays, and two reversing switches for the control of the main hoist and luffing motions. One controller and one reversing switch is provided for each generator. By means of these devices the various control motions described below can be operated by the driver. Each of the generators is connected to all three groups of motors; moreover, any two groups of motors can be operated simultaneously, and yet each group controlled independently. A reduction in output only is necessary when the main hoist motors are operated on the 58 kW. generator. Therefore, when the main hoist motors are connected to this generator, they should be operated on half-load only.

Mechanical Interlocking.

In order to exclude the possibility of having any one group of motors connected to two generators or of simultaneously connecting groups of motors to one generator, mechanical interlocking of the change-over switches is rendered necessary. In addition to this, the change-over switches and controllers are interlocked, so that the change-over switch can only be operated when the two main controllers are in the "off" position. This interlocking is also carried out mechanically. The various arrangements for the controlling and interlocking are, therefore, as follows:—

	Change-over Switch No. 1.	*Change-over Switch No.* 2.
Normal service	1. Main hoist.	1. Slewing auxiliary hoist.
	2. Slewing.	2. Auxiliary hoist.
Emergency operation	3. Auxiliary hoist, slewing, main hoist.	3. Disconnected.
	4. Disconnected.	4. Auxiliary hoist, slewing, main hoist.

Any one of the four operations shown under the heading of "change-over switch No. 1" may be carried out by turning the switch to the operation desired. A similar arrangement has been provided on "change-over switch No. 2." Any operation shown under change-over switch No. 1 can be carried on simultaneously with any one of the operations under change-over switch No. 2 by turning the respective switches to the operating point desired. Items 1 and 2 in the above table are considered as normal operations, while items 3 and 4 would be used only when one of the two main generators was out of commission or defective. In view of the fact that the main hoist motors can be coupled to the crab motions of the auxiliary hoist; and further, since the 58 kW. generator can also, in emergency, serve as exciter for the main unit, an unusually ample provision has been made for the continuity of operation of the crane.

Conditions during Lowering.

The principle of the Ward Leonard system of control renders it impossible to re-generate energy from the driving motors in the event of the load suspended from the crane hook tending to run away. Since the two Ward Leonard generators are driven by a single steam unit there might be danger of the load descending, causing the steam engine to exceed its normal speed of operation. To prevent this, resistances are provided which are inserted in the main circuit whenever the load is being lowered, and these resistances are sufficiently large to obviate the danger of the steam engine running at excessive speed. Each generator is provided with such a load resistance which is connected to the armature terminals and corresponding motors by means of a special contactor. The braking or load resistances have been provided with a number of additional or regulating contacts, so that the braking effect can be adjusted to suit the driver or the load.

To avoid the presence of additional load on the generator, these load resistances are only connected to the control circuit when it is thought they will be required; that is to say, when two generators are in service and are connected to the two main hoists and auxiliary hoist motors, or when they are driving the main hoist and racking motions, or when only one of the generators is in operation and is connected to the main hoist or the auxiliary hoist or racking motion. With any one of the above connections, and with the motor operating in the lowering direction, it may be safely assumed that energy will be released, and the load resistances must be connected in. The load resistance contactors are ordinarily cut in by a circuit on the controller.

Slewing Load Resistances.

The slewing motors are also provided with load resistances of a slightly different character. In order to avoid continuous load, the load resistances for the slewing motors are not constantly connected. The load on the change-over switch which closes the circuit of the load resistance contactor remains disconnected when the slewing gear is in operation. If, however, the slewing motion is in operation at the same time as the main or auxiliary hoist gear or racking motion, one load resistance is connected in on that gear which is lowering. In addition to the load resistances protecting the generators there is the centrifugally-operated limit switch direct connected to the main shaft of the generator sets. This is so arranged as to trip the generator circuit breakers in case of over-speeding of the main steam unit.

A further two contactors are provided in the operator's cabin for the main generator units, as well as two contactors for the solenoid-operated brakes, and for switching in the field-weakening resistances for the motors during pauses in the work. Two overload circuit breakers for the main hoist and auxiliary hoist motors are also placed in the operator's cabin, and the equipment at this point also includes a switchboard with various feeders for lighting, the excitation of motors, brake solenoids and contactors. The incoming leads to this switchboard are also equipped with a voltmeter, an ammeter, and ground indicator.

Operating Arrangements.

Particular attention has been paid to the arrangement of the operator's cabin. The main controllers and change-over switches are built together in a suitable manner, so that the apparatus may be conveniently operated without the driver's view being obstructed in any way. All four switches are built together in pairs, with one side open. The two change-over switches are thus placed directly in front of the operator and the two controllers on either side. The change-over switches stand relatively low and permit an unobstructed view of the field of operation. Fastened to the wall on either side of the driver are the various electrical and mechanical instruments which are used for reference during the operation of the crane.

The lay-out of the cabin is illustrated in Fig. 2.

FIELD RESISTANCES.

The field resistances for the 116 kW. and 58 kW. generators, respectively, are built in direct on the main controllers. To reduce the number of spare parts required, the two change-over switches and controllers, with their self-contained resistances, are made interchangeable. The only necessity for care in the interchanging of switches is due to the fact that the controllers operate different sized units, and therefore, the field resistance is connected up differently on the two machines. The main controllers have 44 single switching elements and are provided with 26 positions on either side. Of these 26 positions, 16 serve to insert the field regulating resistance in the generator, and 10 serve to weaken the motor fields for an increase in speed. The special field-weakening resistances, which are operated from the regulating resistances, are inserted by means of contactors.

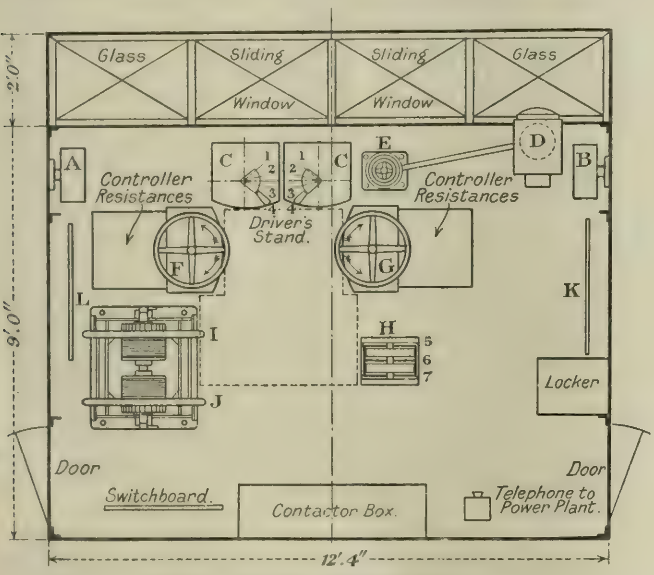

FIG. 2.—PLAN OF DRIVER'S CABIN.

A. Ammeter and voltmeter for 58 kw. generator.
B. Ammeter and voltmeter for 116 kw. generator.
C. Throw-over switch.
    1. Auxiliary hoist.
    2. Slewing.
    3. Main hoist.
    4. Off position.
D. Searchlight.
E. Handwheel for directing the searchlight.
F. Controller for the 58 kw. generator.
G. Controller for the 116 kw. generator.
H. Emergency levers for releasing brakes on :—
    5. Main hoist, left hand.
    6. Main hoist, right hand.
    7. Auxiliary hoist.
I. Hand wheel for actuating mechanical coupling between main hoist and luffing mechanism.
J. Hand wheel for actuating mechanical coupling between auxiliary hoist and trolley.
K. Combined capacity reach and inclination. Indicator for load on individual main motor.
L. Combined capacity, reach and inclination Indicator for load on two main hoists.

CONTACTOR DESIGN.

While in the case of the main controllers only relatively small amounts of current are handled or have to be interrupted, the contacts in the change-over switches have to be sufficiently large to carry the main generator armature current. In the change-over switches there are 12 of the main contacts and 33 auxiliary contacts for relay or control current. By means of the main contacts the various switching operations of the groups of motors and generators, as already described, are carried out. The auxiliary contacts serve to switch in the limit switches, brake solenoids and motor fields of the three groups of motors. They also serve to operate the contactors of the load resistances in particular cases.

HUMIDITY CONSIDERATIONS.

All of the equipment in the operator's cabin has been designed with especial care to guard against the extreme humidity upon the Isthmus, and mica or porcelain insulation has been used throughout. No wood is used in the manufacture of any part of the control equipment in the operator's cabin. The resistances built in as a part of the main controllers are made principally of rheotan sheets, only the first steps being made of rheotan wire in order to provide the necessary resistance. The possibility of the various turns of resistance wire coming in contact due to vibration is prevented by a special design of porcelain insulator carriers. The load resistances are constructed of cast-iron grids.

Particular attention was paid to the construction of the terminal bars of the resistances and cables. The terminal boards of the resistances built on the controllers are of the so-called "marine" type; that is, the individual terminals are clasped on to micanised steel bars of square section. The terminal boards for the load and motor protecting resistances consist of slate panels impregnated with compound and enamelled on all sides. The various resistances are enclosed in sheet steel cases having perforated tops. The connections between the controller fingers of the resistance terminals for the generator and motor field resistances are entirely enclosed in the apparatus itself. All control, generator and motor cables on the cranes are of the armoured type, rubber insulation protected by lead and steel sheathing being used.

The author is indebted to the Governor of the Panama Canal for particulars of the cranes and their equipment, and he takes this opportunity of recording his appreciation.

Electric Traction in South Africa.

We have already announced the decision of the South African Railway Administration to adopt electric traction on the Cape Town–Simonstown line, and the section of the Natal main line from Durban to Pietermaritzburg. In our issues for Nov. 7 and 24 last we gave a full abstract of the report of the consulting engineers (Messrs. Merz & McLellan), recommending the electrification of some nine sections of line, at a cost of £15,427,382. The Administration recommend the adoption of the engineers' proposals in principle, the work to be undertaken in sections and spread over a number of years, but the two sections referred to above are to be converted now, and funds are to be voted without delay.

Owing to the increase in prices, estimates (based on present revised prices) have now been prepared as under, *a* being for the Cape Town–Simonstown line, and *b* for the Durban–Pietermaritzburg double railway (with lines to Point and Bluff):—

Installation of motors and alterations to carriages to adapt them to multiple-unit system (*a*) £425,600, (*b*) £997,000; permanent-way equipment (including transmission line) (*a*) £152,200, (*b*) £496,700; transmission lines (*b*) £133,000; sub-stations (*a*) £165,450, (*b*) £320,000; car sheds (*a*) £40,000, alterations to locomotive sheds (*b*) £50,000; telegraph, &c., alterations (*a*) £2,250, (*b*) £12,100; contingencies, &c. (*a*) £78,500, (*b*) £187,600; and power stations (one at Cape Town and one at Durban) for railway purposes only (*a*) £600,000, (*b*) £725,000. The revised totals are £1,464,000 and £2,921,400, compared with £1,269,538 and £2,033,000 in Messrs. Merz and McLellan's original report.

Electric Driving of U.S. Battleships.

From some particulars to hand from New York it appears that six new battleships and battle cruisers are to be driven by electric power, their guns fought in action by electric power, and every thing possible will be done by the same agency. Four of the battleships (the "Montana," "South Dakota," "Indiana" and "North Carolina") are are to be propelled by an equipment consisting of two Westinghouse 28,000 k.v.a. turbine generators and four 15,000 h.p. Westinghouse propeller motors. The turbines are of the complete expansion impulse reaction type, developing their full rated load of at 265 lb. pressure (steam), 50° superheat and 28½ in. vacuum. The generators are three-phase, 60 cycle, 5,000 volt machines. For the battle cruisers, in which a higher speed is essential (36 knots being aimed as against 21 in the battleships), the turbine power is estimated at 189,000 h.p. or 160,000, k.v.a. The battle cruisers "Ranger" and "Constellation" will each have an equipment of four Westinghouse main turbines capable of developing 49,750 h.p. each, with steam pressure at 265 lb., 50° of superheat, and 28½ in. vacuum; four 40,000 k.v.a. Westinghouse three-phase generators connected directly with the turbines and generating at 5,400 volts, 51-53 cycles, and eight wound rotor Westinghouse motors—two to each propeller—which are rated at 22,500 h.p. each. These figuers give an outline of the power of these naval monsters, which will have a displacement of 43,000 tons each.

The British Association at Cardiff.

A Non-Electrical Meeting.

Tuesday, August 24th.

Several causes conspired to make the annual meeting of the British Association, which opened to-day at Cardiff, rather small. For one thing, members have grown accustomed to meeting in the first or second week of September, and not a few found to their regret that they were unable to attend at the earlier date selected this year. Then there was the increased cost of travelling and rumours of insufficient hotel accommodation. Finally, at the eleventh hour, the tramway men went out on strike, so making it difficult for visitors situated in the outlying districts to reach the centre of the town.

The local organising committee, under the leadership of Dr. Wm. Evans Hoyle (hon. local secretary) had, however, done all that lay in their power to minimise the inconvenience arising from lack of the usual facilities for accommodation and transport, and members were justly pleased with the arrangements which had been made for holding all the meetings in the handsome public buildings in Cathays Park. The reception room and central offices were at the City Hall. Aberdare Hall was used for the secretariat, and provided accommodation for a large number of guests and officials. Section G (Engineering) was housed in the capacious and well-apponited premises of the South Wales Institute of Engineers. The meetings of Sections A, F, H and L were held in the University College, and the remaining sections were accommodated at the Technical College.

The inaugural general meeting was held at the Park Hall at 8 p.m., when Prof. William A. Herdman, C.B.E., D.Sc., the incoming president, delivered an address on "Oceanography and the Sea Fisheries." Sir Charles Parsons, the retiring president, in opening the proceedings, referred to Cardiff as a great industrial locality, famed throughout the world for coal, commerce and shipping. After recording with deep regret the death since their last meeting of Prof. John Perry, F.R.S., general treasurer; Mr. Henry Charles Stewardson, assistant treasurer; and of Sir Norman Lockyer, past president, he announced that the following telegram had been sent to H.M. the King:—

> The members of the British Association for the Advancement of Science desire to express their loyal devotion to your Majesty, and at this their meeting in the Principality of Wales hope that they may be permitted to congratulate your Majesty on the splendid work done by the Prince of Wales, which has drawn towards him the thoughts and hearts of the whole Empire.

It was also announced that the total number of members attending the meeting was 1,317. The revised figure at the end of the meeting was 1,378, compared with a total of 1,497 when the British Association met at Cardiff in 1891.

Thursday, August 26th.

At a meeting of the general committee held this afternoon, Sir T. E. Thorpe, C.B., F.R.S., was appointed president of the Association for the year 1921-22, when the meeting will be held in Edinburgh, and Sir Charles Parsons, ex-president, was appointed trustee, in succession to the late Lord Rayleigh. A deputation was received from Hull inviting the Association to held its meeting in that city in 1922. This invitation was unanimously accepted. To-day Prof. Herdman presided over a specially convened meeting of representatives of all sections, when the question of the application of science to the public services came under discussion. Mr. F. E. Smith, Director of the Research Department of the Admiralty, announced that it had been decided to build a new laboratory at Teddington at a cost of about £25,000, where the fundamental research work of the Navy would be done by a staff consisting of 26 scientists. Prof. C. F. Jenkin gave an outline of the experimental and research work carried on in aeronautics by the Royal Air Force during the war.

Section A.

Tuesday, August 24th.

After the Presidential Address, which we have already briefly referred to, a Paper was read by Mr. J. Evershed, F.R.S., upon the measurement of the shifts of the Fraunhofer lines of a spectrum of the edges of the solar disc. Einstein's relativity theory demands a certain displacement of the lines emitted from such regions possessing different velocities relatively to the observer, and many of the Kodaikanal spectrograms seem to give shifts of the required amount. A closer analysis of other causes which are known to produce such shifts throws doubt, however, on the agreement of the residual displacement with the Einstein value; and Mr. Evershed's general conclusion was that the question still remains open.

Wednesday, August 25th.

To-day Dr. Aston gave an interesting account of his recent work in the measurement of the atomic weights of isotopes by means of the positive rays.

In the discussion which followed, Sir E. Rutherford pointed out the importance to chemical theory of investigating elements derived from various sources, and so determining whether the proportion of isotopes is characteristic of each element or whether it varies with the source, so that the ordinary "atomic weight" of an element is really variable. Other Papers were read by Sir Ernest Rutherford, Prof. Whiddington and Lieut.-Col. Stratton.

Thursday, August 26th.

A discussion on the "Origin of Spectra" occupied the first two hours of to-day's meeting. The report of the Seismology Committee was next taken, and Sir Oliver Lodge contributed a controversial note on "Popular Relativity." He said that the negative result of the famous Michelson-Morley experiment was explained sufficiently by the Fitzgerald-Lorentz contraction in the line of motion, and the more general explanation in terms of relativity involved metaphysics. He had no quarrel with Einstein's mathematical theory; it was the attempts to translate it into physical terms against which he protested. Our experiments were conducted upon matter and energy, about which we knew a good deal; of the relativity of space and time we knew nothing, and theories of them became essentially metaphysical. It was kinematically as true to say that Newton and the earth rose to the apple as to say that the apple fell to the earth; but in reality we had no doubt which statement gave the real truth of the matter.

Prof. Eddington replied that relativists were so far from being metaphysical that they rejected all that could not be measured by a yard stick or a clock; on the contrary, such terms as "simultaneity" and the like, necessary to the description which Sir Oliver gave of phenomena, were essentially metaphysical. Dr. Robb also gave an interesting note on his theory of space and time. Sir Oliver, while quite seeing what the Chairman meant by transferring the title of metaphysician from the relativists to him confessed his continued faith in the Newtonian absolute time, continuous and flowing uniformly on.

Friday, August 26th.

To-day a long programme awaited the Section. Prof. Sydney Chapman, F.R.S., opened with a Paper on "Terrestrial Magnetism." He traced several of the periodic disturbances to variations in the currents induced by the earth's permanent field in the conducting layer of the upper atmosphere, the variations being due to the atmospheric tides.

Father Cortie objected to the explanation advanced by the author of certain equatorial magnetic disturbances as due to narrow pencils of ultra-violet light emitted from rather deep layers in the sun. While agreeing that the source was deep-lying, he thought the facts were better met by the idea of charged ions, which, after being shot out, expanded into clouds under their own mutual repulsions. The entry of the earth into such clouds produced a magnetic storm. Sir Oliver Lodge suggested that positive ions drawn to the equatorial regions might explain the facts. Prof. Chapman, in his reply, remarked that such ions would be drawn, like the negative ones, to the polar regions, but to the ante-meridian instead of the post-meridian hemisphere. Father Cortie's ionic clouds would be quite unable to produce magnetic storms of the suddenness and intensity actually found to occur.

Mr. J. H. Shaxby gave a brief summary of work which led him to an equation giving the saturation pressure of a vapour in terms of the temperature and the density of the liquid and vapour at that temperature, free from all adjustable constants. The theory leads to the view that the space "occupied" (in the sense of the kinetic theory) by the molecules in a liquid per unit volume is equal to the space "unoccupied" in its saturated vapour; that the two phases are in this respect complementary. A modification of the theory to allow for the fact that in actual liquids this relation does not strictly hold leads to a modified equation, which gives much more correct values of the saturation pressure. Similarly an isthermal equation can be obtained which holds fairly well up to the critical temperature, but quite breaks down above it; the corresponding modification of this equation leads to correct values up to the highest temperatures. Slides were shown giving tables of values illustrating this agreement.

Prof. Porter remarked that the form of Dieterici's equation employed with the first power of the absolute temperature had proved quite inaccurate, and that a power approximately 3/2 was necessary. Mr. Shanby replied that this modification of Dieterici's equation had been necessary to retain the constancy of a term in the equation, whereas the present Paper recognised that this term was dependent on temperature and gave its value; the original theoretically deduced equation was thus still valid.

Tuesday, August 24th.

After the presidential address, which we dealt with in our issue of August 27th, a vote of thanks was moved by Sir James B. Henderson, who referred to the impossibility of maintaining supremacy in the air without the systematic employment of the best brains of the country on the research work needed to throw light on the many outstanding fundamental problems to which the President had referred. Prof. F. C. Lea, who seconded the motion, said he had had the honour of being associated with some of the extremely valuable work done by Prof. Jenkin at the Air Ministry, and he particularly admired the way in which Prof. Jenkin always insisted on getting right down to the underlying fundamental principles.

The next Paper taken was by Prof. F. C. Lea on "Testing Materials at High Temperatures." An interesting series of curves showed a remarkably close agreement between the tensile strengths and Brinell hardness numbers of Muntz metal, manganese bronze, delta metal, nicro-copper and aluminium piston alloys tested at a number of different temperatures. Mild steel was found to have a maximum strength at temperatures of from 230°C. to 240°C., and its tenacity fell to a low value of some 7 tons per square inch at about 640°C. Dealing with the fire-resisting properties of reinforced concrete structures, he pointed out that such structures were bound to collapse if, due to fire, the temperature of the steel reinforcement rose to 600°C. or 700°C. By burying thermo-couples to various depths in a concrete block heated in an electric furnace, the rate of temperature-rise had been experimentally determined corresponding to various depths of cover. As a result of such treatment, the concrete block became full of cracks which developed for the most part during cooling. The weakening effect of heat on concrete was largely to be ascribed to the development of these cracks.

Prof. Jenkin said that Monel metal had not got a good name in this country; but having regard to Prof. Lea's tests which showed that it retained its strength at high temperatures better than mild steel, its use for certain purposes deserved reconsideration.

Prof. T. Hudson Beare said that as heated concrete blocks developed cracks even when allowed to cool slowly, it was certain that the violent cooling produced by hydrant jets playing on a fire in a reinforced concrete building would cause severe cracking of the concrete cover. This meant that when the heat of the fire returned to the spot that had just been sprayed, the reinforcing steel would be largely unprotected, and consequently the attempts of the firemen to extinguish the flames would actually assist in causing the building to collapse.

Prof. J. T. Macgregor-Morris desired more precise particulars of the windings used by Prof. Lea in the construction of his electric furnaces. From Prof. Lea's reply to his question it appeared that it had not been found necessary to use low pressures and heavy currents. In some cases, the windings were of sufficient resistance to absorb from 110 to 200 volts.

Prof. W. H. Watkinson suggested that a way to guard against collapse of a reinforced concrete building when subjected to fire would be to introduce the steel reinforcement in the form of continuously connected hollow pipes through which cooling water could be circulated in the event of fire. Prof. Lea, on the other hand, felt it unlikely that such a method would ever be adopted in preference to sprinklers, because sprinklers actually helped to extinguish the fire.

Col. R. E. Crompton, C.B., then read a Paper on the "Cutting Edges of Tools." He mentioned that last year the Institution of Mechanical Engineers formed a Cutting Tools Research Committee and as the result of its labours very important developments might be expected within the near future. It had been found that the great strength and toughness of the cutting edges of properly heat-treated tools made of modern high-speed steel made it possible to largely reduce the cutting angles that had become standard for tools made of ordinary carbon steel, thereby greatly reducing the power required.

Mr. C. E. Stromeyer said that he believed that the most perfect cutting edge was that of the knife used by oculists when removing the lens of the eye, and that there were only two firms in the world that could sharpen them.

Prof. F. C. Lea speculated on what actually took place in the process of stropping a razor, and suggested that it produced a cutting edge of amorphous material.

Dr. J. S. Owens was inclined to agree with this idea, but mentioned that he had failed in an attempt to shave himself with a piece of broken glass. Col. Crompton agreed that it was necessary to lap and burnish the edge of fine cutting tools; but when the cutting angle was only 15 deg. or less, it was necessary to lap and burnish both edges simultaneously, and he had devised means whereby this could be accomplished.

Wednesday, August 25th.

The first Paper taken this morning was "Farm Tractors Regarded from the Viewpoint of the User and Potential User," by Mr. S. F. Edge, during which Col. R. E. Crompton occupied the chair. Mr. Edge traced the history of the industry in this country, and expressed unbounded confidence in its future. For the time being he preferred a slow speed horizontal two-cylinder engine of fairly heavy build; though he had no doubt that the high-speed four-cylinder engine would eventually supplant it.

Col. Crompton gave an account of some of his early experiences with tractors, which dated back to 1861. He thought Mr. Edge had hardly done justice to the caterpillar type of tractor, which had its own sphere of usefulness. One thing which caused him concern was the shortage of liquid fuel. He thought it time that the use of liquid fuel was prohibited in all cases where coal *could* be used, and that efforts should be made to develop gas producers suitable for use on tractors.

Prof. Jenkin referred to the crude character of the ploughshare, which merely burst the earth open instead of cutting it.

Dr. E. Pickworth Farrow and other speakers dwelt on the deplorable lack of intelligence and skill of the farm hands who were entrusted with the driving of tractors.

Wing-Comdr. T. R. Cave-Brown-Cave advocated the desirability of employing visiting inspectors.

Prof. T. Hudson Beare, on the other hand, insisted that all tractor drivers should be compelled to take suitable engineering courses at the agricultural colleges.

Mr. Edge, in reply, said that certain tractors were now fitted with revolving cutters which halved the tractive effort. He thought that the fuel oil problem would inevitably solve itself under the stimulus of money and brains provided the demand for it was sufficiently great.

Mr. H. R. Ricardo then read a Paper on "High-speed Petrol Engines," the discussion on which was deferred.

Section G.

Thursday, August 26.

The first Paper taken this morning was by Prof. J. T. Macgregor-Morris on "A Portable, Direct-reading Anemometer for Measuring Ventilation in Coal Mines," which appeared in our issue of August 27.

In the course of the discussion on this Dr. Ezer Griffiths said the reason why the hot wire anemometer had not been more generally employed for air speeds was because its indications varied as the square root of the velocity and consequently the scale closed up at high velocities, whereas the air speed indicators utilising the Pitot tube, being based on a square law, were sensitive at high velocities and simpler in construction. He criticised the author and stated that he maintained a constant current in the bridge circuit, but that this current value was varied for different air temperatures in order to allow for the mass flow that was the product of the density and the velocity. Changes of air temperature, however, introduced another source of error, as it altered the sensitivity of the bridge. The deflection of a given mass velocity varied as C^2R, hence if the temperature of the bridge was altered R varied, and consequently keeping C constant did not suffice to maintain constant sensitivity. It might, of course, be possible to calculate the appropriate current value for each temperature and incorporate the correction with that made to reduce to true velocities. This reduction to true velocities did not, however, appear to be desirable, since mining engineers are primarily concerned with the weight (or mass velocity) of air circulating rather than the actual velocity. If such was the case, the necessity for reading the temperature and then adjusting the current to a particular value for each observation could be avoided if Prof. Morris altered his bridge arrangement so as to utilise the automatic constant sensitivity arrangement devised by the speaker's brother (Mr. Edgar A. Griffiths) for his petrol depth gauge. This would also simplify the construction of the anemometer by reducing the number of wires necessary. The second criticism was with regard to the method of calibrating the anemometer. His colleague, Mr. Davis, had made some careful experiments and found that for low velocities the calibration in a stream of air moving horizontally was not the same as when the stream was flowing in a vertical direction, owing to the interference of the vertical convection stream set up by the hot wire itself. At low velocities there was no standard for comparison, but it was found possible to do so by constructing a vertical wind channel with a Venturi neck. The hot wire anemometer was placed in the wide section while a Pitot was inserted in the neck, where the velocity was increased in proportion roughly to the reduction in area.

Mr. J. S. G. THOMAS remarked that the indications of the hot-wire anemometer could be obtained with any desired degree of sensitivity, limited only by that of the electrical apparatus available. The windmill instrument necessitated the application of a very uncertain correction, which, moreover, did not remain constant over any very considerable length of time. The hot-wire instrument, owing to its possible extreme sensitivity in the region of low velocities, appeared to be ideally suitable for the measurement of such velocities, though the ultimate standard of calibration of the instrument would probably be the Pitot tube. In the region of low impressed velocities of the gas stream, the effect of the free convection current set up by the heated wire or wires became of paramount importance, and great care had to be exercised in the interpretation of the indications of the hot-wire anemometer in the region of low velocities —of the order of a few centimetres per second.

Prof. MACGREGOR-MORRIS, replying to Dr. Griffiths, said the method of eliminating temperature errors was to re-adjust the current through the bridge for a new temperature to such a value that the bridge galvanometer or indicating instrument gave the same reading for the same velocity. This assumed that the form of the calibration curve was the same for all temperatures between 55°F. and 95°F., which was near enough the truth for the accuracy aimed at in the instrument. This method possessed the advantage of experimentally eliminating all possible sources of change due to temperature. Experimenting on a wind channel, he had found that the revolutions of the fan plotted against the square root of the Pitot tube reading gave a straight line down to 5 miles per hour, and if produced backwards, this straight line was found to pass through the origin. This suggested—and other experiments confirmed—that it was quite near enough for present purposes to treat the velocity in the wind channel as bearing a constant ratio to the speed of revolution of the propeller.

The exhibition of the apparatus described created much interest, and it was a pity that more time was not available for its discussion.

Mr. H. T. TIZARD then read a Paper on "Specific Heat and Dissociation in Internal Combustion Engines," immediately followed by a Paper on "The Indicator Diagram of a Gun," by Sir JAMES B. HENDERSON and Prof. H. R. HASSE. An attempt was made to hold a joint discussion on these two Papers together with the Paper on "High Speed Petrol Engines," read by Mr. RICARDO the day before; but the time available proved altogether inadequate to deal with the immense amount of material provided, and the controversy which arose between Mr. TIZARD and Sir JAMES HENDERSON on what measure of reliance could be placed on experimental determinations of specific heats of gases at temperatures above 1,500°C. did not help matters.

In the short time which remained Prof. A. L. MELLANBY and Mr. W. KERR read their Paper on "Steam Action in Simple Nozzles."

Friday, August 27th.

SECTION G.

At the final session Prof. W. CRAMP opened the proceedings by reading a Paper on the "Pneumatic Conveying of Materials."

Wing-Commander T. R. CAVE-BROWNE-CAVE then dealt with "Airships for Slow-speed Heavy Transport and their Application to Civil Engineering." Many interesting photographs were shown of one airship towing another, of landing operations, and of airships tied to a mast or moored to the ground.

Prof. F. C. LEA asked whether the fabric was sufficiently durable and whether extensive structural repairs were not frequently necessary. It seemed to him that for some of the purposes mentioned heavier-than-air machines might be more suitable than airships. Commander CAVE-BROWNE-CAVE, replying to these questions, said that fabric was now available which would withstand constant exposure in Egypt for one year at least without serious deterioration. Extensive structural repairs were seldom necessary, and it was usual to insist that the crew should undertake any repair work that had to be done. One of the great advantages airships possessed over aeroplanes was that it was not necessary to have a firm flat aerodrome.

Prof. G. W. O. HOWE then gave a popular exposition of the main points dealt with in his Paper on "The Efficiency of Transmitting Aerials and the Power Required for Long-distance Radio Telegraphy." A number of questions were asked; but apparently no wireless experts were present. In his concluding remarks Prof. HOWE said the need for further research would be clear to everyone, seeing that there was still doubt as to whether 20,000 kw. or only 100 kw. was necessary for transmitting a distance of 10,000 metres. It was a problem which might be profitably investigated by the second "Challenger" expedition which was now being mooted. The Paper is dealt with on another page of this issue.

The Efficiency of Aerials and the Power Required for Long Distance Transmission.*

By Prof. G. W. O. HOWE, D.Sc.

Of the total power supplied to the aerial of a transmitting station a portion is dissipated in the resistance of the wires constituting the aerial, tuning coils, secondary winding of the oscillation transformer, and earth or counterpoise wires, a portion is dissipated in imperfect dielectrics situated in the electric field, such as wooden masts, buildings, soil, &c., and a portion is radiated. If R be the total effective resistance of the aerial and I the root-mean-square current, we may write

$$I^2R = I^2(R_w + R_d + R_r)$$

where the suffixes w, d, and r refer to wires, dielectrics and radiation, respectively. Of the three terms the first can be calculated with considerable accuracy and can be kept small by suitable design, the third can also be calculated with some degree of confidence, but it is very difficult to form even a rough estimate of the second term.

The power radiated from an antenna of height h at a wave-length λ is equal to $1584(h/\lambda)^2I^2$ watts on the assumptions that the upper capacity is so large that the current has the same value at every point of the vertical wire and that the height is small compared with the wave-length. The latter assumption is usually justified, and any doubt as to the former is removed by taking h to be the effective height, which is less than the actual height by an amount which can be calculated approximately in many cases. The radiation resistance R is, therefore, equal to $1584(h/\lambda)^2$ and is inversely proportional to the square of the wave-length. With regard to the dielectric losses it is known that the power-factor of a condenser, *i.e.*, the ratio of the power dissipated to the product of current and voltage is approximately independent of the frequency. Hence I^2R_d bears a fixed ratio to IV where V is the voltage to which the aerial is charged, or, since $I=\omega VC$ and $IV=I^2/(\omega C)$, R_d must bear a fixed ratio to $1/(\omega C)$ and ωCR_d must be constant. R_d is, therefore, inversely proportional to the frequency or directly proportional to the wave-length. Now not only can R_w be made small, but it is less dependent on the frequency than either R_r or R_d. If the wave-length is increased by inserting additional turns in the inductance, the conductor resistance would thereby tend to increase, but this would be counteracted to some extent, if not entirely, by reduced skin effect. As an approximation R_w may therefore be regarded as constant, and the equation $R=R_w+R_d+R_r$ may be written

$$R = a + b\lambda + \frac{c}{\lambda^2}$$

where a, b, and c are constants.

$$\frac{dR}{d\lambda} = b - \frac{2c}{\lambda^3}$$

If R be plotted against λ, the slope of the curve will, therefore, be negative for values of λ less than $\sqrt[3]{(2c/b)}$, but positive for higher values of λ. The total effective resistance is a minimum for that value of λ which is equal to $\sqrt[3]{(2c/b)}$. Calling this value of the wave-length λ_m, we have

$$\lambda_m = \sqrt[3]{\frac{2c}{b}}$$

and for the value of the total effective resistance at this wave-length we have

$$R_m = a + b\lambda_m + \frac{c}{\lambda_m^2}$$

$$= a + \frac{2c}{\lambda_m^3} \cdot \lambda_m + \frac{c}{\lambda_m^2}$$

$$= a + \frac{3c}{\lambda_m^2} = a + 3R_{rm}$$

where R_{rm} is the radiation resistance at the wave-length λ_m.

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* Abstract of a Paper read before the British Association (Section G).

The total resistance is a minumum for that wave length at which the dielectric losses are twice the radiated power. From the observed values of R at three different wave-lengths it should be possible to calculate the three constants a, b, and c, and thus determine the three component resistances, but the measurements would have to be made with special care to give accurate values. If it be assumed that R_w is negligibly small, then at the wave-length λ_m, the radiation resistance is a third of the measured total resistance, and therefore

$$\frac{R_m}{3}=1584\frac{h^2}{\lambda_m{}^2}$$

from which the effective height can be calculated.

The San Paolo Aerial.

The San Paolo aerial at Rome is supported by three wooden lattice towers 218 metres high; it is stated* that it has a minimum resistance of 3·25 ohms at a wave-length of 7,000 metres. Reception tests on a calibrated frame aerial indicate an effective height of 138 metres. Neglecting R_w the above formula gives an effective height of 183 metres; to obtain 138 metres, one must assume the conductor resistance R_w to be 1·4 ohms. This is an improbably high value of R_w and tends to confirm the doubt expressed in the Paper referred to as to the accuracy of the measured resistances with undamped waves. $R=0{\cdot}5+0{\cdot}26\lambda+54{\cdot}3/\lambda^2$ gives the minimum resistance at a wave-length of 7·5 km.

It is evidently desirable that very accurate measurements should be made of the total effective resistance at various wave lengths of different types of aerials making allowance for the high-frequency resistance of the aerial, tuning coils, and earth wires, or counterpoise. By making such measurements on aerials with steel masts and wooden masts, with earthing wires and insulated counterpoises, much valuable information would be gained as to the magnitude of the losses and as to the use or misuse of every kilowatt generated. With the limitations at present imposed by the stage of development reached in the construction of large thermionic valves, the last-named consideration is one of the greatest importance. Assuming the aerial to have a large upper capacity and to be radiating at a wave-length very large compared with the height, we have for the radiated power

$$P_{rad}=1{\cdot}584\frac{h^2}{\lambda^2}I^2 \text{ kw.}$$

where I is the root-mean-square current in amperes. The electric field strength at a distant point of the earth's surface s given by the formula

$$E=\frac{4\pi}{10}\cdot\frac{h}{\lambda}\cdot\frac{I}{d} \text{ e.s. units}$$

$$=120\pi\frac{h}{\lambda}\cdot\frac{I}{d} \text{ volts per centimetre,}$$

where d is the distance in centimetres. This is the theoretical value on the assumption that the earth is a plane perfect conductor and that the atmosphere is a perfect dielectric of infinite extent.

Now the power supplied to any receiving station by the electromagnetic waves is proportional to E^2, and to be able to read the signals through atmospheric disturbances it is necessary that the value of E at the receiving station should exceed a certain value. This is not much affected by the size of aerial and degree of amplification employed, since these factors influence the loudness of both signals and atmospheric noises. We are neglecting here any secondary differences due to directive effects, &c.

Putting D for the distance in kilometres, we have

$$E^2=\frac{14400\,.\,\pi^2}{10^{10}}\cdot\frac{h^2}{\lambda^2}\cdot\frac{I^2}{D^2} \quad (E=\text{volts per centimetre})$$

and therefore

$$\frac{P_{rad}}{E^2}=\frac{1{\cdot}584\,.\,10^{10}}{14400\,.\,\pi^2}\,.\,D^2\left(\frac{\text{kilowatts}}{(\text{volts per centimetre})^2}\right)$$
$$=1{\cdot}11\,.\,10^5\,,\,D^2$$

If P is the total power supplied to the transmitting aerial, the ratio of P_{rad} to P may be called the efficiency of the aerial, and we may write

$$\frac{P_{rad}}{P}=\eta.$$

We shall assume that the theoretical formula just established is brought into agreement with experimental results by the introduction of the Austin-Cohen exponential factor. The formula then becomes

$$\frac{P}{E^2}=1{\cdot}11\,.\,10^5\,.\,\frac{D^2}{\eta}\,.\,\varepsilon^{0{\cdot}003D/\sqrt{\lambda}}$$

where D and λ are both in kilometres.

L. W. Austin found that to give readable signals at Brant Rock when receiving from U.S. cruisers, it was necessary to have a received current of 40 microamperes set up in the antenna which had a total effective resistance of 25 ohms, and an effective height of about 200 ft. To produce a current of $40\,.\,10^{-6}$ amperes in 25 ohms requires an E.M.F. of 0·001 volt, which, divided by the effective height of the aerial, gives a field strength of $1{\cdot}64\,.\,10^{-7}$ volts per centimetre.

Inserting this value of E in the above formula we get

$$P=3\,.\,10^{-9}\,.\,\frac{D^2}{\eta}\,.\,\varepsilon^{0{\cdot}003D/\sqrt{\lambda}} \text{ kw.}$$

To ensure a reliable commercial service under all conditions, a considerable factor of safety should be introduced. Assuming a factor of 5, the formula becomes

$$P=15\,.\,10^{-9}\,.\,\frac{D^2}{\eta}\,.\,\varepsilon^{0{\cdot}003D/\sqrt{\lambda}} \text{ kw.}$$

This gives an electric field strength E at the receiving station of 0·37 microvolt per centimetre.

We shall now consider more closely the value of the efficiency η of the transmitting aerial. Let β be the ratio of the conductor resistance R_w of the aerial earth system, which we assume to be constant for all wave-lengths, to the minimum value R_m of the total effective resistance; then

$$R_w=\beta R_m=\beta(R_w+R_{dm}+R_{rm})$$

where R_{dm} and R_{rm} are the dielectric and radiation resistances, respectively, at the wave-length λ_m for which the total effective resistance R_m is a minimum. Since, at this wave-length, $R_{dm}=2R_{rm}$, we have

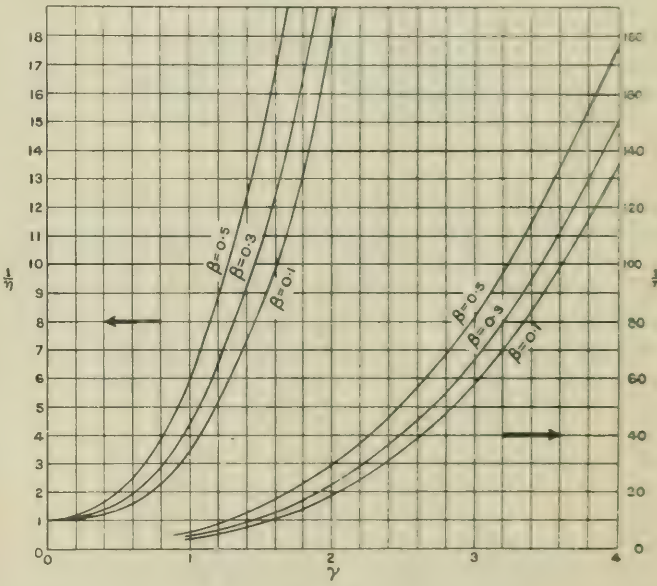

Fig. 1.

$$R_m=\beta R_m+3R_{rm}$$

and
$$R_{rm}=R_m\,.\,\frac{1-\beta}{3}.$$

Since the dielectric resistance is directly proportional to λ, whilst the radiation resistance is inversely proportional to λ^2, we have

$$R=\beta R_m+2\gamma R_{rm}+\frac{R_{rm}}{\gamma^2}$$
$$=R_m\left\{\beta+\frac{1-\beta}{3}\left(2\gamma+\frac{1}{\gamma^2}\right)\right\},$$

where
$$\frac{\lambda}{\lambda_m}=\gamma.$$

Of this total resistance R, the only useful part is that representing the radiation, viz.:—

$$R_r=\frac{R_{rm}}{\gamma^2}=R_m\frac{1-\beta}{3\gamma^2}.$$

Hence

$$\frac{1}{\eta}=\frac{R}{R_r}=\frac{3\gamma^2\beta}{1-\beta}+2\gamma^3+1$$

Fig. 1 shows the relation of $1/\eta$ and γ for $\beta=0{\cdot}1$, 0·3, and 0·5. These figures are very striking; they show that if a warship with an aerial for which $\lambda_m=1{,}000$ metres transmits at a wavelength of 3,000 metres, less than 2 per cent. of the energy actually supplied to the aerial is radiated, the remaining 98 per cent. being dissipated in aerial losses, whereas at a wavelength of 1,000 metres 30 per cent. may be radiated.

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* "Proceedings" of the Institute of Radio Engineers, 8, p. 142, April 1920.

If the values of β and γ are known the corresponding value of η can be substituted in the formula established above for the power P which must be supplied to the transmitting aerial. It is seen that P depends only on β, γ, D, and λ_m. We have calculated P for five values of D, viz., 1,000, 2,000, 3,000, 5,000 and 10,000 kilometres, for two values of β, viz., 0·1 and 0·5, for six values of γ, viz., 0·5, 0·75, 1·0, 2·0, 3·0 and 5·0, and for five values of λ_m, viz., 0·5, 1·0, 2·5, 5·0 and 10·0 kilometres. The actual wavelength in any case is equal to $\gamma\lambda_m$.

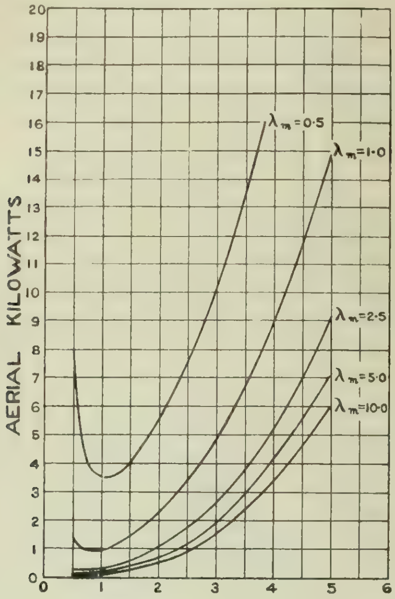


Fig. 2.

The values of the power P in kilowatts are given in Figs. 2 and 3. The curves have only been plotted for one value of β, viz. $\beta=0{\cdot}1$.

It must be remembered that these figures are based upon the Austin-Cohen exponential factor, which is of uncertain application for distances greater than about 5,000 km., and for wavelengths exceeding about 10 km. Of less importance are the assumptions as to the constancy of the conductor resistance, and of the power-factor of the dielectric losses of the aerial.

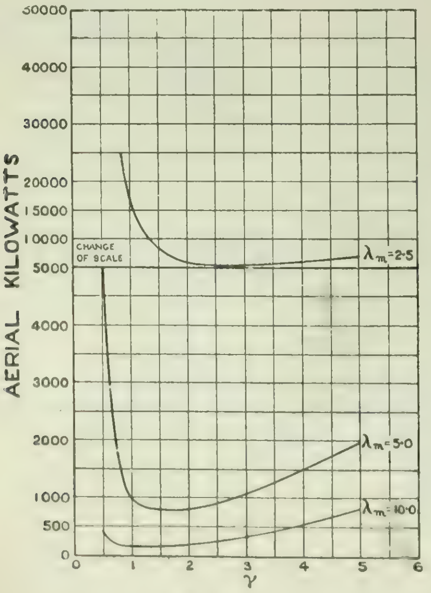


Fig. 3.

These curves bring out clearly the enormous saving of power which can be obtained by using aerials with high values of λ_m, that is with such small dielectric losses that the minimum total effective resistance is reached at long wavelengths. For a given aerial, and therefore a given value of λ_m, there is always a wavelength $\lambda=\gamma\lambda_m$ at which the power necessary for a given distance is a minimum. At longer wavelengths the inefficiency of the aerial more than counteracts the improved transmission.

The limiting factor in the amount of power which can be supplied to a given aerial is the voltage of the aerial at which, even if the insulators do not fail, the losses due to discharge from the wires increase very rapidly. This limiting voltage will depend on the size of wire employed and on the design of the insulators, &c., but for large well constructed aerials will probably be in the neighbourhood of 100,000 volts.

Since $I=2\pi fVC$ where C is in farads
I in amperes
and V in volts

we have

$$V=0{\cdot}53\frac{I\lambda}{C'}=\frac{I\lambda}{2C'}\text{ kilovolts approximately.}$$

where C' is in milli-microfarads
and λ in kilometres.

For example, if $C'=12$ milli-microfarads
$\lambda=11$ km.
and $I=200$ amperes

$$V=0{\cdot}53\,\frac{200\times 11}{12}=97\text{ kilovolts.}$$

Since the power P in kilowatts is equal to $I^2R/1{,}000$, where R is the total effective resistance at the working wave-length, $I=\sqrt{\frac{1{,}000P}{R}}$

and

$$V=17\frac{\lambda}{C'}\sqrt{\frac{P}{R}}\text{ . kilovolts.}$$

It is, therefore, a simple matter to see whether any power P can be supplied at a given wave-length to an aerial of known capacity and resistance without exceeding the permissable voltage. Conversely, from the formula

$$P=\frac{C'^2V^2R}{280\lambda^2}\text{ kilowatts,}$$

one can calculate the power corresponding to a given value of V. For example, if $C'=12$ milli-microfarads, $V=100$ kilovolts, $R=3{\cdot}75$ ohms and $\lambda=11$ kilometres (these values apply approximately to the San Paolo, Rome, aerial) we have as the maximum power

$$P=\frac{144\times 10^4\times 3{\cdot}75}{280\times 121}=160\text{ kw.}$$

Hence, in some cases it may be inadvisable to work at the optimum wave-length, and one may be compelled to use a shorter wave-length and consequently more power in order to keep the aerial voltage within the prescribed limits.

Hydro-Electric Power in U.S.A.

The Federal Water Power Commission, which was set up by this year's U.S.A. Water Power Act, has not been long in setting up its organisation. The work of the Commission has been organised in seven departments, as follows: Engineering, accounting, statistical, regulating, licensing, legal and operation. The engineer officer of the Commission is Lieut.-Col. Wm. Kelly. It is proposed to make a general investigation of the electric power industry, power sites, costs and development, and the results of the investigation will be presented to Congress before the construction work by the United States. The Commission will also consider construction plans proposed by licensees, will make physical valuation of properties in rate-making proceedings, and, when existing plants are brought under the act, will determine necessary repairs for maintenance, develop operating rules and determine adequate depreciation reserves. District offices for the receipt of applications for licenses will be opened in St. Louis, St. Paul, San Francisco and Denver.

It is reported that, in consequence of increased fuel cost and transportation difficulties, applications for developing more than 500,000 H.P. in water-power have been filed.

The U.S. Geological Survey has commenced an investigation of electric power production and distribution methods in the eastern States between Boston and Washington. It is proposed to inquire into the present and probably future demands of the area, including the possible future electrification of industries. All possible sources of power, developed and undeveloped, will be studied. It is said that only 10 per cent. of the power now used in the eastern seaboard district is water developed. The general power system contemplated between Boston and Washington would consist of a main artery, which would be fed from generating plants along the route, including plants already in use in the various cities. These city plants would sell surplus power to the general line. Feeders from the main artery would carry the power wherever needed in the district. Additional water-power and steam generating plants, located with reference to the source of supply rather than the immediate demand, would be built to supply all the extra power needed. Mr. W. S. Murray, of New York, consulting engineer, is in charge of the survey.

The Vacuum Tube in Radio Telephony.

By JOHN SCOTT-TAGGART.

There has, as yet, been no complete summarised account of the part played by that versatile device, the triode valve, in radiotelephony. The best account is undoubtedly that of Dr. W. H. Eccles in his Handbook, but further developments are now taking place with great rapidity.

The essence of valve radio telephony lies in the system of modulation. The production of oscillations is an easy matter; the three-electrode valve, the arc and the high-frequency alternator have all been used for the production of the carrier wave which is to be modulated by the microphonic currents. The purity of the waves produced and its adaptability to small power work make the valve an ideal generator. The other sources of high-frequency energy cannot be controlled in the large number of ways that it is possible to modulate the output of a valve, but on the other hand practically any valve modulation system which can be used with an arc or high-frequency alternator can also be used with a valve generator.

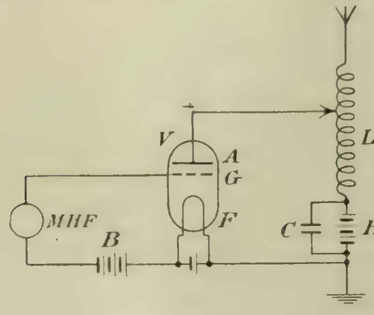


Fig. 1.

The Amplification of Modulated Energy.

It is not essential to proceed further once a suitable method of modulating oscillations has been devised Even if the power thus modulated is very small, yet long range telephony may be obtained by amplifying the weak modulated energy. This method is very old, and is an obvious one. The fundamental circuit is shown in Fig. 1. Across the grid *G* and filament *F* are applied the weak modulated oscillations which will be usually produced by an oscillating valve. The valve *V* will amplify these weak oscillations, and the power output will be developed in the antenna, or in a circuit coupled to the antenna. Several valves may be connected in cascade if the final power is insufficient, the coupling consisting of impedances, or air core (or iron core) high-frequency transformers.

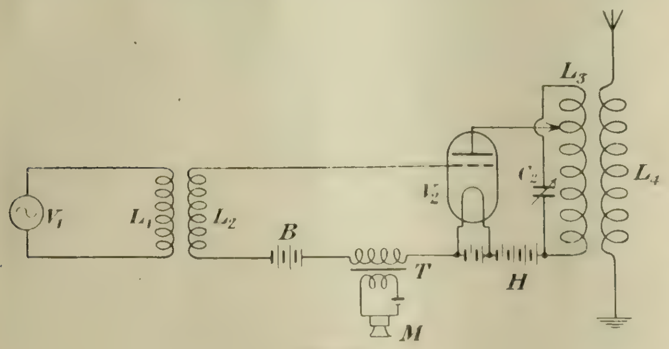


Fig. 2.

The amplifier arrangement of Fig. 1 which lends itself to all systems of modulation has a high efficiency. The "master oscillator" valve may operate off the same source of filament and anode current as the power valve *V*. The normal potential of the grid *G* may be such that the operating point is half-way along the grid-potential-anode-current curve of the amplifier valve *V*. This curve will usually, and should, lie completely to the left of the grid zero ordinate. This necessitates a source of e.m.f. *B* to give *G* a negative potential. A battery may be used, but since the radio frequency e.m.f.'s are probably high, it is possible to utilise the potential drop across the grid leak of the master oscillator to give *G* the requisite potential. The grid leak is preferably a wire coil from which a tapping may be taken. It will usually be preferable to operate *V* not half-way along its curve, but at the foot of it. No anode current will now flow through *V*, except when the modulated oscillations from the master oscillator vary the potential of *G*. Preferably, this latter coupling is effected by inducing the modulated oscillations into an aperiodic coil across *G* and *F*. The coupling between this coil and the oscillator is adjusted to produce the maximum output from *V* without producing distortion. The above amplifier system has the disadvantage that the aerial circuit has to be in tune with the frequency of the local oscillator. This disadvantage does not arise if a fixed wave-length is used.

Modulation Systems.

We now come to the important problem of providing a modulation system which will give perfect articulation. The following are some of the more important methods of modulating the high-frequency output of a valve :—

1. Grid potential control consists in varying by means of a microphone the normal operating point on the anode current curve of an oscillating valve. The output of the valve depends largely on the normal grid potential. This system is critical in its action and is not to be recommended, though the principle has been utilised in very many circuits.

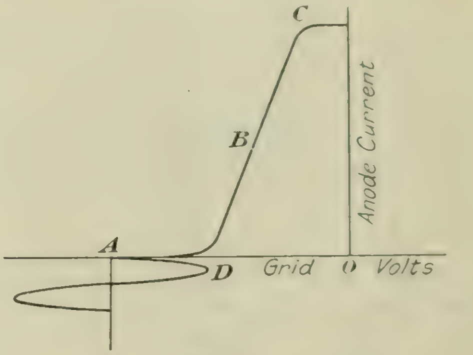


Fig. 3.

2. An amplifying power valve is used in conjunction with a separate source of pure oscillations which excites the grid circuit of the amplifying valve whose output may be modulated by any of the following methods :—

(*a*) The grid "base-line" potential (or operating voltage) is varied by a microphone arrangement.

(*b*) The anode voltage is varied microphonically.

(*c*) High frequency energy is absorbed from the input grid circuit by the microphone arrangement.

A form of the 2 (*a*) system is shown in Fig. 2. A source V_1 of pure continuous oscillations induces into the grid circuit L_2 of V_2. The grid is given a negative potential by a source *B* having an e.m.f. comparable to the e.m.f. of the oscillations in L_2. A microphone *M* and microphone transformer *T* will vary the grid base-line potential during speech. Conditions are roughly illustrated in Fig. 3. When not speaking, the grid potential *A* is such that the oscillations *D* do not cause the grid potential to pass beyond the bend in the curve. Consequently, the power developed in the output circuit of V_2 (shown this time loosely coupled to the antenna circuit) is very small. When *M* is spoken into, the positive half-cycles of the microphone potentials cause the grid base-line to move towards the bend. The oscillating potentials of the grid pass up the steep portion of the curve to an extent depending on the movement of the grid base-line produced by the microphone. The output of V_2 increases greatly, and will be directly proportional to the microphone potentials. This system gives very good speech.

The 2 (*b*) arrangement differs in that the microphone *M* and transformer *T* are removed from their position in the Fig. 2 circuit, and connected in place of *H*. The power developed by V_2 is directly proportionate to the anode voltage. This anode voltage is supplied by *M* and *T*, and the output is consequently proportional to the microphone potentials, which is what is desired for good articulation. Obviously the power developed by *M* and *T* is too small for general use, and valve amplifying arrangements are used to provide a suitable source of e.m.f. for the anode circuit of V_2. It will be noted that this arrangement, like the previous one, is a " quiescent aerial " system. No energy is radiated, except when speaking. Sometimes, however, a source of e.m.f. is connected in series with the transformer *T*. The microphone potentials now increase or decrease this fixed e.m.f., and so vary the output.

In system 2 (*c*) a valve as a resistance is used to damp the oscillations in the grid oscillatory circuit or anode oscillatory circuit of a Fig. 2 arrangement (with *M* and *T* eliminated). The filament and anode of a three-electrode valve are connected across the circuit in question and the energy dissipated in this vavle depends on its grid potential which affects the conductivity. The microphone transformer is connected across grid and filament of the dissipation valve, and thus the microphone controls the amount of energy wasted. It is easy to arrange that energy is only absorbed during speech ; sometimes, however, energy is always being absorbed, and the amount is varied by the microphone. Obviously, if the energy is absorbed on the imput side of V_2, less unnecessary waste will occur than if the energy dissipating valve is connected across the output circuit. Various arrangements for dissipating energy have been suggested, and will now be discussed.

Absorption Method.

It was originally suggested that a gas two-electrode valve could be connected across the aerial circuit of a continuous-wave transmitter, and the leakage through it controlled by a microphone which produced a transverse magnetic field. The advent of the three-electrode valve made it possible to use this device to absorb energy. Fig. 4 shows a fundamental circuit. A generator *A* produces continuous oscillations in the antenna; consequently, there will be a high e.m.f. across L_1. During those half-cycles which make the anode *P* positive, energy is diverted through the valve, and will dissipate itself on the anode. The amount of energy dissipated depends on the conductivity of the valve *P*, which in turn depends on the potential of the grid *G*. By connecting a microphone transformer as shown, the aerial output is controlled by the speech. The valve may be arranged so that energy is only absorbed when speaking into *M*, or as is more usual, the valve may be adjusted (by giving *G* a suitable potential) to absorb about half the output. A resistance is frequently included in the anode circuit. This improves articulation and dissipates energy. At first the valve dissipates most of the energy, but as the valve passes more current the resistance begins to dissipate most of the energy. To prevent the anode potentials affecting *G* electrostatically, a variable inductance in series with a condenser may be connected directly across *G* and *F*.

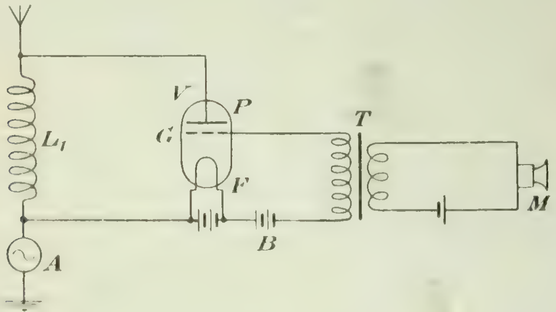


Fig. 4.

Such an arrangement only modulates the positive half cycles. The maximum modulation is effected when the other half cycles are also affected. A second valve may be arranged across L_1 so as to conduct. The filament may be connected to *P* and the anode to *F*. The secondary of another microphone transformer is connected across grid and filament of the second valve. The primaries of the two transformers are operated by the same microphone. Whichever valve is operative, the output is modulated.

Instead of connecting the valve across the whole of L_1, two valves may be used with filaments connected together and grids connected together. One anode is connected to one end of L_1 and the other anode to the other end. A middle tapping from L_1 is taken to the filaments. The potential of the grids is varied by the usual microphone transformer. The oscillatory current L_1 makes the anodes alternatively positive and negative. Thus both half-cycles are absorbed but only half the e.m.f. across L_1 is utilised. Special double anode valves may be used in place of the two valves (*e.g.*, those described by the author in British Patent 146,708). Frequently the absorbing valve or valves are connected across an oscillatory circuit coupled to L_1. The H.F. generator need not be in the position shown, it sufficing that oscillations are produced in L_1 whatever the means employed.

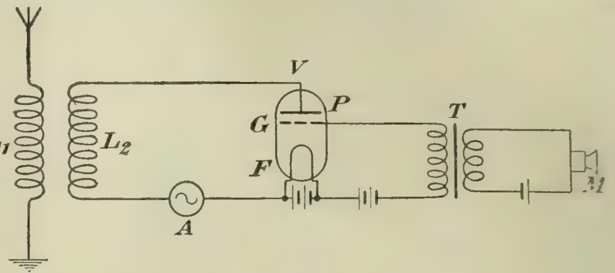


Fig. 5.

Another absorption arrangement consists in connecting a three-electrode absorbing valve across the grid oscillating circuit of a valve generator. The energy absorbed, which is small, produces large alterations in the output. A resistance is usually connected in the anode circuit of the modulator valve. This improves articulation. The microphone transformer is, as usual, connected across grid and filament of the modulator-tube. It is to be noted that absorption schemes cause a loss of power and also cause a variation in the wave-length emitted since the frequency of an oscillatory circuit is dependent on the resistance, if any, across it. In high-power absorption arrangements, modulating valves are connected in parallel, not in the usual manner, but in such a way that the valves become progressively conductive. This is done by grading the negative potentials on the grids. By this arrangement the energy dissipated is roughly proportional to the *square* of the number of valves used.

The Triode as a variable Conductor of Continuous Oscillations.

Another form of modulation consists in using a triode as a conductor of continuous oscillations and varying its conductivity by means of microphonic potentials on its grid. Fig. 5 shows a typical arrangement. The source *A* of oscillations is connected in series with the inductance L_2 and the tube *V*. Oscillations will only be set up in L_2 when *V* conducts. If the grid of *V* is sufficiently negative no current will pass through *V*. It will be seen that the current through *L* will be proportional to the microphonic potentials applied to the grid. As the single *V* will only pass half-oscillations (unless a steady positive anode potential is applied), two valves are sometimes employed so as to conduct both half-cycles of oscillating currents. It would appear that the resistance of the conducting valve or valves is too great for efficient results. These circuits may be arranged so as only to radiate when speaking. It has been proposed also to apply high-frequency potentials to the grids of two conducting tubes. These potentials may be obtained from the main source of energy, and are arranged in phase with the anode potentials. Thus when the anode of one of the triodes is positive the grid is likewise positive. The circuit which passes on these high-frequency potentials contains a microphone which when spoken into, controls their magnitude and so the conductivity of the triodes. This arrangement appears to be difficult to regulate in view of the phase adjustment necessary. All circuits employing a valve as a conductor may be arranged on a small scale and the result magnified by a power amplifier tube coupled to the antenna. To obtain a good system of modulation is the first desideratum. It is usually desirable to give the grid of the amplifier tube a negative potential so that the anode current is normally zero, and only increases when the modulator circuits induce modulated oscillation into the grid circuit of the amplifier. The circuit of Fig. 5 may be modified by replacing *A* by a three-electrode valve, its anode connected to *F*. High-frequency potentials are applied to the grid of this valve.

"Choke Control."

The commonest modulation system depends for its action on the fact that the output of an oscillating triode is directly proportionate to its anode potential. This fact was utilised in several of the earliest radio telephone sets, as far back as 1914. One arrangement provides for a microphone transformer whose secondary is included in the anode circuit of a tube fitted with the usual oscillation circuits. The anode potential is provided by the microphone transformer and is thus zero when not speaking. The system consequently only radiates when the microphone is affected. The arrangement is made more successful when a small steady anode potential, sufficient to maintain weak oscillations, is employed. A more usual though not "quiescent" system provides for a high steady e.m.f. in the anode circuit. The microphone potentials vary this potential above and below its normal value and thus modulate the H.F. output to the antenna. The microphone potentials are invariably magnified by one or more valves to give increased power. The output circuit of the microphone potential amplifier frequently consists of an iron-core choke coil, which is included in the anode circuit of the generating power valve. The modulator tube derives its anode current from the same course as the power valve and is of the same dimensions as the latter. The modulator when operative is capable of varying the H.F. output between nearly zero and twice the normal output. The modulator thus contributes to the output by producing potential surges in the impedance.

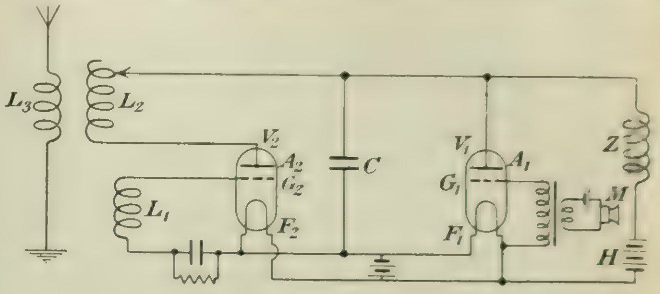


Fig. 6.

A typical circuit employing this "choke control" is shown in Fig. 6. The tube V_1 is the generator and V_2 the modulator; *Z* is the choke-coil. In this, as in all other circuits, a buzzer may replace the microphone if "tonic-train" effects are desired. A recent arrangement proposes to use the microphone not merely as a modulator, but as a primary source of current. The alternating currents are rectified by a valve, the resultant direct current being fed to the power oscillator.

The above arrangements cover practically all present-day modulation systems. It is at present too early to discuss others (including one or two evolved by the present writer's) which are now being tested with success.

The Dalmarnock Power Station.

Coping With Glasgow's Latest Electrical Needs.

Historical.

It is hardly necessary to say that since a supply of electricity was first given in Glasgow in 1890 the demands for that form of energy for lighting, power and traction purposes have very greatly increased and that extensions and alterations to the generating plant have frequently been necessary to cope with the growing connections. To become historical for a moment, we may say that the first stations were erected in Miller-street and John-street in 1890, followed by one in Waterloo-street in 1893. The latter station was conveniently near the centre of gravity of the load, but from the modern point of view possessed the great disadvantage that both coal and ashes had to be road-borne. The site of this station is now used as a sub-station, with the handsome offices of the department above.

What may be called the first step towards modernity was the erection of the Port Dundas and St. Andrew's Cross stations in the 1900-1904 period, and their equipment, first with reciprocating plant and later with turbo-alternator plant generating on the high-tension three-phase system, with conversion to low-tension continuous current for general use in the city. These stations, which are still bearing the bulk of the load, are favourably situated both for coal and water supply, but have now reached the limit of their economical capacity, and it became obvious some time ago that arrangements would have to be made for further extensions.

Mr. W. W. Lackie, then engineer and manager of the electricity department, went into the question, and recommended the purchase of a site, 13½ acres in extent, on the banks of the River Clyde at Dalmarnock, where abundant cooling water supply is available, where coal can be brought both by rail and barge, and where the distance from the centre of gravity of the load is not excessive. This recommendation was adopted, and the work of construction has now reached the stage when the first half of the new station is fast approaching completion. At the formal inspection and official inauguration last week we saw one 25,000 h.p. set put on load, another is being erected, while a third is on order. Eventually five such sets will be installed in the present station, while the site allows for the erection of a second station of the same size, giving a total ultimate capacity of 150,000 h.p.

General Layout.

The layout of the first station, which, as we have said, is now approaching completion, is shown in Fig. 1, which also gives a good idea of the general features of the site. Fig. 2 shows a plan of the turbine house and adjacent buildings in more detail, while Fig. 3 is a cross-section of the same buildings. Figs. 4 to 9 are photographs of different portions of the station, and are sufficiently explained by the accompanying footlines. For both the photographs and drawings we are indebted to Mr. R. B. Mitchell, the city electrical engineer and manager, who took over the work of supervising the construction of the Dalmarnock station on the appointment of Mr. W. W. Lackie to be one of the Electricity Commissioners.

Foundations.

Turning now to the features of the new station in more detail, it may first be stated that the subsoil was found to be quite suitable for a heavy building; but, nevertheless, the extra precaution was taken of constructing a concrete raft about 5 ft. thick over the whole area covered by the boiler room, turbine room and switch house. The original plans were for steel buildings, but, owing to war conditions, reinforced concrete had to be substituted. As will be seen from our illustrations, a simple and workmanlike design has been adopted.

Coal and Ash Handling Plant.

The first part of the station to be completed was the coal-handling section. The system employed is briefly as follows:—The coal comes direct from the mines by rail, and at Dalmarnock sidings each truck passes over a weighbridge to a tipping platform. The truck is then emptied into a filler pit by an electrically operated ram (the coal can be crushed if necessary). It then passes by means of a bucket conveyor to a distributing centre, from which other conveyors take it to the boiler house silos or to the coal store as required. A travelling gantry with a grab and bucket conveyor is provided for handling the contents of the coal store. This store is enclosed in substantial buttressed concrete walls, and has a concrete floor, providing for easy and safe storage. The capacity of the plant is 100 tons per hour. The ashes fall from the boilers into hoppers, and can be taken direct from the hoppers by trucks, but suction ash plant is being installed as the better method of removal.

Boiler House.

The boiler house is a three-storey building. The ground floor is for the forced draught fans and motors and the ash removal hoppers. The first floor is the boiler room, and the top floor is for induced draught plant, economisers, coal silos and hot wells.

Each boiler room contains eight Babcock & Wilcox water tube marine-type boilers, arranged in two rows of four on each side of the room. Each boiler has three chain grate stokers, a superheater and an economiser. Under forced and induced draught the maximum output of each boiler is 62,000 lb. of steam per hour. The final steam conditions are 275 lb. pressure per square inch (gauge), 700°F. total temperature. Each boiler has a heating surface of 6,948 sq. ft. and a grate area of 273 sq. ft. The superheater surface is 2,452 sq. ft. The economiser surface is 5,155 sq. ft. Each induced draught fan is driven by a 125 h.p. B.T.-H. motor, and each forced draught fan by a 35 h.p. B.T.-H. motor. With induced draught only the output is 50,000 lb. per hour. Three boilers are sufficient to supply steam for one turbine. The boiler efficiency at full load is 80 per cent. The boiler house is lighted by means of half-watt lamps.

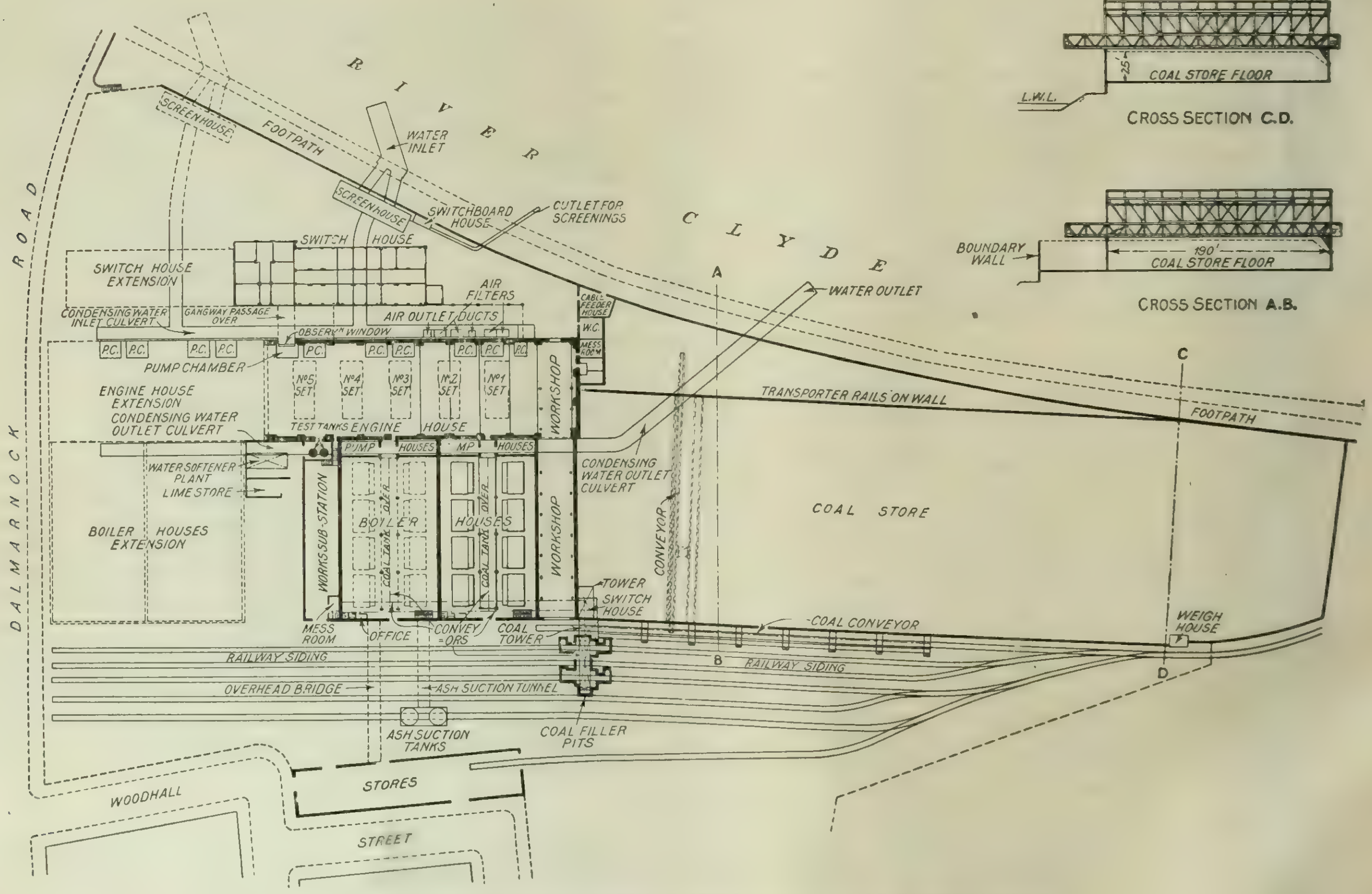


Fig. 1.—Site Plan of the Glasgow Corporation New Dalmarnock Station.

The coal silos are of sufficient capacity to maintain the supply for about 20 hours in the event of stoppage of the conveyors. One chimney is provided for each pair of boilers, thus giving four chimneys per section of the boiler house. All chimneys are of steel, and in the second boiler house each chimney has a grit and dust-settling chamber at its base.

The feed pumps are housed separately, and each pump room contains two pumps, one of which is steam driven, while the other is electrically driven. The capacity of each pump is 20,000 gallons per hour.

Every effort has been made to secure economical working by the provision of proper measuring instruments. The equipment for each boiler includes automatic coal-weighing machines, steam flow meters, thermometers, pressure and draught gauges. A CO_2 indicator is fitted for each boiler.

The boiler mountings and the steam valves throughout the installation embody all the latest improvements, and have been supplied by Messrs. J. Hopkinson & Co.

Turbine House.

The first turbine room will contain five turbo-alternator sets. The main dimensions of the room are: Length, 264 ft.; breadth, 75 ft.; height, 65 ft. The maximum continuous output of each machine is 18,750 kw., but the most economical load is 15,000 kw. At the point of maximum efficiency the steam consumption of the sets is guaranteed not to exceed 10 lb. of steam per kilowatt-hour, the steam being supplied at 250 lb. per square inch and 700°F., and the vacuum 29·1 in. of mercury. Connection with the switch house is made by means of Chadburn's ship telegraph and Graham's loud-speaking telephones, a complete set of inter-communicating instruments being provided for each turbo-alternator.

Two 500 k.v.a. geared turbo-alternator sets, the turbines running at a speed of 3,500 revs. per min., and geared to 440-volt alternators, running at 750 revs. per min., are provided for operating auxiliary plant of the station under special conditions, but normally the auxiliaries will be supplied from the sub-station, or from the special auxiliary windings on the step-up transformers.

Condensers.

A condenser of ample capacity (26,000 sq. ft.) for the enormous volume of steam to be dealt with is fitted to each turbine. The circulating pumps are capable of passing 22,500 gallons of water per minute through each condenser, the guaranteed vacua being 27 at 40°F.

The air pumps installed are capable of extracting 60 lb. of air per hour, and each set has a stand-by system. The condensate is pumped from each condenser through a Lea recorder, and thence passes through a feed water heater to the hotwells.

Cranes.

A 75-ton travelling crane spans the turbine room, and there is a second crane of this size in the workshop, so that it is a comparatively easy matter to move the heaviest parts of the machines installed into or out of the buildings. All crane motors are of the induction type, with wound rotors.

Alternators.

Each main alternator has a maximum continuous output of 23,400 k.v.a. at 6,500 volts, and runs at a speed of 1,500 revs. per min. The set now running was supplied by the Metropolitan

Vickers Company, while the one now under erection is by Fraser & Chalmers-Metropolitan Vickers. The machines are of the most robust construction, and have been specially designed with a view to withstanding the severe stresses they may be called on to bear. The rotors are all of the cylindrical type, and are built from solid forgings. Each machine has its own exciter, mounted on the alternator shaft. The generating voltage is 6,500 volts. The auxiliary alternators are each of 500 k.v.a. capacity at 440 volts. The speed of these machines is 750 revs. per min. The efficiency on full load has been found to be 93·3 per cent. Cooling air at the rate of 70,000 cubic ft. per minute on a 6-in. water gauge is provided. All auxiliaries are driven by 440-volt three-phase induction motors. Each alternator is directly connected to a bank of three single-phase delta-star connected Metropolitan Vickers transformers, which step the voltage up to 20,000 volts for transmission.

SWITCH HOUSE.

One of the most interesting portions of the power station is the switch house. In this building are housed the step-up transformers for each alternator, and the switches and control apparatus for all

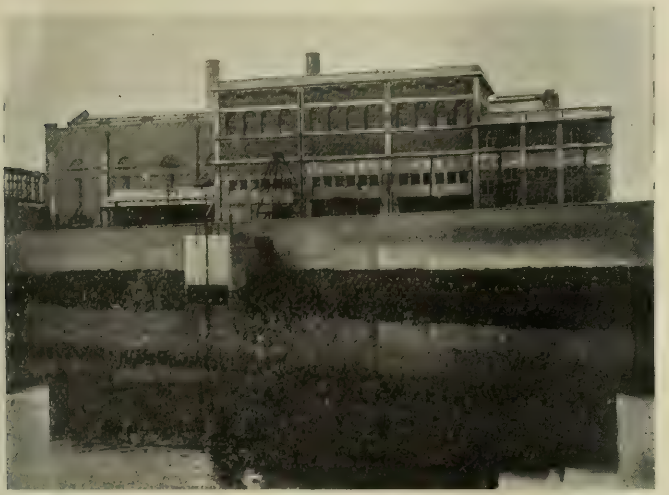


FIG. 4.—DALMARNOCK STATION FROM THE SOUTH, SHOWING EXTENSION OF SWITCHHOUSE.

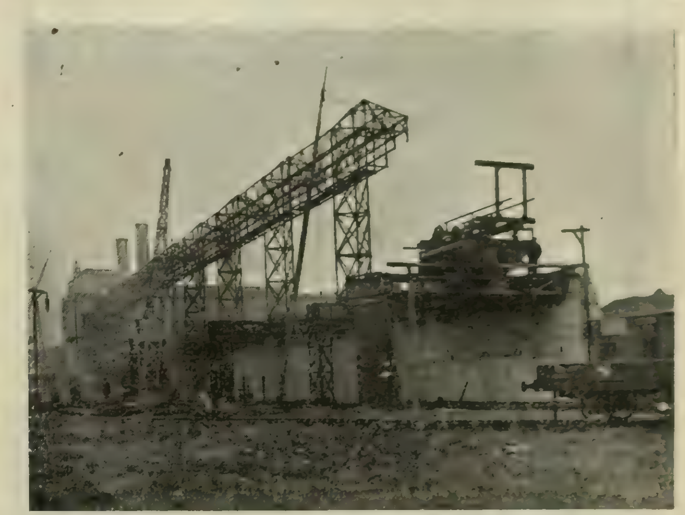


FIG. 5.—THE COAL CONVEYOR.

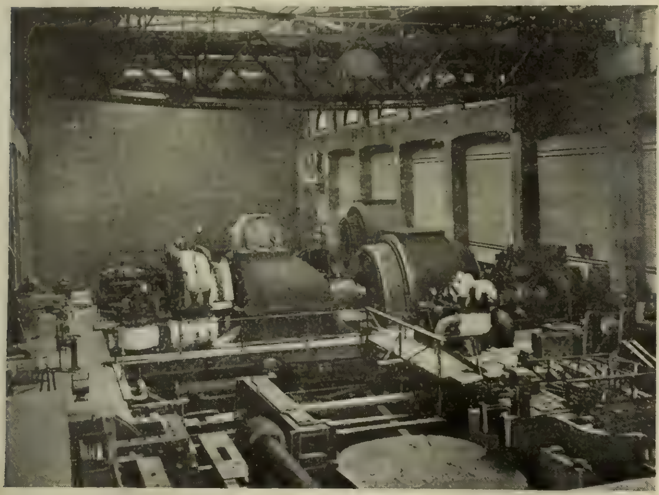


FIG. 6.—TURBINE HOUSE FROM WEST END.

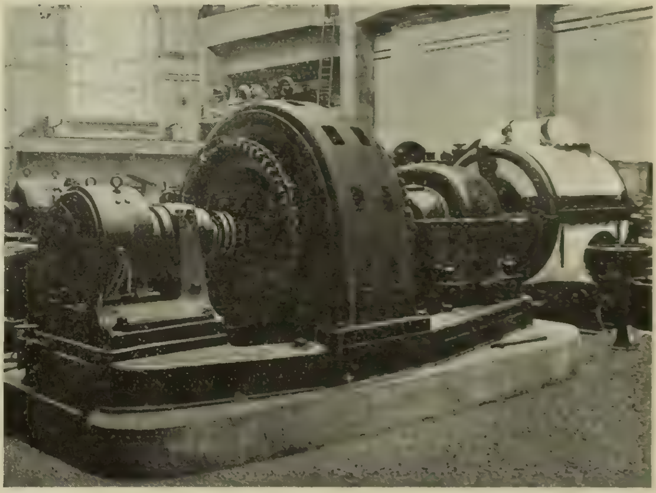


FIG. 7.—500 K.V.A. AUXILIARY SET.

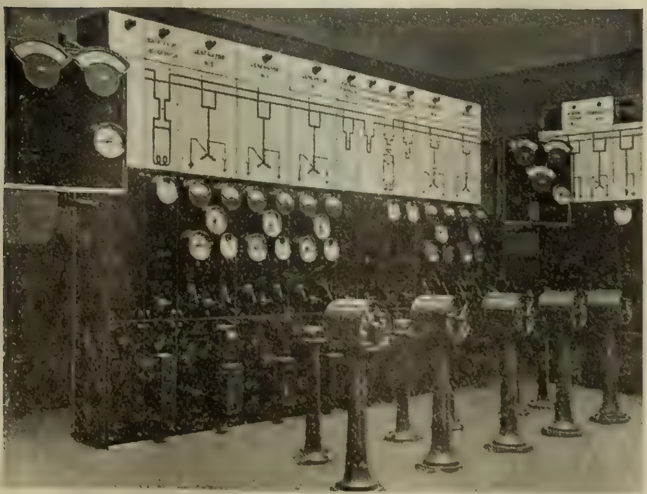


FIG. 8.—VIEW IN THE CONTROL ROOM.

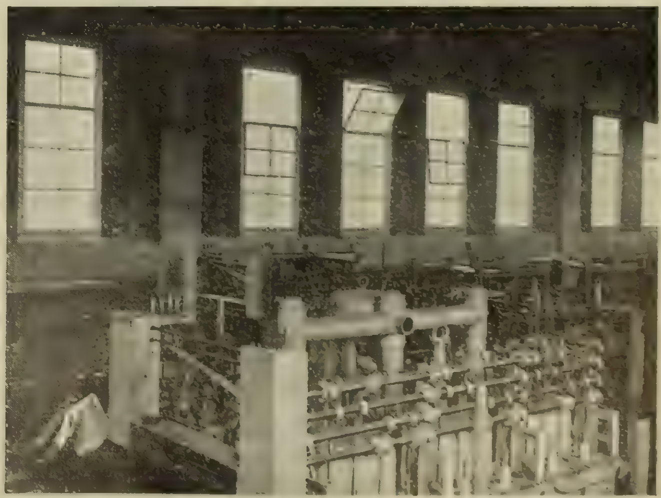


FIG. 9.—20,000 VOLT SWITCHGEAR.

the machines and feeders. The working pressure on the bus-bars is 20,000 volts. The step-up transformers are in single phase units, and have no features of note except their size (7,800 k.v.a) and a third winding for supply to auxiliaries at 440 volts.

A feature of the equipment is that thc switchgear is all of Messrs. A. Reyrolle & Company's well-known design and manufacture. That is, in place of the conventional concrete cell work, ironclad construction is used throughout, and every effort has been made to ensure that the switches will be as safe and satisfactory as any other part of the system. It is hoped that this design will remedy the defects of the apparatus ordinarily used, and special precautions have been taken to ensure that the danger to operators will be reduced to a minimum. All the switches are operated from a control room, in which the electrical measuring instruments and signalling devices are situated. The first section of the switch house contains five alternator switches. eighteen feeder switches, two coupling and two sectionalising switches, arranged as shown. Skeleton diagrams are provided over each panel.

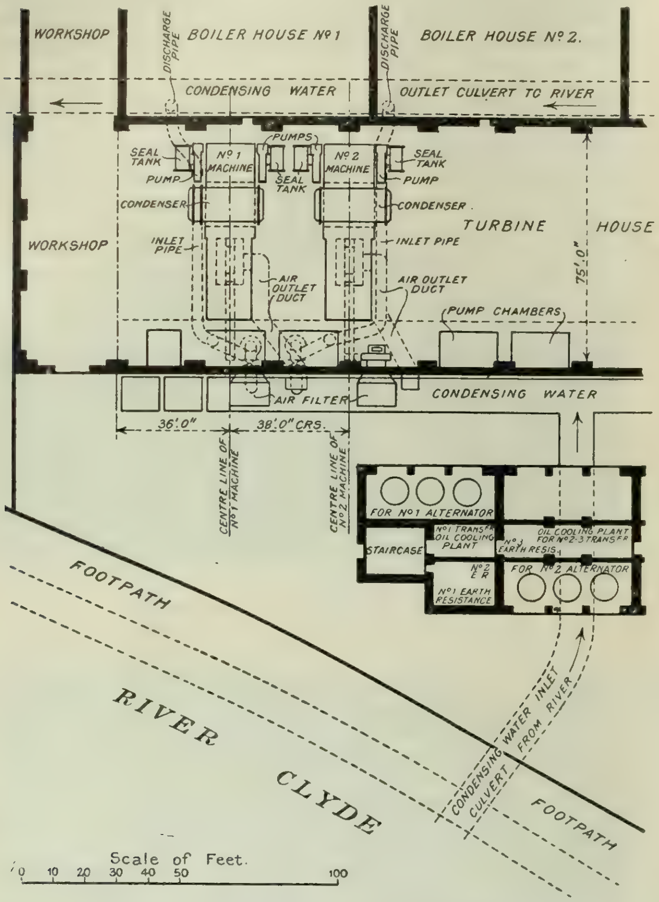


Fig. 2.—Plan of Turbine House.

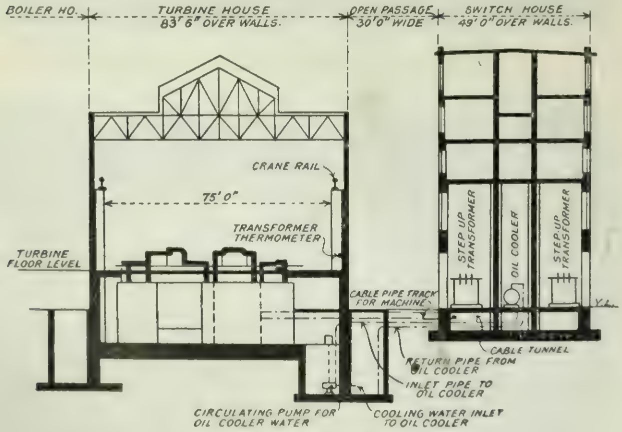


Fig. 3.—Cross Section of Turbine House, &c.

Storage Batteries.

A large 250-volt battery, consisting of 125 cells having a capacity of 3,000 ampere-hours at a discharge rate of 300 amperes for ten hours is placed in the basement of the switch house. This battery will be used for the excitation of the main turbo-alternator exciter fields, the switch house travelling crane and emergency station lighting.

Two 100-volt batteries, each consisting of 55 cells, having a capacity of 250 ampere hours at a one-hour rating of discharge, have been installed below the control room for the operation of the main switchgear controls and telegraphs. These batteries are intended to be used alternately.

The charging of all the batteries will be performed by duplicate motor generators, each consisting of a 440-volt induction motor coupled to a direct current generator, giving 650 amperes at 225 to 325 volts, and another giving 100 amperes at 75 to 150 volts.

Earthing Arrangments.

The neutral point of the 20,000-volt system will be earthed through a resistance capable of passing 500 amperes at 11,500 volts. A water resistance will be used for this purpose, in the first instance at least. The neutral point of each alternator will also be earthed through a resistance, the exact form of which has not yet been definitely decided on. This resistance will pass 1,500 amperes at 3,800 volts.

Distribution.

Electrical energy will be transmitted from Dalmarnock power station at 20,000 volts to various sub-stations, where it will be transformed by step-down transformers to 6,500 volts to supply the existing E.H.T. mains. Transformation to 440 volts for A.C. distribution and conversion to D.C. at 500 volts will also be made for low-tension supplies. The 20,000-volt cables are of the three-core split conductor and six core types and are controlled by the Merz-Hunter system of protection. A twelve pair air-spaced telephone cable is laid with each feeder for signalling and telephone purposes. At the distributing centres banks of 1,875 k.v.a. single-phase (three in a group) step-down transformers 20,000 to 6,500 volts are installed. Switchgear of the ironclad type is provided on both 20,000-volt and 6,500-volt sides. The distributing centres will be inter-connected by 20,000-volt feeders.

The laying, jointing and connecting up of the system of distribution has been carried out by the electricity department with direct labour. The consulting engineers were Messrs. Merz & McLellan.

Siemens Dry Batteries.

Messrs. Siemens Brothers & Company, Ltd., of Palace-place Mansions, Kensington-court, W.8, and Woolwich, have issued a new and enlarged edition of their catalogue 537, which deals with Siemens dry cells and batteries. For about 30 years past the company has been manufacturing dry cells at its Woolwich works, and it has deservedly acquired a high reputation for the excellence of its products. The researches carried out and the experience gained during its long career have resulted in the production of cells which are recognised as a criterion of high quality; and their perfection is the result of prolonged investigations. The number of types and sizes manufactured at Woolwich exceeds 600, but in the present catalogue reference is confined to those more generally employed. Illustrations and particulars (dimensions, weight in lbs and kilograms, E.M.F. and internal resistance) are included of a number of standard dry cells of round, square and oblong shape, low resistance cells, cells specially designed for telephones and electric bells, dry batteries for ignition in internal combustion engines, batteries for pocket flash-lamps, electric torches, hand lamps, &c.

There is also an illustrated description of the Siemens' " Inert " cells. In the form in which these cells have been perfected by the company they may be stored for an indefinite period in any climate without undergoing deterioration. The " Inert " cell is rendered active by the addition of water, which is absorbed by the ingredients within the cell, after which it possesses all properties of a dry cell of the highest class.

Our illustrations show examples of the company's dry cells of sizes " A " and " M." These are representative of the larger types of dry cells which are in extensive use. These sizes are recommended for cases where a large output and strong currents are required, or where intermittent currents are wanted over an extended period. as for small glow lamps, induction coils, telegraph and cable work, small motors, &c.

Correspondence.

PAYMENT FOR EXPERIENCE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: "Enquirer" has raised a most important question, and Mr. Delebecque has contributed usefully to the discussion of it when he says that it is a case for concerted action, and for co-operation amongst those who are so practically interested in this matter of the provision of their bread and butter, with, sometimes, a little jam. Mr. Delebecque's experience is fortunate, as has been that of others of us in manufacturing concerns, but there are many whose lot has been otherwise. Individual and isolated negotiations are rather ineffective for raising the general level, and it is necessary to have a carefully considered method of approach to deal with the whole question at once. The two requisites are: To know what we want, and to know how best to get it. The discovery of the first involves discussion of the relative grades and levels of our various positions—so much more difficult to decide than in, say, power supply work—and of their probable relative values to the manufacturing concerns whose interests we are all doing our best to serve. That will take time, and hence the sooner we start the better; but without some clear knowledge of the issue, attempts to reach a settlement will take longer still for their fulfilment. The getting of what we finally decide we want is also not easy; but it is possible even now to begin to pave the way by approaches to employers as a whole through their Federations, in an endeavour to gain recognition for the general body of technical staffs. Such recognition is essential, in my view, to the accomplishment of anything worth while in the negotiations which might then follow about rates of pay. If any uniform results are to be obtained they must come from employers as a whole to staffs as a whole, and as employers are met, as a body, in their Federations, and are accustomed to deal with bodies of Trade Unionists, staffs must form their Trade Unions so that negotiations may take place in the usual way. There are Trade Unions in being already, waiting to receive them; and I commend the suggested line of action to such a society as the Society of Technical Engineers as a suitable first effort on what appears to be its approaching emergence from the self-imposed obscurity which has hitherto concealed it. Strive for recognition first of all, but do not cease, meantime, to think what the considered policy is to be, once recognition has been obtained.

"Enquirer" suggests that pre-war salaries should be multiplied by two and a-half to indicate present values. That may be true for the lowest-paid grades, but I suggest that there is something to be said for the Civil Service scheme, under which the higher salaries are increased by a smaller percentage than the lower salaries, so that while, when the scheme was published, the then cost of living was held to warrant the doubling of a pre-war salary of £160, a pre-war salary of £400 was to be raised about 70 per cent., and one of £1,000 about 50 per cent. only. The idea of the scheme is that those who are more highly paid have more margin to bear the burden of changed conditions, and should, therefore, receive a smaller relative increase than their juniors. It has been pointed out, in reply to this, that such a scheme makes a diminishing difference between juniors and seniors in respect of salary, and so holds out less inducement to juniors to try to improve their position. On the whole, I think the diminishing percentage has most to be said for it; but that is just one of the points to be thrashed out and embodied in the scheme we formulate.

I close by repeating what I have already said more than once: First recognition, and consequent status; then a sane carrying out of a policy that will impress employers by reason of its essential fairness. And, above all, let us keep our heads. If we join a Trade Union, let us make it an example of what a Trade Union may be, in the midst of so many sorry happenings of the moment.

My name would carry no special weight; it is ideas and not persons that count here, and I prefer, therefore, to remain,—Yours, &c. CHIEF ENGINEER.

Machine Tool Exhibition.

The Machine Tool and Engineering Exhibition, organised by the Machine Tool Trades' Association, opened on Saturday, and will remain open until Sept. 25. There are a number of matters of electrical interest in the exhibition, and we will deal with these in subsequent issues.

INAUGURAL BANQUET.

At a banquet on Friday Sir Alfred Herbert, President of the Machine Tool Trades' Association, presided over a large company of guests and exhibitors, including Lord Ampthill, Sir Frederick Black (late Director of General Munitions Supply), Sir Edgar Jones, M.P. (late head of the Priority Department of the Ministry of Munitions), [illegible] of the United States and the principal Continental and South American States, the Agents-General of several British Colonies, Mr. Peter Rylands (President of the Federation of British Industries), Mr. Robert Young, Mr. Brownlie, Sir Vincent Raven, Sir Henry Fowler, Mr. Edward Iliffe and others. In proposing the toast of "Our Guests," Sir Alfred Herbert said considering the difficulties with which we had contended, and were still contending, he was astonished that there was any trade in the country at all, but in spite of all these difficulties there was a good margin of trade left for us yet, and if only a little more stability could be ensured the prospects before us were wonderful. The world was waiting to buy from us if we would let it, and if the unstable factors would only settle down to steady work for a year we could do more good to the country and to the workers in that year than was likely to follow from ten years of the present industrial strife. Machine tool makers wanted stability of labour, stability of foreign exchange and stability of taxation. He did not suggest that they desired the present level of taxation to be stabilised, but traders wanted to know where they were. How could it be imagined that a man would buy a machine when he was told that the price would be £1,000, more or less, and that it would be as much more as it happened to be when it was delivered. The result was that everybody was buying as little as possible, and if they found an opportunity of buying from a country which had more stable conditions then this country was apt to lose the business.

Sir Frederick Black, President of the Institution of Petroleum Technologists, replying to the toast, and speaking on the subject of oil, said: Every technical and commercial man in the oil trades was doing his utmost to increase the supplies. At the moment the demand was far beyond the supply.

Sir Edgar Rees Jones, M.P., who also replied, referred to the industrial unrest, and said that it would be the consumer who, in the long run, would settle these questions. The men and the employers might fight among themselves, but in the end it was the consumer who found a common denominator, and in the end would win out. We were up against the fact that although the world wanted our goods, the world could not afford to pay for them

Mr. J. A. Seddon, M.P., who proposed "The World's Trade and Industry," said that unless our export trade could be rehabilitated, bad times were in store for us. The causes of the present disquietude were Government extravagance, "ca' canny" and revolutionary tendencies in a small minority of the people. Capital and labour must take on a new orientation, and must remember that unless in the difficult times to come they were partners, they would destroy each other. Capital and labour should be in partnership and sit round the same table threshing out their differences, and when they had come to an agreement the function of Government was to see that justice was done to the general community; also there should be more elasticity in our banking system. The present system of joint stock banks was a handicap and a shackle on trade. The best men in industry were received with cold contempt by bankers when they approached them, unless they could produce fluid assets. What was wanted for a greater expansion of our prosperity and trade was more confidence from the banks. The old doctrine of taxing income was the sound one, and the excess profits tax should be abolished.

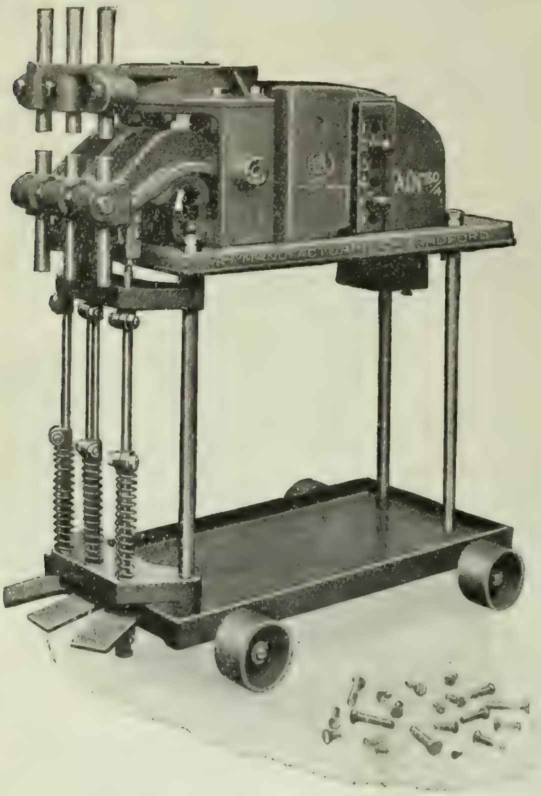
Mr. W. Stanley Hollis (Consul-General for the United States), the Hon. J. M. Hunter (Agent-General for Queensland) and Mr. W. Peter Rylands (President of the Federation of British Industries) replied to the toast. Mr. Hunter laid emphasis upon the danger of combines among manufacturers to prevent competition, and said that although this might assist in the home market it would not prevent competition from abroad in the Colonies. Australia welcomed the efforts now being made by the United States in competing with other countries overseas. There was, however, always a preference for British goods, provided they were sold on a competitive basis. In Australia before the war the United States only secured 12 per cent. of the imports, whereas now she had 28 per cent. whilst the British share had fallen from 48 per cent. to something very much less.

Lord Ampthill, proposing "The Machine Tool and Engineering Exhibition," said that the whole question of our economic position had once more become obscured by the dust and gaseous vapours of political controversy. The education which we all stood in need of was in the history of industry and commerce and its bearing on national affairs and international relations. Britons ought to know a great deal more than they did about how men of their race had led the way in research, discovery, invention and industrial progress; how narrowly we had missed losing our great industrial and commercial position; how splendidly we retrieved the situation during the war, and how vital it was that we should never again run the risk of losing that position. If we all understood these things we should pull together to win the peace just as we all pulled together to win the war. It would not be the fault of those who had organised the Exhibition if the public did not profit by the opportunity which had been afforded them. The one lesson above all others that we as a nation ought to have learned from the war was that the security of the nation depended first and foremost upon the security of her industries. Neither in peace nor in war must we ever again be dependent on foreign nations for the production of any of the essentials of life. That was what was meant by economic security, and it was upon economic security much more than upon armaments that national security depended. The machine tool industry was not, strictly speaking, a key industry, but it depended upon a real key industry, viz., the manufacture of tungsten. The maker of the machine tool, however, held the key to the greatest social problem of the day, viz., that of reconciling higher wages and shorter hours with low prices. What had to be borne in mind was that on the showing of industry and all human experience, labour-saving devices did not mean fewer workmen and less employment, but more employment and more workmen on higher wages.

Mr Charles Wicksteed, who replied, said he regarded the exhibition as the finest collection of machine tools that had ever been brought together.

Electric Rivet Heaters.

An interesting design of electric rivet heater has recently been placed on the market by the A.I. Mfg. Company. As our illustration shows this heater is fitted with three heads and is arranged to deal with mild steel rivets from ¼ in. to ½ in. in diameter by 3 in. long when continuously working. Working can be carried out at any speed and at the same time the best results obtained owing to the fact that when placing the rivet between the top and bottom electrodes heating instantly commences and continues until the rivet is pulled away, so that no time is lost in switching the current on and off. An advantage of using electric heating for this purpose is that no fire comes in contact with the rivet and no dirt, therefore, attaches to the metal and a minimum of scale is formed.



New Electric Rivet Heater.

To give some idea of the speed at which the machine can work we may say that 5/16 in. rivets of mild steel have been passed through the machine at the rate of 1,000 per hour, while those of ½ in. diameter have been passed through at a rate of 600 per hour.

The operation of the machine is extremely simple, the operator simply having to press the foot pedal to bring down the bottom electrode, place the rivet on this electrode, withdraw his foot still holding the rivet, thus pinning the latter between the top and bottom electrodes by a spring. As mentioned above, this immediately causes the rivet to heat up, but as there are three heads no time is lost in this way, as one rivet is always ready to be withdrawn as quickly as the operator can do the work. The maximum current demanded by a machine of the size we have been describing is 15 kw., alternating current, of course, being necessary. As in most of this Company's welders, eight heats are provided. Similar machines are also made for heating rivets up to 1½in. in diameter by 4 in. in length.

New Ellison Switch Designs.

In the list recently issued by Messrs. George Ellison, of Birmingham, which is devoted to totally-enclosed self-resetting emergency and shunt limit switches for cranes, hoists, lifts, &c., two new designs of switches are described and illustrated. The switch or "emergency push" shown in Fig. 1 is a radical departure from the flimsy bell push and lighting switch type of contact commonly employed; it is strongly made; it can be used for arduous duties, and cannot be readily damaged by rough usage. It is for hand operation, and is actuated by pushing a massive brass knob. The switch is made single pole and in one size; it is suitable for small currents such as those in no-volt or shunt trip coils An application for the push switch normally open is in the circuit of a trip coil which must be energised to trip a circuit breaker or similar device, and for normally-closed contacts to release a breaker or starter by interrupting the no-volt coil circuit; other applications are for ringing alarm bells, or as gate switches for lifts and hoists. It is a massive push switch with spring return action, enclosed in a heavy c.i. weather-proof box. The polished brass push knob on the cover can withstand the roughest use, and a rod attached to the knob passes through the cover and strikes on the moving contact arm to operate the switch. The component parts are all of brass and the insulation is mica and "ardwenot." The moving contact is a free roller mounted on, but insulated from the contact arm. The circuit is completed by pressing it between radial plunger type terminals, giving a double-break wiping contact.

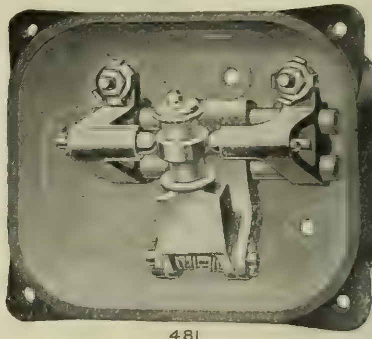


Fig. 1.—Emergency Push Switch.

No 2 switch, which is an improvement on a type with a considerable vogue, is primarily intended for tappet operating on cranes, lifts and hoists, but it can also be adopted for hand operation. Normal position of the contacts may be open or closed. The switch is made single, double or triple pole, is suitable for shunt trip or no-volt coil circuits and for heavier duties than the switch shown in Fig. 1, and the applications are the same, except that it may also be used to close or open the circuit of a motor instead of acting on the circuit breaker. It may be used on highly-inductive direct current circuits such as shunt-wounds, brake magnets or motor fields. The switch is quick make and quick break and is designed to meet every possible requirement of the crane builder. The fixed contacts are large copper studs; they may be dressed up repeatedly and renewals are inexpensive. The moving contact is a substantial copper roller mounted to swivel and rotate, so that it always beds on the fixed contacts no matter how burned they may be. The toggle mechanism ensures that the roller is either firmly in contact with the fixed contacts, or is forcibly held away from them; there is no intermediate position of doubtful contact, and chattering with resulting sparking is impossible. There are no contact jaws to bend or soften with the heat, and the single operating spring is a substantial spiral remote from the arc or any source of heat, and the contacts can be run at high temperatures without damage. The whole terminal box may be removed to allow access to the terminals, and the box fixing centres are symmetrical. The list gives full particulars of the method of operation, current carrying and breaking capacity, diagrams, &c.

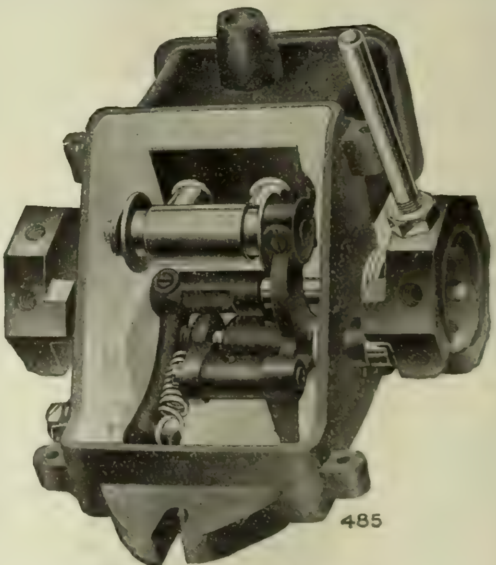


Fig. 2.—S.P. Limit Switch.

Engineering Training Organisation.

A meeting of the Council of this organisation, under the chairmanship, of Sir Maurice Fitzmaurice, C.M.G., was held on the 1st inst. to receive the first report of the executive and to discuss the future in the light of the fact that it did not appear possible to carry on as an independent organisation for financial reasons.

The CHAIRMAN said a great deal of work had been done by the executive, first with Sir William Ellis and later with Mr. C. H. Wordingham as chairman. Perhaps the greater part of the work was done by Mr. A. E. Berriman and Mr. A. P. M. Fleming. A not unreasonable response was obtained from the three principal institutions, who each promised £350, which he thought they intended to be an annual subscription. When it was found that the financial requirements were greater than would be reasonable for the institutions to guarantee, 246 engineering firms were asked for help ; but there was not a very good response (only 30 firms offered to become members). The organisation had never had the funds to appoint a permanent secretary or staff. A great deal of information, however, had been collected ; they had helped a great number of young men who had been anxious to start engineering work, and they had collected a vast amount of statistics and information with regard to engineering training.

Mr. C. H. WORDINGHAM said it was not pleasant to feel that the results of the hard work that had been done were much less than were anticipated. The executive had put in a large amount of time and a good deal of thought ; they had found that there was a great need for such an organisation as the one projected three years ago. The executive were in the position of advising the members that the organisation could not be carried on because they had no funds. A great de al of useful work had been done, and was embodied in the volume sent to the members of the Council. The executive felt that the work ought to be carried on, and that as they could not, as a separate organisation carry it on, they should transfer all they had done to some existing body. There were two, either of which seemed to be suitable. One was the Employers Federation and the other the Federation of British Industries. It was suggested that the executive should be given powers to negotiate with those bodies, and to hand over the organisation and the work already done to whichever of those bodies they thought the better fitted to take it over.

Sir WILLIAM ELLIS said their failure—if it were a failure, which he did not admit—to become a strong organisation was brought about by circumstances beyond their control. It was found that the limited scope they had in mind originally would not efficiently deal with the question. It was also found, following the war, that instead of being in difficulty as regards apprentices, the various works were blocked three or four deep with applications from apprentices. That altered the aspect of things to a great extent, as the organisation was, naturally, unable to get in touch with those firms and get from them a promise that applications recommended by it should be favourably considered. At the same time, the efforts of the organisation, ably helped by Mr. Berriman, had brought into existence a history and record of the present state of things in the country—a volume which would be of great value as a guide to the future policy in connection with apprentices.

Resolutions (moved by Mr. WORDINGHAM) were adopted, authorising the executive to confer with representatives of the F.B.I. and the Engineering and National Employers' Federation as to taking over the organisation, &c.

Prof. WERTHEIMER (Bristol University), who seconded the first resolution, said the members were deeply indebted to the Executive Committee and to Mr. Berriman especially, because those who had been interested in that matter on the university side knew the amount of work Mr. Berriman had done. The book published by the organisation was an adequate excuse—if an excuse were needed—for its existence. He hoped the work would be carried on by some body or organisation with adequate funds.

Votes of thanks to Mr. Berriman for the work he had done, to the Daimler Company for allowing him to do it, and to the Executive Committee concluded the proceedings.

French Electric Supply Standards.

Some literature has recently been issued by the FRENCH PERMANENT COMMISSION ON STANDARDISATION on the regulations for the unification of electrical material, including a circular upon the most suitable voltages and frequency of alternating current and direct current supply systems. There are many 2-phase networks in France, with frequencies of 25 and 42 periods per second, to which the new rules do not apply. For distribution systems below 1,000 volts the following pressures are recommended :—For direct current supply 115, 230 and 460 volts, for 5-phase networks 115 and 230, and 3-phase systems 115, 200 and 500 volts. For alternating current distribution lines above 1,000 volts the following pressures have been selected : 1,000, 3,000, 5,500, 10,000, 13,500, 15,000 and 22,000 volts ; and for transmission purposes 30,000, 45,000, 60,000, 75,000, 90,000 and 120,000 volts. The general frequency is to be 50 periods per second, but for special purposes 25 and 16·66 periods may be employed.

Commercial Topics.

Hong Kong Electrical Imports.

The value of the direct imports of electrical accessories from the United Kingdom into Hong Kong during 1919 was £20,742, against £8,168 in 1918 ; of electric wires and cables £22,733, against £1,450 ; and of machinery and engines £223,992 against £359,630.

* * * *

The Australian Tariff.

Apparently the revision of the new tariff, which came into force on March 24 last, will occupy the Commonwealth Parliament during the greater part of the current session. At a recent meeting of the State Premiers in Melbourne a resolution (moved by Sir Walter Lee, of Tasmania) was adopted urging a remission of duties on machinery, &c., imported by a State Government. The Tasmanian Government is importing a large quantity of electrical machinery for its hydro-electric undertaking, which it wants free of duty, It is, however, doubtful if the Commonwealth Government will make an exception in the case of the State departments. The tariff was established to encourage local manufacturers, and it is claimed that, in the matter of electrical machinery not yet being produced in Australia, that the duty, while handicapping the State, is not yet effecting the purpose for which it was designed.

* * * *

Electricity for Domestic Purposes in Switzerland.

Owing to scarcity and increasing price of coal, petrol and other fuel in Switzerland it is reported that the public is turning more and more to electricity for heating, and increasing efforts are being made to increase the number of water-power stations. According to a report by the Commercial Secretary to H.M. Legation at Berne, the cost of building hydro-electric stations has increased enormously of late, and it is now treble and in some cases five times what it was before the war. With very few exceptions, supply authorities have been obliged to raise the charges for current, and it is suggested that there are only two ways of supplying electric energy at cheaper rates—viz., either by erecting larger power stations and constructing more extensive artificial lakes in the high-lying mountain valleys, or to encourage the use of electricity during the night by reducing the charge during these hours.

The present tendency is to increase the number of artificial lakes, and in this way to build up reserves of water power with a view to cheapening the cost of current. In the towns electricity is being increasingly used for household purposes—for ironing, grilling, toasting, warming up dishes, and for cooking and innumerable other household purposes. The number of bakers and confectioners who bake by electricity is rapidly increasing. A new industry is said to be growing up in the construction of electric stoves (containing either water, oil or terra cotta) for heating private houses. The current used for these stoves is generated at night, during which time the stoves are heated up, whilst in the morning the electric current is turned off and the stoves remain warm during the whole of the day. In all modern houses and hotels a large quantity of water is heated by electricity produced between midnight and 6 a.m. It is asserted that provided the price of electric current used at night can be sufficiently reduced, electric heating in Swiss houses will in time become the general rule.

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Japanese Electrical Exports and Imports.

There was a slight drop in the quantity of insulated electric wire exported from Japan. In 1919 the value rose to 8,411,700 yen from 8,324,333 yen in 1918 and 3,118,915 yen in 1917.

Electrical machinery and textile machinery are going out of the country in increasing quantities, the former chiefly to China and the Kwantung Province (through Dairen). These two took between them over 60 per cent. of the shipments. Spinning machinery went to China and India in 1918, China taking over one million yen worth and India over two million yen. The Indian demand will, it is thought, stop when British machinery is again available

In the last two years a strong demand for motor cars has arisen as a result of war prosperity. During 1918 there was an import of 1,653, valued at 4,524,953 yen, and last year 1,579, valued at 5,531,540 yen, nearly all from America. In 1919 the value of machinery imports was 89,221,936 yen, nearly 67 millions being American machinery, against 58,144,046 yen in 1918 ; Great Britain's share in 1919 was 16,144,046 yen, against 9,820,923 yen. The pre-war positions of Great Britain and America have been reversed, and a recapture of the market will be a matter of the greatest difficulty. British machinery of all kinds, particularly textile machinery, is as much in demand as ever, but the apparent impossibility of obtaining satisfactory delivery and the continuance of high prices, must drive buyers into the American market and keep them there. The heaviest items in the list of imported machinery during the last three years were :—Steam boilers, dynamos, electric motors, transformers, &c. Being cut off from many sources of supply during the war, Japanese engineers were obliged to turn to home supplies and a great advance was made in local maufacture. Given a model on which to work, local production is now of satisfactory quality, especially in electrical machinery, and several firms have made agreements with British and American firms, whereby the latter allow their patents to be worked in Japan in payment of royalty. The General Electric Company of America has considerable interests in two large concerns in which their models are produced for the local market. Japanese engineers are at all times greatly dependent on training and instruction from foreign countries, and the impossibility of getting assistance of this kind from Europe during the war caused a considerable number of engineering and other students to take their training in America, and accordingly these men will doubtless continue to prefer the American machinery.

Electricity Supply.

Kendal Council have applied for authority to borrow £7,469 for the electricity undertaking, including £6,464 for a Diesel set.

An agreement has been made by Erith Urban Council with Woolwich Borough Council for the supply of electricity in bulk.

The Electricity Commissioners have sanctioned the borrowing by Accrington Corporation of £65,000 for extensions of the electricity undertaking.

The following revised rates for current has been adopted by Coventry City Council:—Lighting, m.d. rate, 8d., 6d., and 2d.; flat rate 7d.; domestic purposes 2d.; l.t. power 2d.

Oswaldtwistle Council have decided to apply to the Electricity Commissioners for an order to authorise them to obtain a supply of current in bulk from a neighbouring authority.

Malvern Urban Council have decided, subject to having guarantees representing 7 per cent. on the outlay for five years, to extend the supply mains to West Malvern at a cost of £4,500.

The Town Council of Aldershot has been informed by the War Office that it is unable to accede to the request that Aldershot command power station should supply electric current in bulk to the Council.

Bury St. Edmunds Corporation have applied for authority to increase the maximum charge for electric current to 1s. per unit. It is proposed to spend £12,536 on extensions of the electricity undertaking.

The electric supply scheme prepared for Lurgan Urban Council by Mr. Pleasance, of Belfast, and estimated to cost about £20,000, has been submitted to the L. G. Board, and sanction has been asked for a loan.

Darwen Corporation has been authorised to purchase the necessary cables to take from Blackburn Corporation a supply of electric current for power purposes to the Queen-street Mill, Darwen, and the tender of the Macintosh Cable Company for the supply of h.t. feeder cables has been accepted.

There has been a great increase in electricity sales at Blackpool this summer. During July the sales were 622,708 units, against 522,993 in the corresponding month last year, and from April to July inclusive the number of units sold was 2,152,659, an increase of 485,091. The greatest increase was in private lighting, heating and power, which rose from 722,625 to 997,736.

Hexham Urban Council has assented to the application of the Hexham & District Electric Light Company to employ overhead mains in the district, provided the whole of the poles for the overhead mains are of steel. The Council has also accepted the company's offer to adapt certain existing standards for electric lighting. The cost of wiring standards, providing fittings, electric bulbs of 200 c.p., connecting to main, maintaining and supplying current, will be £5 per standard for the season of 40 weeks.

The Electricity Commissioners notify that they will hold an inquiry at the Middlesex Guildhall, Westminster, on the 6th October and following days into the application of the County of London Electric Supply Company for consent to a generating station at Barking under their Provisional Order of 1912. Objections to the application must be made by letter, and sent to the Secretary of the Electricity Commission, Gwydyr House, Whitehall, S.W.1, on or before the 27th inst., and copies of the objections must also be sent to the Company.

Official notice has been given of the first applications to the Electricity Commissioners for Special Orders under the Electricity (Supply) Act of 1919. The Urban Council of Bedwas and Machen (Mon.) seeks an order to generate and supply electricity for public and private purposes within the whole of the urban area, and the Urban Council of Mynyddislwyn want an order to provide and distribute electrical energy in their area and to authorise them to exercise the powers of the Rhymney Valley and General Electric Supply Company's Order of 1907 so far as they relate to their district. Any objections must be made to the Secretary of the Electricity Commission, Gwydyr House, Whitehall, S.W.1, by Sept. 30.

The St. Anne's-on-the-Sea Electricity Department's accounts for the year ended March 31 show revenue £27,546 (compared with £22,721 for the previous year), working expenses were £19,309 (£17,186) or £22,467 (£18,989), including sundry sales and public lamps, and the gross profit was £5,078 (£3,732). Interest required £1,724, redemption £3,201, and allowances to employees with H.M. Forces £21. The net surplus (£132) has been placed to reserve. Working expenses per unit sold were 3·822d. (3·434d.), and the net profit per unit was 0·021d. (against a loss of 0·217d. in previous year). Maximum supply demanded was 820 kw. Units generated were 1,888,462 and sold 1,522,985 (1,560,749).

Belfast Corporation electricity department made a net profit of £19,046 during the year ended March 31. The total revenue was £276,520, against £164,807, the huge increase in revenue being partly due to increased charges. The total number of units sold was 29,740,000, against 18,514,000, an increase of 11,226,000 units. The expenditure was £217,560, against £127,563, and after meeting interest and sinking fund charges the balance has been transferred to appropriation account. Borrowing powers during the year were exercised to the extent of £251,000, and capital disbursements were made in connection with the extension scheme to the amount of £78,196.

One of the electrical projects being talked about in Ireland is the proposal that Loughanure, County Donegal, should be arranged, so that it could be enlarged beyond its present area of 3 miles in length by ¾ mile in breadth, and thus take in several other streams and lakes into the catchment area. The power of the loughs Dunlewy, Upper and Lower Nacung, could be similarly reservoired and brought to Dowros by a cut the fall being about 200 ft. Lough Owencarrow, which is part of the Rosses lakes system, could also be utilised, the estimated horsepower of the lake mentioned above being nearly 5,000. The county is rich in short, swift running rivers, and their total energy is not, it is said, far short of 12,000 H.P. The swift running rivers which empty into Gweedore Bay could certainly be used for industrial purposes.

Our correspondent states that the company which has been making borings for lignite near Glenavy, on the County Antrim shores of Lough Neagh, has purchased extensive tracts of lands over which the borings were made by their experts. Lignite has been found on several farms at a depth of from 100 ft. to 130 ft., and there is every indication of big supplies. The specimens obtained seem to have a greater specific gravity than the English and Scottish lignite. It has been long known that extensive beds of lignite lie on both sides of Lough Neagh, running from the Tyrone shores right under the Lough to the Antrim side. The borings, however, on the Antrim side seem to be more successful than those on the Tyrone side.

At Wednesday's meeting of Sheffield Corporation the Electric Supply Committee reported that the total number of consumers was 9,902 an increase of 1,938 during the year, or 24 per cent., and the total connections amount to 164,262 kw., an increase of 14,460 kw., or 10 per cent. The total number of units generated (including traction) last year was 158,248,710, compared with 192,839,041 in 1919; the units sold were 132,178,750, against 161,939,041, and the units used in transmission were 14,535,427 (16,571,029). The average price obtained per unit for light and heat was 3·20d., against 2·59d., and for power 1·09d., against ·89d. The cost per unit sold went up from ·89d. in 1919 to 1·23d. last year. The total revenue in 1920 was £786,493, against £735,145; working expenses £569,577 (£504,355) and the balance (after deducting interest and sinking fund) £31,922 (against £69,293), which has been put to renewals and special expenditure fund. The average cost per ton of coal in 1920 was 28s. 1d., compared with 13s. in 1916.

Electric Traction.

The Colne Town Council has been authorised to borrow £10,345 for the erection of a new tramway depot.

The Ministry of Transport has now sanctioned a higher scale of fares on the Accrington tramways, and the new charges came into operation last week.

As Burnley Council has decided to pay the fitters employed in the tramway department back pay on the terms decided by the Joint Industrial Board the ban on overtime has been lifted.

The threatened strike of the Doncaster tramway employees has been averted by the grant of an extra ¼d. per hour by the Tramways Committee.

In consequence of the introduction of the three-shift system, the Walsall Trades Council has asked the Tramways Committee to make arrangements whereby men employed on the mid-day shift system can have the benefit of cheap fares.

The gross profit of the Southport Corporation tramways department for the past year was £21,707, against £20,347 in 1918-19. The sum of £2,100 was applied in aid of rates, and after meeting interest and sinking und, a balance of £819 was applied in reduction of the previous deficit.

The cost of the arbitration proceedings (£4,000) in connection with the purchase of the undertaking of the Oldham, Ashton & Hyde Electric Tramways Company has been allocated as follows: Ashton Council, £2,500, Hyde £1,250, Denton £750 and Audenshaw £500.

Notwithstanding some keen criticism, Glasgow Corporation has finally endorsed the proposal of the Tramways Committee to accept the tender of the United States Steel Products Company for the supply of 10,000 tons of steel tram rails. The Company is to give a written and duly authenticated guarantee regarding the payment of wages and other conditions of labour in carrying out the contract.

The General Vehicle Company, Ltd., have recently supplied Messrs. M. Hancock & Co., brewers, of Cardiff, with one of their 2-ton electric lorries for delivering beer, and another vehicle of the same description is in hand for the firm. The vehicle is one of the standard G.V. 2-ton chassis fitted with an ironclad battery 44 I.M.V. 7. It runs for approximately 40 miles on a charge with a speed of 12 miles per hour.

In order to show their appreciation of the good work done by the volunteers who ran the power station during the recent strike and ensured an unbroken supply of light, the Cardiff City Electric Light & Tramways Committee have passed a resolution of grateful thanks for their public-spirited action. The workmen volunteers in the regular employ of the Council have received an extra week's wages, and compensation has also been paid to the workers from outside.

The accounts of the Oldham municipal tramways for the year ended March 25 show revenue £237,408 (compared with £184,029 in previous year), and working expenses £168,648 (£124,336). Rent of leased lines required £3,743 (£3,811), interest £8,501 (£8,489), sinking fund £19,671 (£19,019) and income tax, &c., £10,270 (£8,227), leaving a net surplus of £26,573 (£20,144). Car-miles run were 2,124,755 (2,093,946) and passengers carried 31,816,891 (31,229,035). Revenue per car-mile was 28·816d. (27·093d.), and working expenses, including power, were 19·049d. (14·251d.). The revenue on the motor 'buses was £447 (£716) and the working expenses were £1,451 (£1,627). Revenue was 14·804d. (11·187d. and working expenses were 47·991d. (25·397d.) per mile.

Imperial and Foreign Notes.

The Town Council of Mount Morgan (Queensland) is considering a proposal to adopt a municipal scheme of electricity supply. The Mount Morgan Company has agreed to supply the electricity at 3¾d. per unit, and it is proposed to sell it at 5d. per unit to consumers. It is estimated that it will cost the Council £7,500 to put in distributing mains.

The Amalgamated Wireless Company of Australasia proposes to establish a high-power high-speed radio station near Sydney, Brisbane, or Perth, in order to communicate direct with England. There is also to be a medium-power station in each of the other States to pass traffic to and from the main trunk station. The company is said to have offered to handle all classes of messages at one-third of the present rates, to give the Commonwealth 25 per cent. of the profits and to undertake to have the stations working within two years.

M. Feligardo Frias has been appointed Director-General of Mexican State Telegraphs.

Direct wireless telegraphic communication has been established between Sweden and Italy by means of the Karlsborg station, in Sweden, and the San Paolo station at Rome. The Radio-telegraph branch of the Swedish Telegraph Dept. is preparing the plans of a large radio station in Sweden for regular communication with the United States. The Riksdag has made a preliminary appropriation of 2,000,000 kroner for the purpose.

A good illustration of the Evil Effects of the Nationalisation of Industry is given by the results of the operation of the Budapest tramways by the State. During the period of the Kàrolyi Government and revolution the Tramway Company of Budapest and the City Electric Tramway of Budapest were nationalised, and now, though they are burdened with a debt of 200 million crowns, the permanent way and rolling-stock are quite neglected and in great need of repair. The Government have been compelled to return the tramways to the former proprietors, and have had to open negotiations with regard to the conditions of cancelling nationalisation. We feel sure that similar results would ensue here if there were any general attempt made by the Government to embark in trade or industry.

From a report on the German Iron, Steel and Metal Trades Situation by Mr. C. J. Kavanagh, British Commercial Commissioner in Cologne, which appeared in the last issue of the "Board of Trade Journal," we learn that at the commencement of August lower prices were established for electrolytic copper wire, refined copper, rough and sheet zinc, &c. The Price Control Office of the Zentralverband der deutschen electrotechnischen Industrie decided in July, in spite of increased wages and expenses, to reduce the extra charge for machines and transformers by 10 per cent.

The Rhineland works engaged on electrical fittings did a good export trade at the beginning of the quarter, but little liveliness is now to be noticed, primarily owing to the appreciation of exchange rendering quotations expensive. Cable makers are busy on foreign account, having booked many orders in the early part of the year. The large electrical concerns in Berlin are said to have adopted a very accommodating attitude to English inquiries, not only quoting fixed prices, but also guaranteeing deliveries, no doubt with the intention of regaining their position.

An interesting scheme for the reorganisation of the Tramway and Omnibus Services in Paris and the remainder of the Department of the Seine has been prepared. For the present the underground electric railways are not included, but the General Council of the Seine and the Paris City Council have decided that the surface transport undertakings are to be combined into a single concern under the ownership of the Department and the City. A concession for working the services is to be granted to a new company to be formed with a capital of 60,000,000 frs. The purchase price of the six existing companies will be paid by annuities extending over 30 years as follows: 16,800,000 frs. to the Cie Générale des Omnibus, 5,400,000 frs. to the Cie de Tramways de Paris et de la Seine, 4,100,000 frs. to the Tramways-Sud, 3,600,000 frs. to the Tramways de l'Est-Parisien, 2,000,000 frs. to the Tramways Nogentais and 620,000 frs. to the Tramways de la Rive gauche. Though all the companies have not accepted the offer, it is thought agreement will soon be reached.

The financial responsibility and control of the new company will be exercised by the General Council of the Department and by the Paris City Council. The present position is difficult. Higher fares were introduced in April last, since when the volume of traffic has declined considerably. On the other hand, coal and petrol prices have further increased, while the working expenses for labour, which already reach 130,000,000 frs. per annum, will be increased by the adoption of a new pension system. The estimated annual revenue of the new company is put at 225,000,000 frs. at first, but the expenses, including the redemption annuities, will be considerably greater than the receipts. The receipts and expenditure of the company will be credited and debited to the General Council of the Seine, and on the company's share capital of 60,000,000 frs. the Council will pay 6 per cent., or 4·9 per cent. net after deduction of taxes. In addition, the Council will pay a receipts premium of 1 per cent. for the management of the undertaking in order to promote the development of the traffic, and also a small economy premium so as to encourage a reduction in working expenses. If the amount payable to the shareholders should surpass 8 per cent., the excess is to be divided equally between the company and the Department, but the latter will also receive three-fourths of the excess over 10 per cent.

Miscellaneous.

The Birmingham and Midlands Business Efficiency Exhibition is being held at Bingley Hall, Birmingham, from Sept. 9 to 18 inclusive. All Messrs. Benn Brothers' journals, books and other publications are on view at Stand No. 57, which is near the main entrance.

A 50 years' concession for the Supply of Electrical Energy in the Villages on the Asiatic Shore of the Bosphorus has been awarded to the Société du Gaz de Scutari Kadikeuy, Constantinople. Firms wishing to become sub-contractors should communicate with the Société.

We regret to record the death of Mr. G. E. Hales, assistant sales manager of the Edison Accumulators, Ltd. Mr. Hales has been identified with the electric vehicle world since the introduction of the Edison battery in this country, and his decease is a distinct loss to the industry.

The death is announced of Dr. F. Rutherfoord Harris, for some time confidential agent of Cecil Rhodes, and for many years a prominent political figure in South Africa and in England. He was a director of the Cape Electric Tramways, the Cape Town Consolidated Tramways & Lands and the Lisbon Electric Tramways Companies.

On the 28th ult. the first annual works sports of Messrs. George Ellison were held in the Ellison Recreation Ground at Perry Barr, Birmingham. A long programme of athletic events was carried through successfully in ideal weather, and keen rivalry marked the various competitions. Representatives from all sections of the staff and works competed for the prizes before an audience of about 2,000. Members of the staffs at London, Cardiff, Manchester, Leeds and Newcastle were present, and also engineers from the Scandinavian and Dutch agencies.

The 1920 edition of the "Directory of Shipowners, Shipbuilders and Marine Engineers," which has just been issued, gives particulars of the leading steamship companies, shipbuilders, ship repairers and marine engineering works throughout the world. The names and addresses of the companies are given, and lists of fleets, together with such information as principal officials, passenger accommodation, speeds, carrying capacities and so on are presented in such a way as to be readily referred to. The directory, which is priced at 20s. net, is published under the direction of the editor of the "Shipbuilding and Shipping Record," by the Directory Publishing Company, Ltd., Queen Anne's Chambers, Westminster, S.W.1.

On the 1st inst. the Centenary of Oersted's Discovery of Electromagnetism was celebrated in Copenhagen. Some of Oersted's early correspondence was published for the first time, and the assembly of men of science at the university to do honour to the occasion seems to have been of special interest. We notice that much attention is given in the Danish Press to a communication which is stated to have an important bearing on telephony, describing some effects produced when a lithographic plate is brought in intimate contact with a metal sheet and a minute electrical current is passed through the two. It appears that the two plates are strongly attracted, and that the arrangement can be utilised as a telephonic receiver. We shall await further particulars of this work with interest.

The ninth annual meeting of the "Anchor" Cable Works Hospital and Distress Fund was held at the Leigh Works canteen on the 31st ult., Mr. J. Bowyer, J.P., chairman of the fund, presiding. It was reported that during the past year the committee had made grants in 29 cases, the amount expended being £157. The amount to credit of the special war fund on June 30, 1919, was £1,300. Payments of £25 each had been made to dependents of 25 employees killed in the war, and £500 had been paid to disabled soldiers and sailors, leaving £175. One employee had received assistance to enable him to set up in business, and £200 had been set apart for another who had had both feet blown off by an enemy shell. The Hospital and Distress Fund now stood at £748, and the Disabled Soldiers' and Sailors' Fund at £146. The report and accounts were adopted. From the Hospital and Distress Fund various grants were made to local hospitals, &c., for the ensuing year. The following officers were re-appointed: *President*, Mr. T. Petersen (London); *Trustees*, Mr. Bowyer and Mr. C. Hulme; *Hon. Treasurer*, Mr. Wm. Mort; *Secretary*, Mr. W. Hulme Jones.

The employees of the Hart Accumulator Company, Ltd., of Stratford, held their 23rd annual outing on the 21st ult., when a most enjoyable day was spent. The outing took the form of a river trip, the well-appointed s.l. "England" being chartered for the return journey from Richmond to Chertsey. The party numbered 120, and, after cold luncheon on board, the quietude of the upper reaches of the river was taken as a favourable opportunity to honour the usual toasts and to make a presentation to Mr. E. J. Clark, late managing director of the company, as a mark of appreciation and esteem for the 22 years he has held his position. The presentation from the employees and staff took the form of an English lever gold hunter watch, suitably inscribed. Mr. F. J. Holmes, M.I.E.E., manager of the company, made the presentation, and in a few well-chosen words eulogised the work which Mr. Clark had done for the Hart Company during his long association as manager and managing director, and asked for the continued co-operation of the employees in order to maintain the high position in the electrical world which the Hart Company had attained. Mr. Clark briefly replied, and assured his hearers that, although he had resigned from his position as managing director, he would still be able to watch their interests as a director of the company. He also asked that the united efforts of the employees should be placed at the disposal of his successor, Mr. F. J. Holmes. At Chertsey a stay of 1½ hours was made. A splendid tea was served on board as soon as the return journey had commenced, after which the social intercourse was continued on deck.

Educational.

The past and present students of the Finsbury Technical College and other interested persons have formed a Defence Committee in order to consider the possibility of helping to carry on the work of the College, and thus obviate the threatened closing in July next. Particulars may be obtained from Dr. Atkinson, Finsbury Technical College, Leonard-street, E.C.2.

The prospectus of the Faculty of Engineering in the University of Bristol (which is provided and maintained by the Society of Merchant Venturers in the Merchant Venturers' Technical College) gives particulars of the courses in civil, mechanical, electrical and automobile engineering. The ordinances and regulations relating to degrees and certificates in engineering subjects are included, and there is also some information concerning the Bristol sandwich system of training engineers. The prospectus can be obtained from the Registrar of the University, Tyndall's Park, Bristol.

In connection with the new aeronautics department of the Imperial College of Science a comprehensive scheme of instruction mainly post-graduate in character, has been arranged for the next session beginning in October, including special sections in aeronautical engineering, meteorology, and navigation. Sir Napier Shaw is Professor of Meteorology; Mr. Leonard Bairstow, Professor of Aerodynamics; Mr. A. Sutton Pippard will deal with the structure and strength of aircraft, and Mr. A. T. Evans with aircraft engines. Courses of lectures will also be given on airships and with navigation, while arrangements are in hand for special instruction in air-cooled engines, high-compression engines dopes, instruments, wireless telegraphy, etc. Students will carry out part of their practical training in one or other of the Government establishments concerned with aeronautics.

The 1920-21 programme of the Department of Technology of the City and Guilds of London Institute, which contains the general regulations and syllabuses for examinations, has been issued. Among the alterations are the inclusion of a new syllabus and examinations in aeronautical engineering, and the discontinuance of the examinations in the smith's work section of Division II. of mechanical engineering. A useful feature of the programme is the inclusion of text-books and works of reference, but we notice a few errors in the lists under Telegraphy and Telephony and in the Electrical Engineering. Some of the books given are out of print, and a few are distinctly antiquated. The Electrician Printing & Publishing Company, whose publishing business was taken over by Messrs. Benn Bros., Ltd., over three years ago, is credited with being the publishers of "The Electrician" Series of Standard Electrical Works. Perhaps in the next edition of the work these matters will receive attention. The programme is published by Mr. John Murray, at 2s. 6d. net.

Three other universities, those of London and Leeds and the National University of Ireland, have now notified an Increase of Students' Examination Fees. The authorities of the various university colleges have also decided to increase fees from the beginning of the next session.

The present difficult position of universities and education institutions was well stated by Sir T. Gregory Foster, Provost of University College, London, in a recent interview with a representative of the Press. He pointed out that the revenue of university institutions was derived from fees, annual grants from Parliament and local authorities, endowments, donations and subscriptions. Before the war the fee revenue of his college was equivalent to about 38 per cent. of the expenditure; at Manchester it was 29 per cent., and at Birmingham 26 per cent. If we are, said Sir Gregory, to get the best brains of the country into the universities the fees must be kept low. It is quite impossible for the cost of university education to be defrayed solely by fees; but the grave financial position in which we find ourselves compels us to put up the fees if we are to carry on. Even so, we have kept the fees as low as possible. Our endowments before the war covered about 20 per cent. of our expenditure; their effective value has been at least halved since then by the depreciation in the purchasing power of money. The London County Council have slightly increased their grants, and the Parliamentary grant has been doubled—from £21,000 before the war to £42,000. The Provost went on to give particulars of the expenditure side. Rates, taxes and insurance, which in 1913-14 were just under £3,000, were now over £6,000. Ordinary repairs have increased from about £3,000 a year to £6,550; wages of servants from £2,500 to nearly £6,000. In regard to the salaries of the teaching staff, the best they had been able to do was to increase them by about 35 per cent. In 1913-14 the expenditure was £71,000; next year it would be at least £133,000. Apart from private benefactions, the only way in which university colleges could be brought to a proper state of efficiency was by larger grants from the State and local authorities. He added that University College had never been as full as it was last session, the number of students having been 300 more than in the year before the war. The departments in which the pressure of attendance was most felt were engineering, medicine, chemistry, physics and architecture.

Bankruptcies and Liquidations.

A receiving order has been made against J. J. Simons (trading as the Zodiac Peerless Electric Lamp Company), 25, Denmark-street, Charing Cross, W.C. First meeting of creditors on Sept. 16 at Bankruptcy-buildings, London, W.C., and public examination on Nov. 16 at same place.

Mr. E. H. Hawkins, 4, Charterhouse-square, London, E.C., has been appointed sole liquidator of the Signal Electric Company, Ltd., with a committee of inspection, in the place of Mr. Geo. L. Winn, on his retirement.

Business Items, &c.

Messrs. Todman, Ryall & Company, Ltd., electrical engineers and manufacturers of the "L. W." dynamos, motor-generators, &c., have removed to 38, Grosvenor-gardens, Westminster, S.W.

The Enterprise Manufacturing Company, Ltd., of Gun-street Works, Birmingham, have appointed Mr. A. E. Outhwaite, 63, Lancaster-avenue, Manchester, to look after their interests in the Manchester and Liverpool districts.

Mr. Robert Jenkins, representative of Joseph Sankey & Sons, Ltd. has removed from 57, Bishopsgate, E.C., to Ulster Chambers, 168, Regent-street, London, W. 1. Telegraphic address: Permeable; Phone London: Telephone number: Regent 5,508.

Mr. Ernest F. Holden, A.M.I.E.E., until recently chief sales engineer for Scotland of the British Electric Plant Company, has joined Messrs. Barrus & Cullen, Ltd. (35-37, Upper Thames-street, London E.C. 4, dealers in engineers' tools) as representative for the European Continent.

Mr. Watson, managing director of W. G Watson & Company, Ltd., electrical engineers, of Sydney, N.S.W., is at present in London, having taken up his quarters at Messrs. Murray Coombs & Richards, 150, Southampton-row, W.C.1, and will be pleased to see manufacturers and exporters desirous of extending their trading in the colonies.

We understand that the City Accumulator Company, 75, Great Eastern-street, London, E.C., are selling off surplus Government stock of Fuller block accumulators. These batteries are quite new, and are in strong cases with leather handles and outside terminals, making them very suitable for such purposes as lighting cars.

The partnership between Sydney Parker Cook and Brooke Robinson Churchill (trading as Cook & Company), electrical and mechanical engineers, 62, Holly-lane, Smethwick, 7, Ingestre-road, Stafford, and New-street, Dudley, has been dissolved so far as concerns Mr. Cook, who retires from the firm. Debts by Mr. Churchill, who continues the business at New-street, Dudley, under the style of Cook & Company.

Personal and Appointments.

Dr. R. M. Caven, Principal of Darlington Technical College, has been appointed Professor of Chemistry at Glasgow University.

Mr. W. D. Brassington, of the Clyde Valley Electric Power Company, has been recommended for appointment as burgh electrical engineer at Motherwell.

The Provost's Committee of Greenock Corporation recommend that the salary of the electrical engineer (Mr. F. H. Whysall) be increased from £1,000 to £1,100 per annum.

Prof. John B. Farmer, D.Sc., F.R.S., Imperial College of Science and Technology, has been appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

Mr. L. E. Little, who launched the Northern Ball Bearings Co., Ltd., in this country has resigned his position as Managing Director, having found scope more compatible with his energies and abilities, and he will shortly be heard of to the advantage of engineers and motor car manufacturers interested in these products, together with other lines in which Mr. Little has a complete technical knowledge and experience.

On the 3rd inst. complimentary addresses were presented to Mr. W. W. Lackie, formerly chief engineer of the Glasgow Corporation electricity department, and Mr. Archibald Page, formerly general manager of the Clyde Valley Electrical Power Company, on the occasion of their appointment as members of the Electricity Commission. Mr. J. A. Rudd presided, and in the name of the subscribers (representative members of the manufacturing, mechanical, electrical and allied engineering industries in the Glasgow district) presented Mr. Lackie and Mr. Page with illuminated addresses each in the form of an album enclosed in a carved oak casket made by disabled soldiers at the Prince Albert workshops. Mr. Lackie acknowledged the presentations on behalf of himself and Mr. Page, who was unable to be present.

Catalogues, Price Lists, &c.

Messrs. Higgs Bros., Birmingham, have issued their September price list of d.-c. and a.-c. stock motors.

The British Electric Transformer Company, Ltd., have prepared "Move-o-graphs" which show the flame effect of their "Tricity" Fires. This has been done in order that contractors may have them not only as a novelty but of use to show clients the flame effect obtained. The company will send one or more to contractors who are interested. The instructions on the back are printed in both French and Spanish for distribution among agents in these countries.

Oil switches of the switchboard mounting pattern as manufactured by Messrs. Johnson & Phillips, Ltd., Charlton, S.E.7, are described and illustrated in a pamphlet recently issued by the firm. These switches are intended for controlling and protecting feeder circuits, transformers and a.c. generators where only moderate breaking capacity is required, and they are arranged either for direct operation or for remote mechanical operation from a control board. The pamphlet gives particulars of the design, construction, ratings, dimensions, &c., of some standard switches.

The latest edition of the Electrical Fixtures Catalogue of Messrs. Falk, Stadelmann & Company, Ltd., contains prices and particulars of a comprehensive list of artistic electric light fittings, lanterns, electroliers, pendants, brackets, lustre ceiling and cut-crystal fixtures, portable standards, table lamps, statuettes, silk shades, shade carriers, cord ornaments, &c. A good index facilitates reference to the contents of a catalogue which runs to nearly 150 pages. A special list is being prepared for semi-direct lighting fixtures.

Institution Notes.

The Committee of the N.W. Students' Centre of the INSTITUTION OF ELECTRICAL ENGINEERS invite offers of students to read papers during the coming session. Communications to the Honorary Secretary (Mr. C. Filmer), 55, Ashfield-road, Altrincham.

At the recent annual meeting of the CHEMICAL METALLURGICAL and MINING SOCIETY OF SOUTH AFRICA, the retiring president (Mr. J. Gray) reported that the scientific and technical societies of South Africa had been successful in obtaining a joint home (in Fox-street, Johannesburg). The number of new members and associates elected during the year showed a gratifying increase. It was hoped that the proposed awards from the research endowment fund would result in original contributions of real merit being presented to the society. The new president is Mr. J. Chilton, with Messrs. F. Wartenweiler, G. A. Watermeyer and F. W. Watson as vice-presidents.

THE INSTITUTE OF TRANSPORT (169,896) was registered on Aug. 26 as a company limited by guarantees, not formed for purpose or profit, the word "limited" being omitted from title by licence of the Board of Trade. The number of members is unlimited, and each member is liable for not more than £1 in the event of winding up. The objects are: To promote and encourage knowledge of traffic science and the art of transport and the means and appliances connected therewith, to provide facilities for study and the exchange of ideas, to grant certificates, medals, diplomas and scholarships, to raise the status of those engaged in traffic and transport, to promote exhibitions, &c. The Institute is to consist of members, associate members, graduates, students and honorary members. Members and associates only are to be "members" for the purposes of the Companies' Acts. They must have had respectively 10 or 5 years' experience involving official responsibility in dealing with traffic or providing transport or works connected therewith, or fulfil other specified conditions. Among the members of the council are the following: Sir Eric C. Geddes (Minister of Transport), Lord Ashfield, H. E. Blain, Sir A. A. Booth, Sir J. G. Broadbank, Sir A. H. Butterworth, Sir F. Dent, Sir S. Fay, Sir M. Fitzmaurice, S. E. Garcke, H. H. Gordon, J. B. Hamilton, R. J. Rowley, Sir L. L. Macassey, K.C., D. A. Matheson, Sir H. P. Maybury, J. M. McElroy, Sir P. A. M. Nash, Sir A. Stanley, E. S. Shrapnell-Smith, F. Tatlow, and Sir H. A. Walker. Reg. office, 2-3, The Sanctuary, S.W. 1.

Tenders Invited and Accepted.

LEVEN Corporation require tenders for wiring 86 houses. Specifications from Messrs. Dewar & Haxton, Joint Architects, Leven.

CHELTENHAM Corporation want tenders by Sept. 15, for electrical installation at Alstone baths. Specifications from the Borough Surveyor.

NUNEATON Corporation want tenders by Sept. 20 for h. and l.t. switchgear, connecting cables and accessories. Specifications from the Borough Electrical Engineer.

WESTMINSTER Guardians require tenders by Sept. 15 for the supply of electric lamps and fittings. Forms of tender from the Clerk, Prince's-row, Buckingham Palace-road, S.W.1.

MANCHESTER Tramways Committee require tenders by Sept. 14 for steel girder tram rails and special track work. Specifications from the General Manager, 55, Piccadilly, Manchester.

Tenders are invited (by Sept. 20) for steam, exhaust, circulating water and other pipes work at IPSWICH Corporation electricity works. Specifications from Mr. F. Ayton, Chief Engineer and Manager.

LONDON County Council invite tenders (by 4 p.m. Sept. 20) for supply of 1,500 tons of mild steel conductor rails of plain tee section. Forms of tender from the Chief Engineer, County Hall, Spring Gardens, S.W.

SOUTHAMPTON guardians want tenders by Sept. 20 for wiring, &c., in the proposed Children's Homes at Shirley. Specifications, &c., from Messrs. Gutteridge & Gutteridge, 9, Portland-street, Southampton.

The METROPOLITAN ASYLUMS BOARD require tenders by 2.30 p.m., Sept. 29, for extensions of telephone installation at Grove Hospital, Tooting Graveney, S.W. 17.

The SOUTH AFRICAN RAILWAYS & HARBOURS DEPARTMENT, Johannesburg, require tenders by Oct. 25 for metal filament lamps for train lighting. Specifications may be seen at the Department of Overseas Trade, 73, Basinghall-street, London, E.C.2.

The Electricity Committee of BOLTON CORPORATION invite tenders for the supply and erection of one 12,000 kw. turbo-alternator. Specifications from the borough electrical engineer, Mr. W. J. H. Wood, and tenders to the town clerk, Mr. Samuel Parker, by noon, Sept. 16.

The VICTORIAN RAILWAY COMMISSIONERS require tenders by Oct. 27 for the supply of an electric travelling crane with buffing jib (contract 29,090). Specification, &c., can be seen at the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W.1.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the AUSTRALIAN COMMONWEALTH Postmaster-General's Department: Instruments and parts (schedule 499) for Queensland (Oct. 6); telegraph and telephone instruments (schedules 546 and 549) (Oct. 20), and telephone instruments (schedule 548) (Nov. 3) for S. Australia. Tender forms from the Office of the High Commissioner, 406, Australia House, Strand, London, W.C.2.

NELSON Council has accepted the tender of W. T. Henley's Telegraph Works Company for the supply and laying of e.h.t. cables.

BRIDGWATER Council have accepted the tender of H. West & Son for an electric light installation at the municipal buildings at £485.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstracts from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1916 SPECIFICATIONS.

145,805 CLARKE. Apparatus for recording and reproducing sounds and electric signals. (9/3/16. Complete accepted 5/2/20, patent sealed 5/2/20.)

1919 SPECIFICATIONS.

124,721 CONNECTICUT TELEPHONE & ELECTRIC CO. Electron discharge apparatus and process of operating the same. (2[illegible]/3/18.)
125,382 NATIONAL CARBON CO. Machines for making bobbins for electric batteries. (1/10/17.)
125,391 STEIGER. Electric furnaces. (8/4/18.)
130,960 GEORGE. Mercury lamps. (8/8/18.)

Comprises means whereby the continuous and automatic circulation of the metal through the illuminating tube and the [illegible] causes the [illegible] originally into the illuminating tube to be displaced and collected in an auxiliary reservoir during the operation of the lamp, where it acts to force the liquid mercury to make contact between the anode and the cathode when the [illegible] the lamp is interrupted.

131,875 SOC. ANON. DES ETABLISSEMENTS L. BLERIOT. Electromagnetic controlling devices. (28/8/18.)
132,232 PIQUEREZ. Electric furnace. (2/9/18.)
132,501 WEID. Incandescent electric lighting apparatus. (13/9/18.)
132,517 MAVRON. Current-reversing devices for dynamos running in both directions. (10/9/18.)
140.366 BEYER. Electromagnetic clutches. (14/3/19.)
145,835 ROBINSON & CO., GILL & CHAMIARE. Synchronous operation by electrical means of two or more mechanisms. (27/3/19.)
145,837 ENTWISTLE. Electric arc apparatus employed in the generation of oscillating currents. (27/3/19.)
145,839 B.T.-H. CO. (G.E. Co.) X-ray apparatus. (27/3/19.)

Relates to an X-ray or electron discharge apparatus, and comprises an X-ray tube having an anode separated from the exterior of the tube by a path of sufficient thermal conductivity to effectively cool said anode, an enclosing receptacle and a non-gaseous heat conducting medium of high dielectric strength therein surrounding the tube and the terminal conductors conveying current thereto.

145,869 ROBINSON & CHAMNEY. Telephonic repeaters. (1/4/19.)
145.879 MYERS. Dynamo-electric machines. (2/4/19.)
145,881 B.T.-H. CO. (G.E. Co.) Systems of electric power transmission. (2/4/19.)
145,905 LODGE, LODGE & LODGE FUME DEPOSIT CO. (in liquidation). Induction coils. (14/419.)
145,907 SIMON. Electric fault-detecting devices. (16/4/19.)
145,909 CHITTY. Commutators for dynamo-electric machines. (22/4/19. Patent of addition not granted.)
145,913 HASLEM & STRETTON, STRETTON & JONES. Miners electric lamps. (24/4/19.)
145.950 QUAIN. Electric radiators. (30/5/19.)
145.966 B.T.-H. CO. (G.E. Co.) Electric voltage regulator. (18/6/19.)
145.972 B.T.-H. CO. (G.E. Co.) Electric induction apparatus. (23/6/19.)
145.975 WOOD & METROPOLITAN-VICKERS ELECTRICAL CO. Insulation of the leads passing through the case of electrical measuring instruments. (27/6/19.)
145,976 KAY & CALLENDER'S CABLE & CONSTRUCTION CO. Fault localisation for underground electric cables. (27/6/19.)
145,992 CHALMERS & MITCHELL. Electric plug couplings. (28/7/19.)
145,995 TUMBELTY. Apparatus for testing of magnetos and sparking plugs as used for the ignition of internal-combustion engines. (30/7/19.)
146,013 DESPLATS. Electric switches for signalling and like purposes. (20/9/19.)
146,033 WHITE. (U.S. Light and Heat Corporation.) Electric regulators. (11/11/19.)
146.038 BARBER. Electric condensers. (27/11/19.)
146,041 GALER. Electric motor controllers. (5/12/19.)

1920 SPECIFICATIONS.

139,779 SIEMENS & HALSKE AKT.-GES. Switchboard arrangements particularly for field telephone apparatus. (4/3/16.)
140.100 SIEMENS-SCHUCKERTWERKE. Safety device for electric generators. (22/10/18.)
144,608 FABRIQUES DES MONTRES ZENITH. Ignition magnetos for internal-combustion engines. (11/6/19.)

APPLICATIONS FOR PATENTS.

NOTE.—*Names within parentheses are those of communicators of inventions.*

March 18.

8.015 NORTON. Incandescent lamp holders.
8,026 BRITISH L. M. ERICSSON MFG. CO. & GODFREY HAYES. Lamp holders.
8.062 WALKER. Electro-magnetic step-by-step mechanism.
8.063 ANGUS. Apparatus for electrically controlling railway trains. (10/10/17, Sweden.)
8,065 BESWICK. Storage batteries.
8.073 JONES. Continuous-current dynamo or motor.
8.081 WESTERN ELECTRIC CO. Oscillation generators. (4/6/17, U.S.)
8.114 DAMEY. Electric candle lamps.
8,120 BODDINGTON. Switch.

March 19.

8,144 TAYLOR. Operating generating stations in parallel.
8.149 SIMMONDS & SUMNER. Medical galvanic battery.
8,160 CRESSALL MFG. CO. Electric heating elements.
8,165 JOHNSON. Armoured cable.
8.174 AZIENDA ELETTRICA MUNICIPALE. Meters for alternating currents. (26/3/19, Italy).
8,177 ERSKINE-MURRAY & ROBINSON. Radio-navigational apparatus, &c.
8,200 PRICE. Wireless transmitting and receiving apparatus.
8.234 SIEMENS & HALSKE A. G. X-ray tube. (22/6/12, Germany.)
8.244 BOSCH (R.) AKT. GES. Electric motors for starting engines. (5/5/19, Germanny.)
8.245 WESTERN ELECTRIC CO. Transformers. (15/11/17. U.S.)
8.249 GENERAL ELECTRIC CO. & GOSSLING. Electron discharge devices.
8.262 CARTWRIGHT & SIMS. Terminal fittings for electrical devices.

March 20.

8.340 AUTOMATIC TELEPHONE MFG. CO. Telephone systems. (30/6/19, U.S.)

March 22. 1920.

8.388 DEWHURST, ERNILL & GATLEY. Electric hoists, lifts, &c.
8.403 PITT. Device for testing sparking plugs or electric circuits therefor.
8.421 MORSE. Apparatus for electric welding and cutting.
8.424 COBBOLD & JOSEPH. Electric soldering irons.
8.428 BILLIEUX. High-frequency alternator. (27/11/17, France.)
8,435 VALLINO. Current-collecting devices for electric traction.
8,438 HODGES. Switches.
8,440 B.T.-H CO. (G. E. Co.). Electric ship propulsion.
8,444 SOC. METALLURGIQUE DU FRAYOL. Electric furnaces. (7/1/20, France.)
8,450 BILLIEUX. High-frequency alternator. (24/1/18. France.)
8.484 HUGONIOT. Electrical musical instruments. (30/4/19. France.)
8.488 REDDIE. (Camillo Olivetti & Co.). Magneto-electric machine.
8,491 MYERS. Electro-medical treatment.

Companies' Reports, &c.

The directors of MATHER & PLATT, LTD., have recently offered 210,000 new ordinary shares of £1 each to the ordinary shareholders at par.

The NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY COMPANY, LTD., has declared an interim dividend of 2½ per cent. on the ordinary shares.

The directors of the OXFORD ELECTRIC COMPANY, LTD., have declared an interim dividend of 5 per cent. per annum (2s. 6d. per share) on the ordinary shares for the past half-year.

In addition to the dividend on the 7 per cent. preference shares, Messrs. CLARKE, CHAPMAN & COMPANY, LTD., have declared an interim dividend of 1s. per share on the ordinary shares for the past half-year.

The directors of the CITY OF LONDON ELECTRIC LIGHTING COMPANY, LTD., have declared an interim dividend of 7½ per cent. per annum (9d. per share) on the ordinary shares for the past half-year, compared with 6 per cent. in 1919.

The offer of the Agricultural and General Engineers (Ltd.) to purchase the whole of the fully-paid ordinary shares of Henry Bessemer and Company has lapsed, as only about 74 per cent. of the holders accepted the offer by the date fixed.

The directors of the DIRECT SPANISH TELEGRAPH COMPANY, LTD., have decided to pay, in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, an interim dividend at the rate of 8 per cent. per annum, tax free, on the ordinary shares for the half-year ended June 30, and payable on the 1st prox.

The transfer books of the WESTERN TELEGRAPH COMPANY, LTD., will be closed from Sept. 20 to 28 inclusive, preparatory to paying on the 29th inst. to holders of shares Nos. 1 to 207,930 a dividend of 7s. per share, making, with previous dividends, a total distribution for the year ended June 30, of 10 per cent., tax free.

The 20th annual report of the SOC. ANON. BROWN, BOVERI & CIE (Baden, Switzerland), states that the income for the year ended March 31 last (including 94,871 fr. brought forward) was 15,137,201 fr., and the net profit was 5,084,755 fr., out of which a final dividend of 3 per cent. is proposed, making 8 per cent. for the year. Vickers Limited have taken a holding in the company amounting to 7,000,000 fr., and the share capital has been increased by 20,000,000 fr. to a total of 56,000,000 fr. The nominal value of the shares has been changed from 1,250 fr. to 500 fr. The market has revived with such animation that the orders booked by the Swiss works during the year amount to 75,000,000 fr., although this is not equivalent to the actual production before the war. The fall of the foreign exchanges has not had any influence on orders, but the proportion of profit has been diminished, and this, with the increased cost of materials, necessitated several increases in selling prices. Diminished supplies of carbon, iron and steel have made it necessary to forgo some engagements which involved great risks. The cost of production has also been increased by the exactions of the personnel and the reduction of working hours, and so far there has been no increase of output, even in the inverse ratio of the reduction of hours. Thanks to the electrification of the railways, Switzerland has assumed greater importance as an outlet for the company's manufactures, and it has equipped at Richen, near Basle, on the feeder system of the Basle-Larrach tramways, the first sub-station with entirely automatic transformers on the Continent.

New Companies.

S. DAGNALL, LTD. (169,775).—Private company. Reg. August 20, capital £5,000 in £1 shares, to acquire the business of an electrical, mechanical and general engineer and contractor carried on as " S. Dagnall," at Birmingham. First directors are: R. S. J. Dagnall and S. Phillips. Reg. office: 420, Stratford-road, Sparkhill, Birmingham.

ELECTRO-CHEMICAL INDUSTRIES. LTD. (169,790).—Private company; reg. Aug. 21, capital £10,000 in 9,000 20 per cent. cumulative preference shares of £1 each, and 20,000 ordinary shares of 1s. each. To carry on the business indicated by the title, and that of smelters and reducers of ores and minerals, &c. Reg. office, Regent House, Regent-street, London.

INSULATING PRODUCTS, LTD. (169,944).—Private company. Reg Aug. 28, capital £10,000 in £1 shares, to carry on the business of manufacturers of insulated wires and cables, electrical engineers, &c. First directors are: H. T. Baker (managing) and W. Muir. Reg. office: Clendon-lane, East Bolden, co. Durham.

OLDFIELD ENGINEERING CO., LTD. (169,770).—Private company. Reg. August 20, capital £10,000 in £1 shares, to carry on the business of engineers, millwrights, manufacturers of rubber machinery, gas and oil engines, electrical and gas works plant, etc. Subscribers are: J. W. J. Walker, 24, Rivington-road, Pendleton, works director, and J. Hedges, 89, Albert-avenue, Sedgeley Park, Prestwich, electrical engineer.

STEYNING ELECTRIC LIGHT COMPANY, LTD. (169,904.)—Reg. Aug. 26, capital £10,000 in £1 shares. To acquire the business carried on by S. C. D. Oxley as the " Steyning & District Electric Lighting, Heat & Power Supply Company." First directors are W. L. Burt, W. A. Carter, G. A. Flowers, A Linfield, G. S. Mitchell, E. Prior (managing director) and H. G. Sugden. Secretary, S. C. D. Oxley. Reg. office, High-street, Steyning, Sussex.

VENTOCK, LTD. (169,725).—Private company. Reg. August 18, capital £5,000 in £1 shares to carry on business as electrical, mechanical and general engineers, manufacturers of electrical conduits, switchboards and apparatus, &c. Reg. office: Dacre House, Victoria-street, S.W. 1.

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 4, 1880.)

PORTSMOUTH DOCKYARD.—On Tuesday the Lords Commissioners of the Admiralty began their official inspection, and after visiting the " Inflexible," they were taken to the adjoining electric shop. Here they saw the electric light, and witnessed the operation of electro-plating, &c.

SOMETHING LIKE A MISTAKE.—In the celebrated " Preliminary Discourse on the Study of Natural Philosophy," which forms one of the volumes in Lardner's " Cabinet Cyclopædia," it is stated that " All the phenomena of magnetic polarity, attraction, and repulsion have at length been resolved into one general fact, that two currents of electricity, moving in the same direction repel, and in contrary directions attract, each other." As most of our readers are already aware, the words " repel " and " attract " should here change places.

BURTON-ON-TRENT.—Messrs. Bass & Co. have introduced the electric light into their extensive premises at Burton-on-Trent. There are at present 21 lights, worked by a Brush dynamo-machine, the whole supplied by the Anglo-American Electric Light Co. Two rooms—the cask office and square room—are fully lighted by electric lights, whilst other parts are only partially lighted. Hitherto the cask room has been lighted by 35 gas lights, and these are replaced by two electric lamps.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

" Aeronautics ": " The Rise of Civil Aviation "; and " Supply of Navigators."

" Cabinet Maker ": " Twenty Years Ago: Changing Fashions in Furniture "; " Syllabus of the City and Guilds Examination in Textile Subjects "; and " Proposed Factory Act Regulations for the Use of Wood-working Machinery."

" Chemical Age ": " Natural Soda from Lake Magadi " (with photographs); " British Chemical Merchants and Industries Fairs "; and " Review of the Bale Chemical Industry."

" Fruit Grower ": " A Defence of the Industry "; Bird Life and Food Production; Swifts and Swallows; " Leaf Curl Disease of Potatoes."

" Gas World ": " The Gas Regulation Act," by S. B. Langlands; " Reconstruction of Vertical Retorts," by T. W. Harper; and " Notes on Fuel Economy."

" Hardware Trade Journal ": " The Ironmongers' Showroom "; " Labour Saving in the Foundry (XVI.)," by Joseph Horner; and " Normandy's Hardware Trade."

" Ways and Means ": " Holiday Musings," by W. J. Noble; " Civil Aviation in Foreign Countries," by Major P. L. Holmes; " The Minimum Income League," by Dennis Milner.

Prices of Metals, Chemicals, &c.

TUESDAY, Sept. 7.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£107 0 0	—	—
Electro Wirebars...	,,	£117 0 0	—	—
H.C. wire basis......	per lb.	1s. $4\frac{7}{16}$d.	—	—
Sheet	,,	1s. $5\frac{7}{8}$d.	—	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. $9\frac{7}{16}$d.	—	—
Brass 60/40—				
Rod, basis	,,	0s. $10\frac{5}{8}$d.	—	$\frac{1}{8}$d.
Sheet, basis	,,	1s. $4\frac{1}{2}$d.	—	—
Wire, basis	,,	1s. $3\frac{1}{2}$d.	—	$\frac{3}{8}$d.
Iron –				
Cleveland Warrants	per ton	£11 17 6	7s. 6d.	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig –				
English	,,	£38 10 0	—	—
Foreign or Colonial	,,	36 5 0	—	5s. 0d.
Tin –Ingot	,,	266 10 0	—	£6 10 0
Wire, basis	per lb.	0 3 $5\frac{1}{2}$	$\frac{1}{4}$d.	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £8 8s. 9d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 6d.

Sodium Chlorate.—Per lb. $5\frac{1}{4}$d.

Rubber.—Para fine, 1s. 9d.; plantation 1st. latex, 1s. $8\frac{3}{4}$d. per lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co.

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Notes.

The Coal Crisis.

THE thanks of the nation at this juncture are due to Mr. ROBERT SMILLIE. At Wrexham a week or two ago he stated that the miners "were determined to have nationalisation." At the conference with Sir ROBERT HORNE on September 9th he said: "The question of coal prices is our business. I deny the right of Parliament to take the action they have taken if it is going to make our position worse than it would have been even under the uncontrolled private ownership of the mines." Apparently, however, the reception this clear-cut policy has received from the public and from a large section of the miners themselves has rendered hedging desirable. The result is to be found in a letter that appeared in Wednesday's "Times." Here, amidst a mass of irrelevancies, Mr. SMILLIE protests that the fight is not one for nationalisation, nor is it political, nor is it undertaken to dislocate the industries of the country, but only to give the miners a wage commensurate with the cost of living. Could ingenuousness go further? Better propaganda than this will be necessary if the public is to believe in the miners' case. Mr. SMILLIE is distressed at the public's obtuseness in this matter, but he does not seem to realise that the best way to overcome that attitude is to submit the whole question of wages claims, profits, output, salaries and maintenance expenses to an impartial tribunal, and, in the meantime, for his followers to remain steadily at work in order that the true facts of the case may be arrived at. We are ready to admit that there are faults on both sides, but it is quite as impossible to apportion the blame in the present confused state of the industry as it is to hold a dance on a quicksand. As regards the course of the dispute, on the surface at any rate matters are no nearer a settlement than they were last week. The failure of the conference was not surprising, for in spite of the optimism with which its assembly was heralded, both parties attending it expected the other to give way. Settlement is not reached along that road. In spite of its failure it had, however, the effect of clearing the air and of throwing into high relief the essential weakness of the miners' case as a measure of social reform. This is emphasised by their refusal to submit the wages claim to the Industrial Court; while their desire to get rid of the surplus of £66,000,000 by reducing the price of domestic coal is stultified by the announcement that owing to reduction in output there is no such surplus. We still hope that a strike may be avoided, but things look very black.

The E.T.U. Again.

THE other industrial dispute which is now in progress is likely, if unsettled, to affect very profoundly both the electrical industry and the general public. A Court of Inquiry appointed by the Ministry of Labour began its deliberations on Tuesday, but the lock-out into which the dispute has developed is already in being, and it seems inevitable that the E.T.U. will execute its threat to call out those of its members who are working in the electricity supply stations and on the electric railways and tramways of the country, unless the Employers' Federation lifts its embargo. The executive of the E.T.U. is always a little more illogical than those of other Trade Unions, and its action in this case is no exception to that rule. For it is a little difficult to see how inflicting inconvenience and danger on the working people of London and other towns will make the Employers' Federation alter their opinion on a question of discipline, especially when that opinion is widely supported by the public and by many members of the E.T.U. itself. Fortunately, as we go to press, we hear that saner councils have prevailed, and that the E.T.U. have agreed to suspend the strike notices until the Court of Inquiry has reported, and to withdraw the question of principle in the Penistone dispute. It only remains for the Employers' Federation to follow suit to ensure a settlement.

An Unfortunate Policy.

WE have always held and expressed great sympathy for the aims and objects of the Electrical Power Engineers' Association. Therefore we have the more reason for being equally outspoken when we think they are wrong, as we certainly think they are in giving their support to the E.T.U. in the present disagreement. On another page of this issue we publish a letter from Mr. W. ARTHUR JONES which sufficiently explains the policy of the Association. Briefly this policy is: the maintenance of a position midway between employer and employed, refraining from drastic action either on their own account or in support of others except in the last resort, and the support of the consenting party when one party to a dispute refuses arbitration. We are not happy about this policy, and we are not sure that the E.P.E.A. are either. Mr. Jones in his letter "doth protest too much" for that; and a letter from certain station engineers shows that there is by no means unanimity within the Association itself. To occupy a neutral position in the middle in these troublous times is difficult enough, but to occupy a place which sometimes moves to one side and sometimes to the other is likely to be so difficult as to be impossible. The result will be a disintegration of their Association accompanied by its gradual absorption in the E.T.U., which would be a pity. The action of these two Trade Unions recalls an important legal point which they seem to have forgotten. Section 31 of the Electricity (Supply) Act of 1919 applies Section 4 of the Conspiracy and Protection of Property Act, 1875, to persons employed by an electricity undertaking. This section makes it a criminal offence, punishable by imprisonment, for any person so employed to deprive the inhabitants of a place of electricity without adequate notice. The penalty may seem severe, but the consequences of such a stoppage would be so harmful as to lay anyone causing it open to the charge of conspiring against the public in the gravest manner.

Small Conductors and Large 'Bus Bars.

There are certain writers on technical subjects who give up "to party what was meant for mankind" by publishing in the pages of obscure magazines or house organs information which deserves to be more widely disseminated. Mr. W. A. Coates is the latest culprit. In a recent issue of "The Metropolitan Vickers Gazette" he makes an interesting excursion into a byway of switch-gear design, and discloses a weakness which the increase in size and number of the generating units housed under one roof has shown in our 'bus bar systems. Such systems may be regarded as a temporary reservoir of electrical energy. This energy, when instantaneously released by a short circuit may completely destroy the small wires such as connect an instrument transformer to the main 'bus bars in spite of the insertion of fuses in the circuit, and the arc thus started may, of course, lead to disastrous results. The employment of properly connected oil circuit breakers does not altogether overcome this trouble, and a series of calculations made to determine the minimum safe size of conductor which could be used on any system without the risk of fusion of the small wiring while the switch was opening was therefore undertaken.

Data for Consideration.

A number of curves given in the original Paper summarise the results obtained, it being found, for instance, that with a full load of 1,800 amperes a 0·1 sq. in. conductor would on short circuit act as a fuse before an ordinary instantaneous circuit breaker could operate. Such a current corresponds to that found on a 6,600-volt 3-phase system with 55,000 k.v.a. on the 'bus-bars. Mr. Coates takes 500 C. as the maximum allowable temperature under the presumed emergency conditions and gives results showing the time within which the oil circuit breaker must operate for safety with various normal full-load 'bus-bars current. It is desirable, however, that trouble of this kind occurring in an instrument transformer circuit should be localised to that circuit by a series resistance of some robuster material and construction than those at present employed. At the same time the largest section of conductor indicated by these tests must be used. All this data raises points which must receive careful consideration if the safety and continuity of supply in our large electrical systems is to be preserved.

Series v. Parallel Street Lighting.

The two articles appearing in the present issue dealing respectively with series and parallel street lighting in the United States, furnish a useful comparison of the merits of these methods. In this country parallel distribution is almost the invariable rule; in the United States series lighting is equally predominant. Various explanations may be offered such as the greater prevalence of alternating-current systems in the States, and the consequent ease in obtaining high pressures, the greater facilities for overhead high-pressure conductors, and the high cost of labour involved in local or hand methods of lighting and extinction. Probably, too, the relatively scattered districts often met with, and the larger distances from the electrical supply are influential factors. It would seem, however, that the advantages as regards efficiency are not so entirely with the series system as is commonly supposed. It is generally assumed that the low-voltage, high-current incandescent lamps used with this system are stronger and more efficient; but the advocates of the two systems are somewhat at variance on this point, Mr. Ward Harrison claiming that the advantage is not important. It is interesting to observe that in many cases the value of the lamps installed equals that of the generator supplying them; constancy of supply current is, therefore, an important factor. It is too early to predict what influence the creation of bulk supply transmission in this country, and the use of superstations and long-distance alternating-current transmission will have on the adoption of series lighting systems. It seems likely, however, that the advantage of greater flexibility claimed for the parallel system will continue to favour this method, in view of the fact that most important supply areas in Great Britain are in a state of constant development, and that an interference with existing long-standing conditions might involve considerable scrapping and expense.

Colloidal Electrolytes.

A good deal of useful work on the subject of colloidal electrolytes has recently been carried out by Prof. J. W. McBain in the laboratory of physical chemistry in the University of Bristol. These experiments show first that soap solutions possess a high degree of electrical conductivity, both in the dilute and in the concentrated state, and that these solutions also have a high degree of osmotic activity. The presence of these two properties is most satisfactorily explained by the theory of the "ionic micelle." This "micelle" is a cluster of atoms replacing one ion in a salt solution (which thus becomes a colloidal electrolyte), carrying an electrical charge equal to the sum of the charges of the constituent ions and thereby, owing to the reduction of the resistance to movement through the fluid, serving as a good electrical conductor. As this new class of electrical conductor includes most organic compounds and especially proteins, dyes and soaps, its investigation is of the highest importance. This is especially the case with regard to soaps, and this research would again appear to be an example of a highly theoretical investigation having a profound effect on practical work. Dr. T. M. Lowry, writing in "Nature" on the subject, claims that the "elucidation of soap solutions by the theory of the ionic micelle is perhaps the biggest advance that has been made in the theory of electrolytic dissociation since the early work of Arrhenius and Van 't Hoff."

Audible Railway Signalling.

In his report on the accident which took place on July 17th last at the Eglinton Street Station, Glasgow, on the Caledonian Railway, Major G. L. Hall once again makes a point upon which we have often insisted in The Electrician—the need for supplementing the present visual signalling either by some form of audible signal in the driver's cab or by some automatic train control device. The accident in question provides a good argument why this should be done. A passenger train was standing in Eglinton Street Station when another train was accepted by the signalman at Larkfield Junction, the box further down the line. This second train was brought to a stand at the signal box; and the signalman then proceeded to draw it, as he thought, slowly forward by lowering the home signal, keeping the starting signal at danger. To his surprise, however, the train passed the starting signal; and in spite of all his efforts to stop it ran into the rear of the first stationary train. It appeared in evidence that the driver's attention was called by his fireman to some defect in the fire-box and that owing to his being engaged in examining this he failed to see the state of the signals. There are many reflections we might make on this but the most pertinent one is that had audible cab signals been fitted the accident would not have happened.

Constitution of Joint Electricity Authorities.

Though the Electricity Commissioners have made substantial progress with the task of defining electricity supply areas the formation of joint electricity authorities is proceeding very slowly, and we seem on this question to be approaching a crisis. So far as we are aware it is only for the Severn area that a draft constitution for a joint authority has been prepared, and even in that area there is a good deal of opposition, mainly on account of the reluctance of the local authorities to pledge the rates for maintaining and extending the electricity works in the district. Compared with some other districts, such as the West Yorkshire (Aire and Calder), the South East Lancashire and the London districts, the position in the Severn area is quite simple, for there are no big supply companies to be dealt with. The position of these companies may indeed be a bigger complication than was realised. The resolution of the Bradford Corporation that the control of the generating stations and main transmission lines in a district should be placed in the hands of the duly elected representatives of the district was unanimously approved by the I.M.E.A. in June, and it has since been endorsed by the great majority of local authorities who are electricity undertakers. This policy, if acted upon, will entail the purchase of large undertakings such as the Yorkshire Electric Power Company and its subsidiary company, and raises important and difficult questions of a financial and technical character.

Finance and Uncertainty.

For our own part we should be sorry to see such a prosperous and progressive concern as that of the Yorkshire Company absorbed, and we cannot see why some system of co-operation or co-partnership cannot be arranged to which each of the existing supply authorities would contribute its quota. The purchase of the Yorkshire Company will necessitate the raising of a large sum, and though some of the most progressive municipal undertakings in the country are in this particular area it will not be easy to find the purchase money at present. It must, however be remembered that the acquisition must be effected by a voluntary agreement between the parties, for the Electricity Supply Act gives no right of compulsory purchase. Apart from the question of purchasing the company, large sums will also be needed for extensions of mains to existing supply areas and for dealing with the demands in districts at present without a supply of electricity. For these reasons the Leeds Corporation has petitioned the Government for financial assistance, but it is difficult to see how it can be given until the new Electricity Supply Bill is passed. Unhappily the present feeling of uncertainty is not only holding up extensions, but is preventing the progress of the industry, and we hope, therefore, that an early solution of the difficulty will be found.

Commercial Profit and Municipal Undertakings.

An interesting problem has arisen in connection with proposed extensions of the Manchester Corporation Electricity undertaking in order to provide a bulk supply to the Lancashire Electric Power Company. It appears that the Corporation will have to be put in another 25,000 kw. generating set and carry out other work which will entail a cost of about £700,000. On these grounds the Electricity Committee think the Corporation should charge a higher rate to the Company than to its own consumers. To do this the basis of supply would be the total working cost, plus one per cent. on the capital outlay for the relief of the Manchester rates together with a commercial profit of 7½ per cent., which would give a yield of 3 per cent. net upon the capital outlay. The Electricity Committee think that the transaction should be on a profit earning basis because the rates of the City would have to be pledged for the necessary extension, and because they would be providing a commodity for sale to a commercial company outside the municipal boundaries, while the extension would not increase the rateable value of the City. On the other hand, the Finance Committee of the Corporation, in a report upon the matter, state that the pledging of the municipal credit for such a large sum at the present time is a serious matter, and they therefore recommend the City Council not to proceed with it. It is pointed out that the scheme is really a national one, that the benefit of it would accrue to a large area outside the city, and therefore they think that the money should be provided by the Electricity Commissioners. Though we agree that the extensions, which have the approval of the Electricity Commissioners, are part of the national scheme of reorganisation, we think that the transaction would prove remunerative and it would not, or at all events need not, entail any permanent charge upon the Manchester rates. Electricity supply, whether on a national or a municipal basis, must be and can be easily made self-supporting, and therefore we regret the timidity of the Finance Committee. It shows, however, that the present condition of affairs is unsatisfactory, and that the sooner the uncertainty about Joint Electricity Authorities is removed the better for the whole country in general and for the electricity supply in particular.

The Waste of Small Generating Plants.

Those who believe that greater advantages are to be obtained by works, large shops and other similar consumers of electrical energy installing their own generating plant rather than in taking the necessary supply of electricity from the public mains will derive cold comfort from some figures recently given by Mr. George H. Jones. These figures relate to a dozen or so plants installed in the centre of the City of Chicago and having a total maximum demand of some 2,200 kw. It should be added that the equipment was modern in every way and tests undertaken showed that the average fuel consumption was about 9 lb. per unit generated. But had these consumers been supplied with energy from a public generating station it is estimated that 13,000 tons of fuel per annum would have been saved, or sufficient to supply the electrical requirements of a small town for a year. In another plant with a capacity of 5,000 kw. the fuel consumption was about 7·5 lb. per unit, but had this demand been supplied from a public generating station a saving of about 5,000 tons of coal a year would have been effected. We do not propose to draw a general deduction from a particular case, but these figures are worth consideration by those enquirers who nowadays show a tendency to flirt with the idea of works generating stations and to cast aspersions on Electricity Departments and all their doings.

An Appeal for Support.

During its brief existence the British Electrical Development Association has done such good work and possesses such potentialities for further usefulness that it should receive every support from every section of the electrical industry. The more support it receives the more useful it will be. We are, therefore, glad to learn that the Council of the Incorporated Municipal Electrical Association are appealing to its members to support the B.E.D.A. in the most obvious of all ways. Believing as we do in the co-ordination of the branches of the industry so that they can work together whole-heartedly for the common good, we desire to endorse this appeal with the utmost warmth and to include within its range not only municipal engineers, but manufacturers, factors, contractors and so on. For it is only by combination that we can progress, and to this end the B·E.D.A. will, we feel sure, prove of the greatest assistance.

Coal Storage.

To write about coal storage when we may, before long, be faced with all the disabilities which a national coal strike will bring in its train, may seem rather like closing the stable door after the horse has gone. Nevertheless, this storage question has a direct bearing on certain points which are likely to arise during such an upheaval from a consideration of which some useful deductions may be drawn. A coal strike means cessation of output. But unlike a stoppage in some other industries, notably on a railway, this cessation is not followed by immediate results. The strangling effect, though sure, is slow. That is, all industries which rely upon coal for their existence can carry on for a longer or shorter period, depending on the supplies they have available at the time the strike occurs. And before those stocks run out the strike may be over. The industrial undertaking then that can build up sufficient stocks of fuel to supply its wants for several weeks can face a coal strike with some equanimity. It is, therefore, to every industrial undertaking's benefit to preserve within economic limits as high a stock of fuel as possible ; and this applies specially to electricity generating stations and gas works which operate more particularly in the public interest.

Idealism v. Practice.

Unfortunately, like all plans which are more than faintly tinged with idealism, this arrangement cannot be carried out without certain practical difficulties being overcome. In spite of the increasing amount of coal which the miners have recently been winning, our national wants far exceed the supply —delivery is bad and quality is poor. For some time past it has, therefore, been impossible to accumulate any great stock. Moreover, many factories and generating stations have not sufficient ground available for storage. The area required for this purpose is considerable, as will be realised when we say that to store 20,000 tons requires in space a solid cone whose base is a circular area of 380 ft. diameter though the figure varies a little with the method of storage employed. In some cases so great is the space required to store a reasonable amount of fuel that it has been found necessary to plan special storage grounds at places remote from the station. The Commonwealth Edison Company of Chicago is a case in point, having a supply of several hundred thousand tons available for emergency purposes outside the city, in addition to fair-sized storage piles at each of the generating stations. This emergency storage during the strike last year was reduced to about 15,000 tons, but the supply of energy was successfully maintained, forming a tribute to the utility of the arrangement. Indeed, seeing the importance of maintaining the supply, such a storage must be considered as a cheap and useful form of insurance, while in any event the irregularity of deliveries renders it a necessity in all stations of more than a moderate size.

Chemical and Physical Troubles.

However, it is not all plain sailing in this matter, and some interesting questions of a chemical and physical character arise in connection with it. It is well known, for instance, that large quantities of coal piled together in a heap sometimes ignite spontaneously and that a slower interaction is also in operation more or less continuously, leading to a deterioration of the thermal value of the fuel. These points, much as they require elucidation, have recently formed the subject of an investigation in the United States by Prof. H. H. Stoek, of the University of Illinois and though not wholly applicable to conditions over here are still of considerable interest.

Prof. Stoek considers the deterioration of coal when stored under the following heads : It may change in appearance or suffer degradation and a consequent increase in the proportion of comparatively useless fine coal. It may suffer a loss of heating value, of firing quality, of coking and gas making qualities, and from spontaneous combustion. These changes are of varying importance, but the elimination of as much of the fine coal as possible by reducing the handling, not because of any reduction in fuel value, but because of its tendency to cause spontaneous combustion, is highly essential.

No Deterioration from Storage.

There is a widespread opinion that the heating value of coal suffers by storage. Very carefully conducted experiments made at the University of Illinois and by the U.S. State Department of Mines show this to be a fallacy. In fact, where storage under water is used there is no deterioration at all. Storage does, however, appear to injure the coking properties of coal owing to the heating that takes place, and, indeed, the greatest difficulty attendant on any system of coal storage is the liability to spontaneous combustion that is always present. The gradual heating of a coal pile is due mainly to the slow oxidation of the carbon in the coal and to a less extent to the oxidation of the sulphur in the iron pyrites contained in the coal. If the air supply is sufficient to permit oxidation, but not sufficient to carry it away, the temperature of the pile will gradually rise and eventually a fire will occur. This tendency to oxidation is more apparent with freshly-mined than with old coal and in hot weather than in cold. These are two points which it is possible to deal with without difficulty.

The Factors in Combustion.

Some coals are more liable to spontaneous combustion than others, though data on the point is not very definite. But it would seem that this liability to combustion depends more on the size, freedom from dust and sulphur content of the coal, and on the way in which it is piled than upon other inherent qualities. Indeed, it may be said that risk of spontaneous combustion is greatly reduced if dust and fine coal can be kept out of the pile, if the piling is so arranged that the heat generated by the oxidation can be carried off by air currents, or alternatively if the coal is so closely packed that oxidation cannot take place. Breakage is to be avoided as it exposes fresh surfaces to oxidation and the least friable coal is safest to store. It is further important that the coal storage area should be well drained and so arranged that dirt does not get mixed with the stored coal, while care is also necessary to see that inflammable material such as waste, wood, oil and tar are eliminated.

The question of cost is finally one that must receive consideration. Such a storage not only means considerable expenditure in the preparation of a suitable ground, and in the provision of adequate handling equipment if the amount to be stored is large, but running costs have also to be added in a certain proportion, all of which are an additional charge on the undertaking. Nevertheless, there seems to be no doubt that it is an absolute essential form of expenditure which labour and running conditions at the present time unfortunately only too often justify.

The Metric System.

The report of the Metric Committee appointed by the Conjoint Board of Scientific Societies is rather a colourless document. Its findings and recommendations are not likely to please either those conservatives who think that our present system of weights and measures and coinage is the best that could be employed, nor those perfervid propagandists, to be found in every country, who would make a clean sweep of all duodecimal units and erect in their place a universal metric system. Like all pure-spirited preachers of idealism, however, these enthusiasts fail to recognise that while there would be undoubted advantages in carrying out their policy, the disadvantages would be equally, if not more, undoubted, and that no such change could be made without most carefully weighing the pros and cons of the question.

Men and Opinions.

This consideration has, however, undoubtedly influenced the Committee in their findings, as have the conditions under which the report was produced. The report was first prepared in 1917. It is based not on the examination and cross-examination of witnesses, but on the perusal of documents, on personal experience and on *ex parte* statements of persons and representatives of learned societies. We cannot agree that this procedure was "no impediment to the consideration of the subject." Opinions which are held on this question (and it is a question on which everyone of us has his opinion) too often have no logical basis and for that very reason, perhaps, are the more rigidly fixed. Moreover, the opinions so held throw certain phases of the subject into relief and obscure others so that the personal views tend to be unreliable. Cautiousness in dealing with this subject is, therefore, a quality of more than usual value.

The Quality of Cautiousness.

This quality is freely exhibited in the historical accounts of the metric and British systems with which the report begins. Care in drafting legislation to make the metric system compulsory is advised, while the facts that there are cases when even a decimal system is not acceptable and that duodecimal arithmetic has the advantage of having four easily obtainable factors are stressed. On the other hand, the arguments that the British system is inconvenient and wasteful, that its retention is an obstacle to the scientific improvement of industry and international commerce, and that it wastes a year of school time, all find a place, though in reference to the last of these the Committee add that the compulsory adoption of the metric system in this country would not be likely to have the beneficial influence on elementary education that its advocates claim for it.

Present v. Future Complications.

Too much indeed is made of the complications of our present system. The fact is that it is perfectly easy to work with, that its apparent cumbersomeness is largely mitigated by familiarity and, though clumsy, the units are not confusing. To get rid of these advantages by wiping the system out altogether is too drastic a procedure, and the Committee are quite right in stating that a good deal could be done by modifying its more glaring idiosyncracies, by using it properly and by judiciously introducing decimalisation into it. To do anything else is, in our opinion, most unwise. Not only would the general public have to be educated anew, but all present weights and measures would have to go and new ones introduced at an expenditure which, in the case of the textile industry alone, the Committee estimate at some thirty to forty million pounds. And for what? To gain the advantage of simpler inter-relations and of international acceptance of the metric system. It is emphatically not worth while. And in this connection it may usefully be pointed out that in no country yet has the metric system received universal adoption, while in France, the land of its birth, local systems are still extensively employed in ordinary trading.

Decimalisation.

Having said so much we do not wish to give the impression that we consider the metric system should be debarred from this country. If that were possible it would be in the last degree unwise. It has already proved its great utility, not only in scientific and engineering work, but for the purposes of international trade. For the latter purpose its employment might be still further developed by education, but we agree with the Committee that the self-interest of those concerned is likely to bring this about with less friction than compulsion. This, however, is a matter which, after all, is of importance to relatively few, and for the rest the decimalisation of our present system would give all the advantages that the metric system offers with much less trouble and confusion.

The recommendations of the Committee tend to this end. They consider that the present system of weights and measures should be retained, with the minor modification that certain units, such as the league, might be abolished and that decimalisation should be introduced. On the other hand, statistics should be compiled in metric equally with British units, and that the same procedure should be followed with regard to maps and plans, that the subdivision of units, such as centimetre, should not be used, and that the metric system should be made compulsory in the fine chemical and drug trade. These changes can be effected without any great legislative action, but this legislation should be drafted by those who know something about it and should be submitted to criticism to the Director of the National Physical Laboratory, the Deputy Warden of the Standards and other similar authorities. In this suggestion we see a refreshing idealism which is generally absent from reports of this kind. The important proviso is made that nothing should actually be done until agreement on any suggested change has been reached with the United States. And there we suppose the matter will rest until it is considered by the next Committee.

Pulverised Coal in the Power Station.

A New Boiler House Fuel.

By L. C. HARVEY and E. E. NOBLE.

PROGRESS IN AMERICA.

At the close of the year 1918 it was accepted by American Engineers, following upon the successful development of pulverised coal applications in the iron, steel and copper industries, and also in view of the proved economies resulting from the use of this fuel for steam raising, that greater attention would be given to this method of firing power house and industrial boiler plants in the near future.

That this prophecy has not been long in proving correct is evidenced by the decision of the Milwaukee Electric Traction & Light Company to equip the first unit of 40,000 kw. capacity at the new super power station in that city with boilers which will be exclusively fired with pulverised coal. This will mark a turning point of great importance in the history of pulverised coal as a boiler-house fuel. It means that following upon exhaustive tests carried out at the old station the results obtained have convinced Mr. Anderson, chief power engineer, that pulverised coal-firing is going to save him money.

In the same city mechanical stokers purchased for a new power plant, delivered and paid for, have been recently sold in favour of pulverised coal firing.

The past year has also seen the starting up of several additional boiler plants, more especially at the anthracite collieries, and definite opinions of steam power engineers are now available on this subject. Brief reference to these opinions, given after many months, and in some cases over two years' continuous operation, are herein reproduced. These very positive statements, coupled with the departure authorised by the Milwaukee Electric Traction & Light Company, can leave little doubt in the mind of anyone as to the successful development of this method of firing boilers which has taken place in America.

The old fears so long held that pulverised coal as fuel for boilers is unreliable and dangerous can be laid to rest. Opinions on this matter are as follows :—

SOME OPINIONS.

Extract No. 1, October, 1919.

" Referring to your inquiry relative to the reliability of our boiler installation (13 boilers), we are pleased to advise you that at no time since this plant was started last February have we had for any reason whatever to shut down any of the boilers due to operation of the pulverised coal plant and the boiler equipment for same.

" We do not hesitate to say that we are not at all, from our experience, liable to have to shut down any of our equipment, which naturally would interfere with the operation of our sugar machinery output, which is run 24 hours per day continuously. (Mill pulverising plant run 18 to 20 hours per day, which gives sufficient pulverised coal to operate the boilers 24 hours per day.)"

Extract No. 2, October, 1919.

" We have been burning 150 tons of coal per day for the last two years in a plant located in the centre of the city. (Pulverised fuel-fired boiler plant.)"

Extract No. 3, January, 1920.

" *Re* your inquiry about what becomes of the fine ash resulting from the burning of pulverised coal under a steam boiler. I have learned to answer this as directly as possible by saying ' I do not know.' (150 tons of coal burnt per day.)

" We have received no complaints and can find no evidence round about as yet that would indicate that our ash descends anywhere in the vicinity.

" I do not think I can say anything more practical or definite than to reiterate that the disposal of ash has not been one of our troubles."

Extract No. 4, January, 1920.

" We have made some few changes and are now running very smoothly and the installation is very satisfactory in every way, both as to the reliability of the pulverising plant and also to burning the coal (bituminous sludge) underneath the boilers. We will probably install one more 600 H.P. boiler in the coming year and it will be under powdered coal, the same as the rest.

" We have had no trouble with the furnaces since starting to burn this sludge, nor have we had any trouble with the boilers as the tubes have stayed clean all the time."

COST OF INSTALLATION.

It is unnecessary in this article to repeat the general advantages of using pulverised coal as a power-house fuel, for these have been so often put into print. It is, however, important to remember that in a country where coal is still cheap, some 250 plants are now

Table I.—*Showing Plant, Equipment, Overall Costs and Operating Expenses per Ton of Coal, Pulverised and Burned.*

Normal working output in tons per day (24 hours).*	Costs per ton of Coal pulverised, conveyed and burned.							Capital Outlay.			Number and rating (lb. per hour) of boilers, included in estimate.	Total output of all boilers, lb. water evaporated per hour at 79% efficiency.¶	Value of fuel savings per year using coal at 35s. per ton.**		Normal working output in tons per day (24 hours).
	Labour cost at £3. 10s. per man per week.†	Total power cost at 1½d. per unit for power.‡	Cost of fuel for dryer using coal costing 35s. per ton.	Cost of repairs.	Interest on initial outlay, at 6 per cent.§	Depreciation on plant, including building, at 10 per cent.§	Total Cost. Pulverising, transporting, burning and power for air fans.	Approximate cost of mill house plant with buildings.‖	Cost of boiler equipment for boilers, as specified.‖	Total cost of complete plant.‖			Mechanical stokers, 20% reduction in fuel.	Hand firing, 33⅓% reduction in fuel.***	
	s. d.	s. d.	s. d.	s. d.	d.	s. d.	s. d.	£	£	£			£	£	
30	1 8½	3 1½	0 6½	0 4	1 1	1 10	8 7½	6,600	1,500	8,100	3/8,000	23,000	30	2,550	30
40	1 10½	3 1½	0 6½	0 4	0 10	1 4	8 0½	6,600	1,500	8,100	3/9,000	30,000	400	3,800	40
50	1 0½	3 1½	0 6½	0 4	0 9	1 3¼	7 0¾	7,500	2,000	9,500	4/8,000	38,000	1,000	5,200	50
60	0 10½	3 1½	0 6½	0 4	0 7½	1 0½	6 6½	7,500	1,800	9,300	3/15,000	46,000	1,500	6,600	60
70	0 8¾	3 1½	0 6½	0 4	0 6¾	0 11¼	6 2¾	7,500	2,350	9,850	3/18,000	53,500	2,300	7,900	70
80	1 1	3 1½	0 6	0 4	0 6	0 10	6 4½	7,500	2,350	9,850	4/15,000	61,000	2,300	9,000	80
90	0 10¼	3 1½	0 6	0 4	0 7½	1 1	6 6¼	11,200	2,800	14,000	4/20,000	69,000	2,600	10,000	90
100	0 9¼	3 1½	0 6	0 4	0 7	0 11¾	6 3½	11,200	3,500	14,700	4/25,000	76,500	3,000	12,100	100
125	0 5	3 1½	0 6	0 4	0 5¾	0 9½	5 7¾	11,200	3,500	14,700	4/25,000	95,000	4,700	15,000	125
150	0 6	3 1½	0 5½	0 4	0 5	0 8¼	5 6¼	11,200	4,350	15,550	5/25,000	115,000	5,800	18,200	150
200	0 4½	3 1½	0 5½	0 4	0 5	0 8¼	5 4¾	15,000	5,300	20,300	6/25,000	153,000	8,400	24,200	200
250	0 5½	3 1½	0 5½	0 4	0 4¼	0 6¾	5 3½	15,000	6,500	21,500	6/32,000	190,000	10,200	30,200	250
300	0 4½	3 1½	0 5½	0 4	0 4¼	0 7	5 2¾	18,000	8,700	26,700	8/30,000	230,000	12,500	37,000	300

* Average operating time of mills not more than 20 hours per day, but operating time of boilers taken as 24 hours per day.

† Labour charges based on 5½ working days per week, and maximum working day of 8 hours per man.

‡ Power taken at 25 kw. hours per ton to cover all power from raw coal to completed combustion in furnace.

§ Interest and depreciation based on 300 working days per year.

‖ Cost of plant given above is based upon prices for equipment made in America F.O. Cars New York Harbour, and based on an exchange rate of $4.82 per £1 (normal exchange).

¶ Calculated on the following conditions : Steam pressure 150 lb. sq. in., feed temperature 150°F., superheat 150°F., and coal 12,500 B.T.U. per lb.

** Price of raw coal taken at 35s. per ton, and in case of pulverised coal firing, the total overall preparation cost for the corresponding size of plant as given above has been added to the cost of raw coal.

*** It is realised that the larger boilers could not be conveniently hand fired.

operating. At a cost of 12s. to 14s. for raw coal some 15,000,000 tons p.a. are pulverised in America at an overall cost of, say, 3s. 6d. per ton. These overall economies effected, including those due to reduction of labour and metal losses, increased output of boilers and furnaces, have rendered these propositions very attractive.

As an indication of approximate present-day cost of installations of various capacities, and as a guide to the relative additional expense which will be incurred by pulverising and burning coal, Table I. has been prepared. Generous allowance has been made, when compiling this Table, to cover normal incidental expenses.

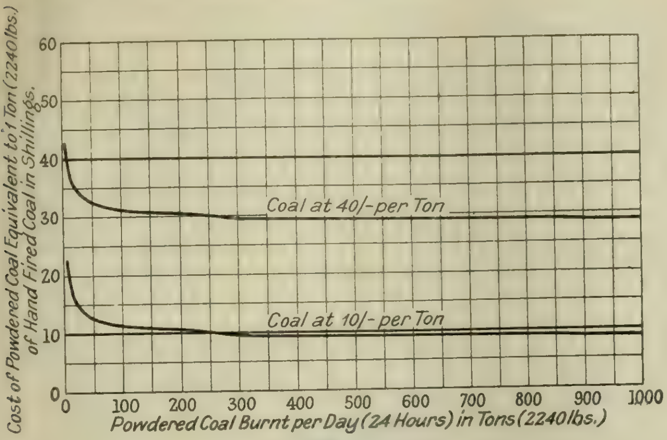

FIG. 1.

Assuming $33\frac{1}{2}$ per cent. saving in fuel by the use of powdered coal, and as an off-set against the value of the fuel saving, the cost of preparation and burning powdered coal has been added.

The relation between cost of raw coal, total overall costs for preparing and burning the fuel in pulverised form, and the attendant value of savings effected for plants of various daily capacities, can be seen in Fig. 1. Two prices of raw coal are given, 40s. per ton and 10s. per ton. The spaces between the straight horizontal lines at 40s. and 10s. (the cost of the raw coal) and the curves which indicate the total cost of pulverised coal, are areas showing the margin of net savings to be made for the plants of various capacities. At 10s. per ton these "savings" areas are insignificant, but at 40s. per ton they are considerable. At 10s. per ton for raw coal the economy point for *fuel saving only* occurs at, say, 250 tons of coal consumed per day; with higher prices for coal, 40s. per ton, the economy point is reached below 20 tons per day. In making this comparison it must not be forgotten that 40s. may be the price for raw coal in certain cases where inferior fuels at 10s. can be obtained, and that these latter may be usable in pulverised form, whereas otherwise this low-grade fuel must remain idle on the waste dumps.

Whereas, in America, where coal is cheap, it is contended that *on the basis of fuel economy alone* pulverised plants will not show a good return on capital expended on plants having a daily capacity less than 50 or 100 tons of coal. This argument does not hold good for present conditions in Europe, where plants of 30 or even 20 tons per day can be advocated in very many instances.

MACHINERY AND EQUIPMENT REQUIRED.

There is, perhaps, little necessity to refer at any length to the type of drying and pulverising machinery advocated, except to emphasise in the strongest possible manner the need for caution against installing inefficient and unsuitable plant. The pulveriser mill is the heart of the system and these machines should be of rigid construction, preferably fitted with bearings outside the pulverising zone; they should have no lubricated journals working in the dust chamber and should have a high output efficiency in relation to the required degree of fineness. With badly designed inefficient pulverising plant, the required output and fineness are unobtainable, firing conditions are unsatisfactory and maintenance costs excessive.

Any efficient and proved type of machinery can be accepted for the coal preparation and milling machinery, and the only essential point to bear in mind in regard to the application of pulverised fuel supply to boilers is to maintain an 8 or 10 hours' supply in bunkers at the actual boilers. Screw feeders are attached to the outlets from these bunkers in order to supply the powdered fuel to the air blast at a point as near as possible to the burner pipes entering the walls of the combustion chambers. In this way there is no possibility of igniting a large volume of explosive mixture, prior to actual combustion in the furnaces.

This reserve fuel supply system is the only rational arrangement that can be put forward with any degree of confidence for power-house boiler firing, where continuity of steam supply is of such vital importance. In a list of American boiler installations taken from Messrs. Barnhurst and Sheffler's Paper read before the American Institute of Electrical Engineers, there is not one single case where the boiler storage fuel bin method has not been adopted.

SUITABLE FUELS.

Particular attention may be called to the wide variety of coal now successfully applied as a boiler fuel; in fact, it can be said with certainty that any grade of carbonaceous fuel, be it lignite or peat, anthracite or bituminous, lump, slack or dust, culm, washery waste, or coke breeze, can be made use of in pulverised form. By no other known method or means can many of these low-grade fuels be used. Fuel containing up to 40 per cent. of ash, and as low as 5 per cent. volatile matter, can be equally applied and burned so as to produce a combustion efficiency of 99·5 per cent. A typical illustration of a B. & W. boiler fitted with fuel supply bunker, screw feeders, air fan and burners, and indicating the flame conditions within the combustion chamber, is given in Fig. 2.

PULVERISED COAL *v.* LOW-TEMPERATURE CARBONISATION.

On the question of fuel consumption and boiler efficiencies, the final report of the Nitrogen Products Committee contains a mass of interesting data relative to steam power generation for stations of 125,000 kw. capacity.

It is therein clearly shown that with coal at 7s. 6d. per ton (and the lower the price of coal the greater advantage accrues to by-product recovery processes), direct coal-firing of boilers stands alone as the most economical system, so far as actual overall fuel consumption is concerned. It was suggested to members of that Committee that a boiler efficiency of 85 per cent. with superheaters and economisers might be assumed, but in the light of the wide experience of some of its members, 80 per cent. has been accepted as the average working efficiency figure at 95 per cent. power factor.

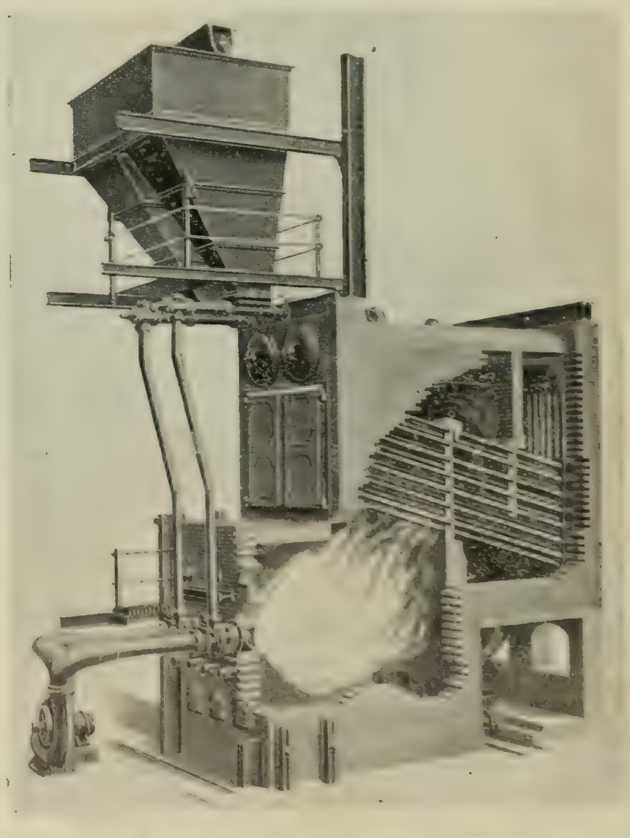

FIG. 2.—B. & W. BOILER FITTED WITH PULVERISED FUEL INSTALLATION.

An average working efficiency of 80 per cent. is a standard that could only be reached for stations having the constant 95 per cent. to 100 per cent. factor. Normal city power station load varies throughout the 24 hours, so that a power factor of 60 per cent. is considered good. Under these conditions the best average working efficiency, due to banking losses, clinker formation on stokers at peak loads, excess air supply under forced draught, &c., cannot be any higher than 70 per cent. With pulverised coal-firing it would be quite possible to maintain the average working efficiency at 78 to 80 per cent

COAL SAMPLES, BOILER EFFICIENCIES AND THE USE OF COKE.

On the question of boiler efficiency tests, much depends upon the sample of fuel forming the basis of calculation. Such samples may well be unduly moist or may have become contaminated with ash, thus an incorrect figure is returned for the apparent calorific value of the coal used. Samples of pulverised coal as fired are perfect samples of the fuel used, for it will be conceded that no better method can be suggested for their preparation. With this system of boiler firing steady working efficiencies of 75 to 80 per cent. can be maintained for all loads from 25 per cent. of full load to 100 per cent. above maker's rating. Mechanical stokers could not possibly be worked at the latter duty for any length of time, but pulverised coal is similar to oil-firing in this respect.

When dealing with coke-fired boilers the Nitrogen Products Committee suggests a figure of 70 or 75 per cent. for average working efficiency with superheaters and economiser. With pulverised coke, especially the product of low temperature carbonisation, efficiencies equal to coal-firing could be readily obtained.

To substantiate this assertion it may be mentioned that 82 per cent. efficiency has been realised at the Susquehanna Collieries in America when burning anthracite culm, containing no more than 5 per cent. of volatile matter and up to 30 per cent. ash. "Low-temperature" low ash coke, therefore, would be an ideal fuel for pulverisation, and it is hoped that this method of burning will assist towards increased overall efficiency of combined by-product recovery and power supply plants.

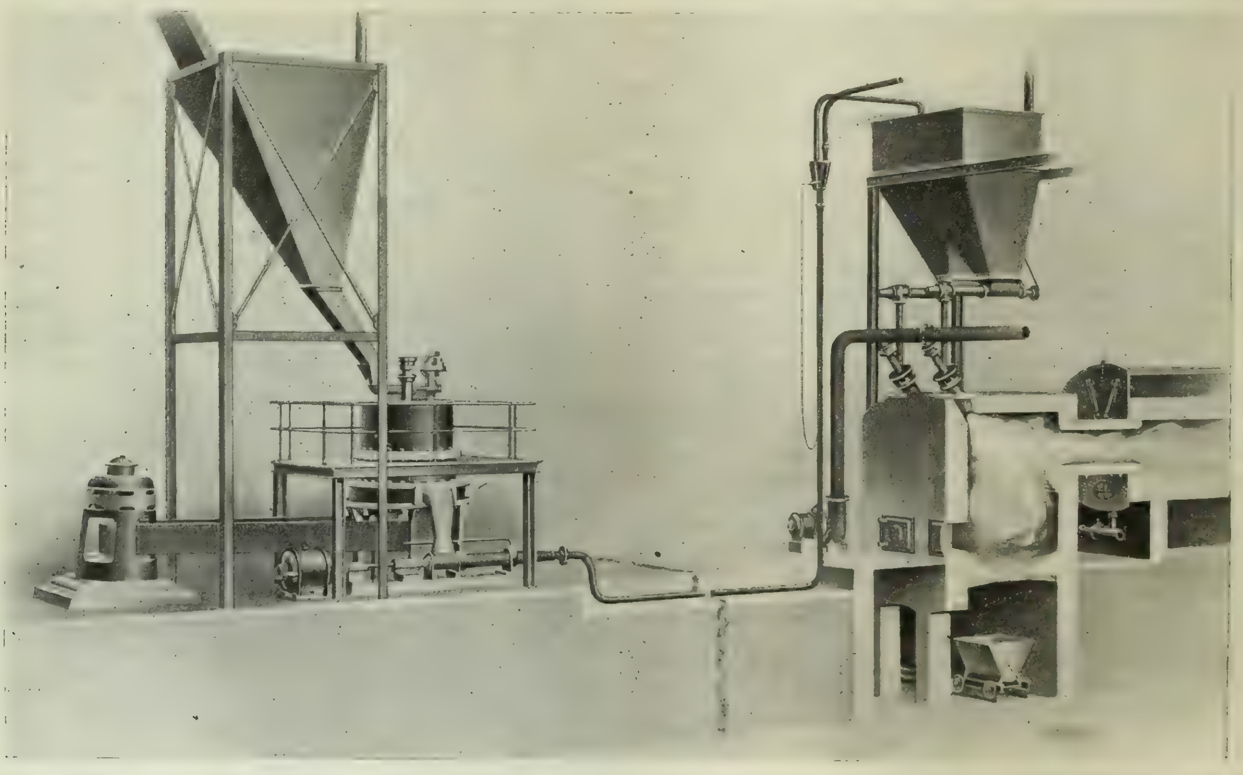

FIG. 3.—PULVERISED COAL EQUIPMENT, SHOWING FULLER-KINYON PUMPING SYSTEM.

TRANSPORTATION OF FUEL.

Too much attention cannot be given to methods of transporting the coal dust to the boilers. If the fuel supply bin system is adopted transportation can be accomplished by several means, such as, by screw conveyors; by air pressure, the fuel being delivered into blowing tanks and compressed air supplied so that the fuel is forced through delivery pipes to the boiler bins; or by the Fuller-Kinyon pumping system, a method which includes a simple coal-pumping outfit requiring a minimum of power and with which ordinary delivery pipes to the boiler bins can be used as with the air-pressure blowing system. If bins are not used, then the air and coal-dust mixture system must be adopted.

The Fuller-Kinyon pumping system referred to is the latest method of transporting the fuel under dustless conditions. Many equipments are now in use in the States, where, in addition to new propositions, these are being installed in place of the older methods. Fig. 3 will give a general impression of this arrangement as proposed for a Lancashire boiler-plant, and clearly shows the added convenience over the screw conveyor system, which, up to recently, was considered the only reliable positive action method of fuel supply for boilers. Fig. 4 shows a typical lay-out arrangement for a pulverised coal plant.

WATER TUBE AND LANCASHIRE BOILERS

At the present time cost of coal and the quantities required for the raising of steam are two of the most important factors that station engineers have to consider, and are universal considerations of great moment the world over.

The efficiency of steam boilers during the past 20 years has increasingly engaged the attention of designers and technical engineers, and the call for high working pressures has necessarily brought the water-tube boiler into greater prominence at the expense of the simpler and less suitable shell type. Indeed, it may, perhaps, be reasonably held that as far as the boiler itself is concerned, the last word has been said in regard to the design of the Cornish and Lancashire types.

It has been held that the Lancashire boiler has one great advantage, that of reliability, also that it requires no skilled attention and carries a large reserve of steam. These claims are quite justifiable, but they have often been the cause of absolute neglect of efficiency. The lack of skilled attention, instead of being an asse is more often a source of financial loss. The steam reserve is accumulated at a high potential fuel cost. It may be generally stated that the evaporation capacity of a boiler is dependent on the coal consumption, and in the recent past, when coal was plentiful and cheap, unnecessary consumption of coal was a matter of little importance

MECHANICAL STOKERS FOR LANCASHIRE BOILERS.

The fitting of forced draught and mechanical stokers, in order to obtain higher rates of coal consumption for given flue diameters, has been the only means of increasing the steaming capacities of Lancashire boilers, with, however, little improvement, if any, in boiler efficiency.

With mechanical stokers of the most approved type the efficiency of a Lancashire boiler will seldom exceed 60 per cent. under average working conditions, unless special low-ash coal of non-caking quality and of high calorific value is used. With hand-fired boilers efficiency falls to, say, 54 per cent., and only then is this figure maintained with suitable good quality coal.

ECONOMISERS FOR LANCASHIRE BOILERS.

By the addition of economisers, and taking coal of 12,500 B.T.U.'s, the overall efficiency of boilers fitted with mechanical stokers and working under good conditions and trained supervision can be raised to about 72 per cent.

Combustion and Working Conditions. Systems Compared.

The combustion of powdered coal, of a high degree of fineness. when intimately mixed with air is analogous to that of gas, due to the instantaneous diffusion of the minute particles of coal with the air supply which occurs at the point of their liberation at the burner nozzle. Each particle is surrounded by a volume of air sufficient for its complete oxidation, and the smaller the particles the better the conditions for instantaneous ignition, and the less time will be required for complete combustion of the fuel, thus preventing all chance of unconsumed carbon coming into contact with cool boiler surfaces.

Owing to the finely-divided nature of pulverised coal, when thoroughly mixed with air, combustion therefore takes place the instant that this mixture has been raised to the temperature required for the ignition of its volatile constituents. The control of air can be adjusted to a degree closely approaching theoretical requirements, so that 17 per cent. to 18 per cent. of CO_2 in the products of combustion can be obtained in normal practice. Under these conditions the furnace flame temperature will be in the neighbourhood of 3,100°F., which is above the softening point of refractory fire bricks, and this was one of the difficulties originally experienced. With combustion chambers as now designed, however, the coal flame is some distance from the refractory walls, so that, owing to a "blanket" of cooler gases between the flame and the inner surface of the combustion chamber, the overheating and fusing of the brick surfaces does not occur.

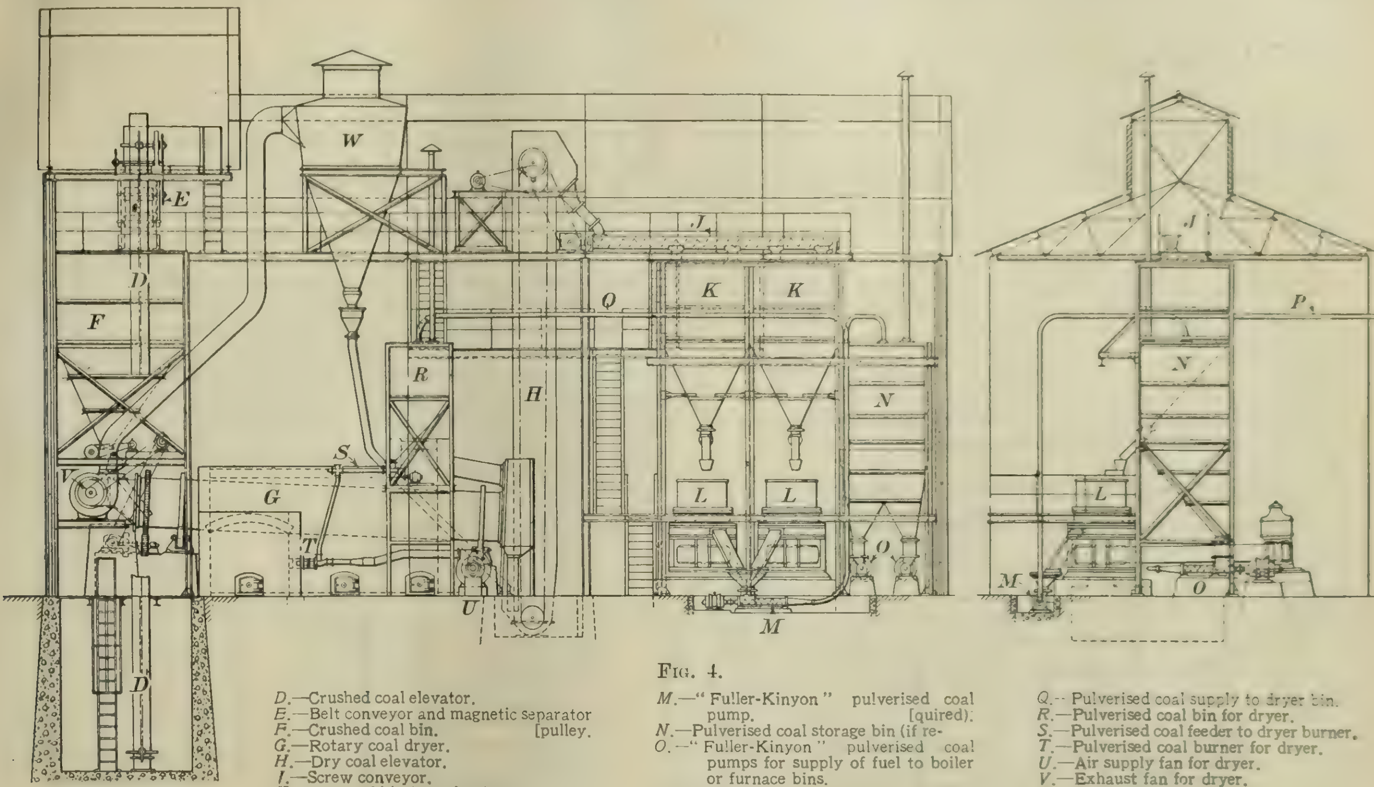

Fig. 4.

D.—Crushed coal elevator.
E.—Belt conveyor and magnetic separator pulley.
F.—Crushed coal bin.
G.—Rotary coal dryer.
H.—Dry coal elevator.
I.—Screw conveyor.
K.—Dry coal bin for pulverisers.
L.—"Fuller-Lehigh" pulveriser mills.
M.—"Fuller-Kinyon" pulverised coal pump.
N.—Pulverised coal storage bin (if required).
O.—"Fuller-Kinyon" pulverised coal pumps for supply of fuel to boiler or furnace bins.
P.—Pulverised coal supply pipe to boiler furnace bins.
Q.—Pulverised coal supply to dryer bin.
R.—Pulverised coal bin for dryer.
S.—Pulverised coal feeder to dryer burner.
T.—Pulverised coal burner for dryer.
U.—Air supply fan for dryer.
V.—Exhaust fan for dryer.
W.—Dust separator for dryer.

(*To be concluded.*)

Data on Mercury Vapour Rectifiers.

Some interesting articles on mercury arc rectifiers have recently been published in the Continental Press. One of these, by Monsieur Henri George, appeared in a recent number of "Revue Generale d'Electricité," and describes the principle of a new mercury vapour lamp in which the arc is struck by simply closing a switch. This does away with the usual system of employing a tilting apparatus. As is well known, the drawbacks of the ordinary mercury vapour lamp are the slowness with which it attains its full efficiency, though the efficiency once attained is high, the high starting current, its sensitiveness to all atmospheric conditions, its fragility, its complicated means of ignition and its deterioration owing to infiltration of air. The best means of remedying most of these defects is evidently to strike the arc at high pressure. Experiments were made with preliminary heating of the mercury, and an arrangement in which the mercury and the connecting tube is boiled by enclosing a tube in a spiral electrically heated platinum is described. With this arrangement, when the mercury boils a bubble of vapour breaks the connection, and the arc is struck at about atmospheric pressure. The apparatus for obtaining this arrangement is, however, very cumbrous and difficult to arrange practically. In the new lamp a receptacle containing some inert gas, such as argon, at a pressure of 70 cm. of mercury, communicates with the mercury filled lighting tube. A tungsten filament passes through this gas, and when the current is switched on sufficient temperature is reached to cause the gas to expand and break the mercury column in about five or ten seconds. This fracture of the mercury column strikes the arc, and the circulation of the mercury vapour thus generated forces the gas back into the reservoir. The lamp should, of course, work equally well under all conditions, which cannot be said of the tilting type. The gas prevents also the mercury from moving about and breaking the tube when in transit, and the intensity of both the visible and ultra-violet spectra are increased.

An article by M. E. Carlevaro in "Elletricita" gives the results of experiments on a single-phase Cooper-Hewitt converter with a capacity of 10 amperes, both with an external resistance and with a battery of accumulators replacing the resistance. The author finds the losses in the regulator are due to the drop across the arc.

In an article in "L'Electricien," M. S. Cohen points out that the only available rectifying apparatus for voltages exceeding 5,000 volts are the synchronised rotating commutator and the vacuum tube. He describes a method, due to himself, which consists in passing a spark from a point to a plate in gas under pressure, and how he has now obtained an efficiency of 85 per cent. by the use of ammonia under a pressure of about 100 lb. per square inch. Various gases, including air, have been experimented with, but ammonia was found to be the most suitable, because it also acted as a cooling agent, and the spark field was increased by its enclosure in an atmosphere of nascent hydrogen. Various electrodes were used—*e.g.*, aluminium and copper, iron and copper with a mercury cap, and aluminium and iron. The best results were obtained with aluminium and copper, the aluminium being in the form of a rotating disc, so as to present a new sparking surface during the operation of the instrument.

Multiple Systems of Distribution for Street Lighting.*

By WARD HARRISON.

The problem of securing street lighting most economically from multiple connections is one whose possibilities are far from exhausted. The same degree of standardisation as in the series type of circuit has not yet been attained. The purpose of this Paper is to review systems now in use and to indicate some of the more promising avenues of development.

Extent of Use.

In European cities, multiple street lighting systems are practically as common for both arc and incandescent lamps as are series systems in the United States. Even in the latter country there are a large number of straight multiple systems in operation, though chiefly confined to cities where low-tension current only can be used. Of these, New York, is the most promising example.

Advantages.

The following advantages which contributed to the standardisation of multiple distribution for all other types of electric service, apply also to street lighting :—

1. Widest choice in number and sizes of lamps to be connected to circuit.
2. Ease of adding more lamps or lamps of higher wattage.
3. Simplicity and low cost of fixtures and accessories.
4. Safety.

Flexibility is of immediate importance in view of the growth in population and area covered ; there are also unexpected demands from time to time for increased street lighting service in given areas. Series circuits of units of 50 to 100 lamps included on a single line would involve an almost continuous process of rearrangement and redivision of lamps, occasioning considerable delay and high cost. No such limitations attend the multiple distribution system.

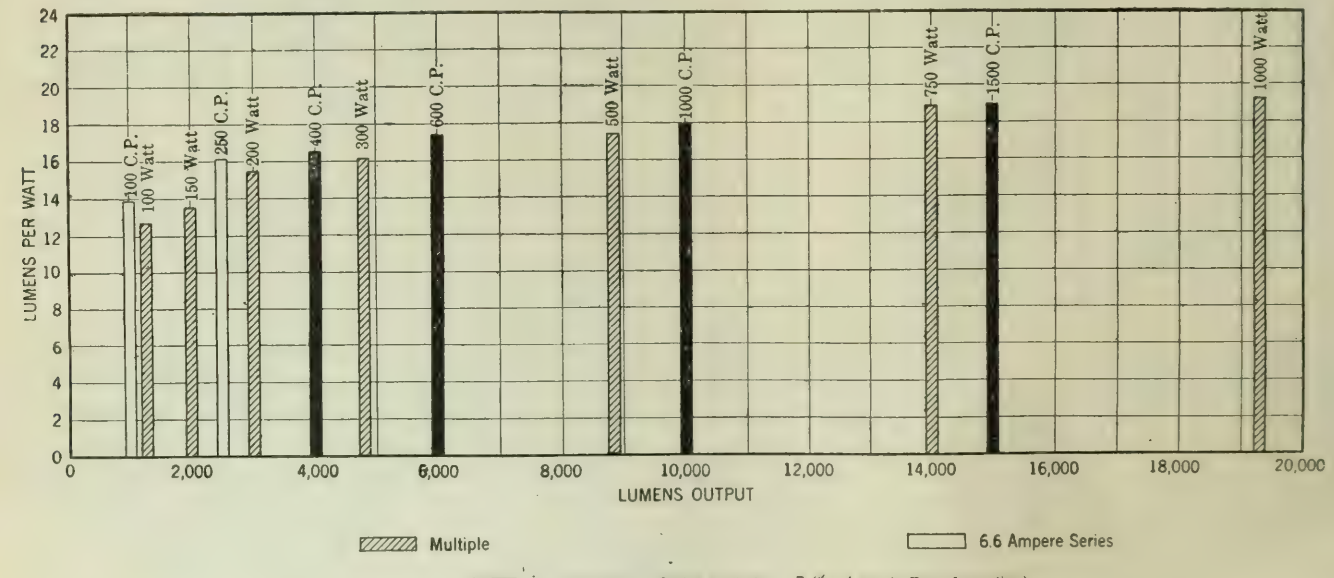

Fig. 1.—Comparative Efficiency of Series and Multiple Incandescent Lamps.

An additional advantage of multiple street lighting is that this form of circuit is now used exclusively by central stations for every other service. Its general use for street lighting would result in a reduction in types of apparatus required and the resulting simplicity of operation would benefit both the electrical manufacturer and the central station. At present, when a new sub-division or allotment is opened, it is usual to run a set of 2,300-volt feeders to cover the plot, and to furnish service to houses as they are built. At the same time, a series transmission line is extended to furnish the necessary street lighting for the sub-division. In anticipation of increased requirements both supply circuits are installed with a large excess capacity. The principal reasons for this duplication of service have been :—

1. The arc lamp is inherently a constant current device and gives its best operation and greatest efficiency on series rather than on multiple circuits.
2. The series circuit is the simplest and most efficient method of supplying energy to comparatively small units scattered over wide areas ; in many cases electric street lighting ante-dated the general use of electricity in residences by a considerable period.
3. A separate system of distribution has furnished a convenient means of automatically lighting and extinguishing street lamps from the central station.

There is an insistent demand for the extension of electric street lighting service in territory not now served by series lines. The residences are chiefly furnished with current from overhead circuits along the rear lot lines, and the introduction of a pole along the street to carry the series circuit has often met with protest from property holders. Yet the cost of underground construction, with ducts running parallel to the curb, is almost prohibitive. High-tension underground lines passing through private property from the rear lot lines to the street, also involve expensive construction. The conditions thus point to the use of low-tension multiple circuits from the pole lines in the rear to the posts on the street, brought out either overhead or underground, as occasion may require. Under these circumstances the underground construction may be in the form of a relatively inexpensive lightly insulated sheathed conductor protected simply by fuses at the transformer. Such a conductor is much less expensive than that designed for high-tension work, and it can be installed without opening a wide trench across the lawn. If such a conductor is accidentally severed no serious harm can result and the loss in itself is small.

Control.

If incandescent street lamps were to be operated throughout the 24 hours instead of at night only, there would be no discussion as to the desirability of connecting them to the existing multiple distribution system. The difficulty lies in obtaining a thoroughly satisfactory method for turning the lamps on and off. Concentrated loads may justify a separate circuit from the sub-station, whence the lamps may be controlled as in the case of series circuits. Usually, however, to bring the circuits back to the sub-station entails prohibitive expense, and it is necessary to supply the lamps from several different transformers or feeders located nearer the lamps.

The simplest plan, *i.e.*, to have the lamps turned on and off by hand, is often impracticable in the United States owing to the higher cost of labour and the extended distances between lamps.

Most of the efforts toward the development of remote control of multiple street lamps on 110-220-volt circuits can be grouped under three general types of systems cascading, relay switches operated from a pilot wire, and automatic clock or impulse-operated relay switches without separate control circuit. Diagrams illustrating these three methods of remote control are shown in Figs. 2, 3 and 4.

In the cascade method the section of lamps nearest the sub-station or control point are switched on and off by hand or a clock control switch. Energising of this section serves to close a relay operating the switch for a second section. At the end of the second section is a similar relay which, being energised, closes the circuit for the third section of lamps, and so on. Opening the switch on the first section of lamps serves to de-energise the other sections of lamps in the same order. This method can be used for either alternating or direct-current systems, or even a combination, and the load may be carried from as many separate transformers or sets of feeders as desired.

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* Abstract of a Paper read before the American Institute of Electrical Engineers.

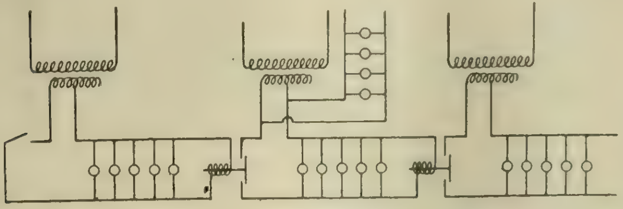

Fig. 2.—Cascade Control of Multiple Street Lamps.

In the cascade system a failure of current supply in any section will turn out the lamps in succeeding sections of that cascade. This difficulty can be minimised by provision for hand operation of the switches in case of failure of one of the units.

The pilot wire control utilises a somewhat different principle for switching the lamps on and off. In this method (Fig 3) the lamps of the system are grouped in sections of suitable size to be controlled by a single switch and the separate switches are operated from a pilot wire of low current-carrying capacity, which is energised from the sub-station or control point. The simplest type of relay consists of a solenoid-operated switch, which is preferably closed when the pilot wire is de-energised; then if the pilot circuit is accidentally opened the lamps will all be lighted.

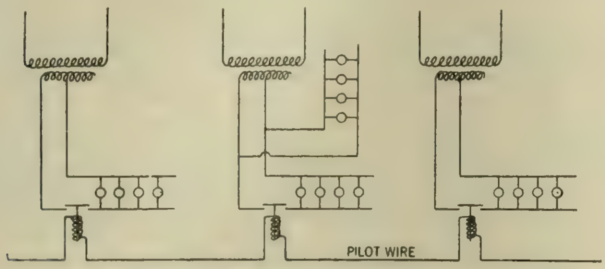

Fig. 3.—Pilot Wire Relay Switch Control.

Another type includes a mechanism with on and off positions. The first time the control wire is energised the lamps are lighted. The next time the lamps are turned off, and so on. Continuous application of current to the control wire is not necessary with this form, but there exists a possibility of lamps being left turned off when it was desired to have them on, or vice versa, due to switches getting out of step. A pilot or signal switch at the control station has been suggested to obviate this uncertainty. Also, one manufacturer has provided for convenient hand setting of individual switches which might drop out of step. In an endeavour to avoid the objections raised against the impulse-operated switches of the type just described, other forms have been developed which operate from impulses of different strength.

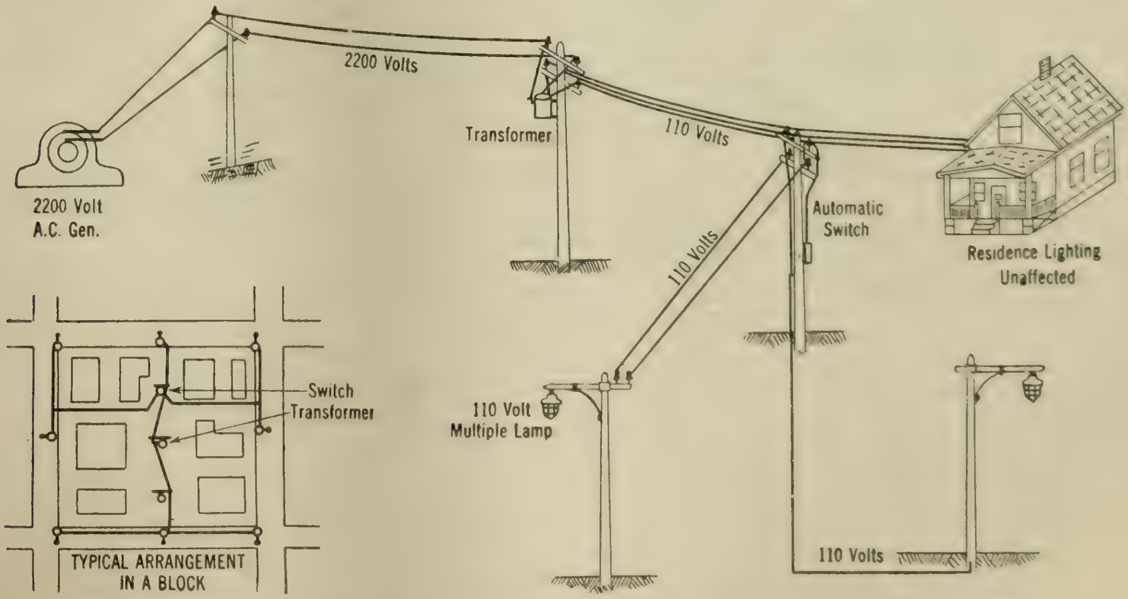

Fig. 5.—Plan of Operating Street Lamps from Secondaries of a House Lighting System.

Since the installation of a pilot or control circuit involves a certain amount of inconvenience and expense, attention has been directed to the development of a remote-control switch system requiring no extra wiring. One of the earliest devices for accomplishing this result was the clock or time switch. Again, time clock switches may be had which are electrically wound and which may be set to change the time of switching the lamps automatically, according to a prearranged schedule of burning. Such clocks require much attention and regulation to keep them in agreement. This factor and the question of initial cost has hindered the more extended use of these devices.

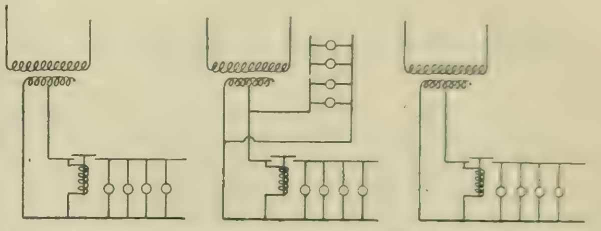

Fig. 4.—Control by Automatic Clock or Impulse Operated Relay Switches without Separate Control Circuit.

A tiny synchronous motor-operated clock switch requiring an almost negligible wattage, is available for remote control switching on alternating-current circuits. This switch is best applied to systems whose average frequency is well maintained and where there are but few interruptions of service. Otherwise the switches are liable to require a considerable amount of re-setting. A different and a more satisfying solution of the problem would appear to lie in the development of a system of switch controls operated without pilot wires and without clock mechanisms, but actuated at will from the power station or control point. One remote control switch now on the market is operated by "winking," or quickly opening and closing the supply circuit. Also, experimental apparatus has been built showing the practicability of operating switch relays by varying the frequency of the alternating-current supply a few cycles above and below normal. Experimenters have proposed also the use of relay switches receiving impulses from wireless waves.

Operation of the switch relays by means of selenium cells has been suggested. Such switches would, however, be entirely dependent on the amount of daylight, and would not necessarily control the lamps according to the fixed hours of burning involved in many street lighting contracts. Furthermore, it would not be possible to turn the system on and off for test or other purposes, except by the additional provision of hand-operated switches.

It seems reasonable to believe that apparatus operated without a pilot wire should soon be developed by means of which street lamps can be lighted and extinguished at will,in a manner which is not open to any of the foregoing objections. Such a system, to be successful, must not involve a high cost per unit installed; also, it must not require the addition of any considerable amount of equipment on the 2,200 lines; finally, its mode of operation, particularly if it involves the use of high frequency, must be such that there is no possibility of injury to transformer insulation or to any apparatus forming a part of the present standard distribution system.

Lamp Characteristics.

The serious loss in light output when incandescent lamps are operated at less than rated voltage is well known, and it is essential with multiple systems that lamps be used whose ratings correspond closely to the voltage measured at the socket. Difference in supply voltage may become so great that the expedient of using lamps of two or even three different voltages is sometimes followed. However, confusion of lamp voltages is likely to arise. A plan which is usually preferable is to provide for a very small drop between the street lamp and the supply circuit by running short branches and operating from one to three lamps on a branch. Fig. 1 shows the efficiency of the various sizes of multiple and series lamps computed in lumens per watt. The slight inferiority of multiple lamps from the standpoint of efficiency is worthy of note.

The depreciation in candle-power or falling off in light output during life, is comparatively slight for the modern types of gas-filled incandescent lamps.

The Series System of Street Lighting Distribution.*

By W. P. HURLEY.

A series system of lighting distribution is one in which all the current in the circuit, which is maintained constant, passes through each individual lamp in turn. Special short circuiting devices preserve the continuity of the circuit when the lamps burn out and maintain a constant current in the circuit with the various conditions of load.

Such series systems are employed on a large scale to operate various types of lamps for street lighting. Where a suitable current and frequency are used the same circuit may operate both arc and incandescent lamps without difficulty. However, practically all factory and residence lighting is operated with arc lamps in parallel, approximately 95 per cent. of the incandescent lamps in the U.S.A. being so used. Other systems combine the principles of volt systems by connecting a number of lamps in series and operating this series of lamps on a multiple circuit of higher voltage than is suitable for single lamps. Street cars thus use five of the substantial 110-volt lamps in series on their 550-volt circuits. Some street lighting systems, series street lamps are connected in a similar manner. In such cases alternating current is employed and special devices are provided to maintain the continuity of the circuit when individual lamps go out.

Extent of Use.

Approximately 1,000,000, street lamps in the United States are supplied by series distribution circuits, *i.e.*, practically the entire street lighting distribution system of most companies. Although requiring but a small proportion of the total output, the system is of importance because of the conspicuous position and essential duty of each small unit. Many companies provide street lighting for all the inhabitants of a city, but only private lightihg for 20 per cent. Yet its total actual cost may be only 1 or 2 per cent. of the total city budget and seldom over one dollar (approximately 5s.) per year per inhabitant. The series system is changed only slightly from the original concept brought out with the development of the first arc lamp by Mr. Charles F. Brush.

Advantage of a Series System.

Street lamps constitute a comparatively small load operated over a wide area. The line cost per k.v.a. of installation is relatively high. This is offset to a certain extent by a load factor of approximately 45 per cent. with a 4,000-hr. per year schedule. Special precautions must be taken to maintain constant power at the lamps, regardless of the wide distribution. The series system is particularly adaptable to this service. Assume that power is supplied to a 500-watt lamp every 500 feet along a street. A conductor smaller than No. 8 would be too weak and is seldom used. As regards current-carrying consideration, a No. 14 wire would be ample, although the watts lost in transmission would be approximately four times as high as in a typical street lighting system. If 110-volt multiple distribution is attempted, even with No. 8 conductor, not more than two such lamps, the most distant being 1,000 feet away, can be successfully operated, because of the poor regulation resulting from the voltage drop in the conductor. On a similar series circuit, 100 or more of such lamps, or a much larger number of smaller lamps, with as much as 40 miles of line wire, are readily operated. Under such conditions there would not be over 50 kw. in load per square mile of territory served, and where the lamps are small, or spaced even further apart, due to the presence of gas lamps in many locations or due to a scattered population, this load may be of the order of 5 kw. per square mile and 1 kw. per mile of single wire.

The low current in the series circuit prevents excessive drop in the line even with No. 8 conductor. The regulator compensates perfectly for this drop. Long high-voltage circuits have the great advantage of less apparatus per kilowatt of load because fewer circuits will be required. Also a smaller percentage of the line is used in running back to the station for purposes of control. The size of such a circuit may be limited by any one of several factors, *i.e.*, (1) voltage of the circuit to ground; (2) humber of lamps to operate on one circuit; (3) insulation of lines and equipment.

Series lighting circuits on poles are subject to grounds due to trees, lines breaking, crosses with other circuits, &c. Ground at any point may cause a heavy strain on the insulation at other points if the drop across the large number of lamps is excessive. This drop can be reduced by cutting the circuit in parts and connecting a portion only of the generator or regulator winding between these sections. The whole combination, consisting of from two to four sections, is thus connected in series as shown in Fig. 1 and takes the same current throughout the circuits. Such a system has been used in the direct-current arc generators for many years and also in the constant-current regulating transformers.

Earths must be promptly removed. Double earths may practically short circuit one section of the regulator winding and the adjacent lamps. This double earth rarely occurs with good line construction, but equality of current in the two circuits may be insured by a relay so connected as to disconnect the regulator or circuits if current in the two circuits becomes unbalanced. This system of interconnection is in general use, particularly where the voltage of a circuit would otherwise exceed 5,000.

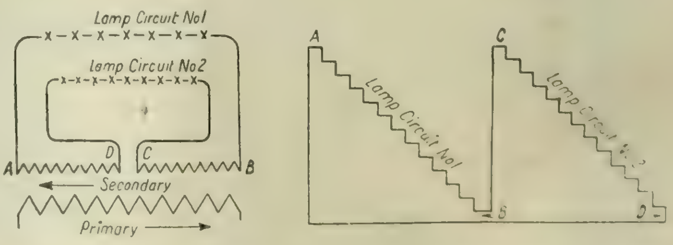

Fig. 1.—Regulator with Two Interconnected Secondary Circuits and Development of the Diagram Showing the Voltage to Earth in the Various Parts of the Circuit.

In many cases one circuit is used for the all-night lamps of a white way system and the others for the half-night lamps. The high light load efficiency of the regulating transformer makes this arrangement very suitable.

The number of lamps on a circuit depends upon the density of the lighting units and their size. In extreme cases 500 low candle poewer lamps are found on a single circuit. The numerous lamp loops of such circuits greatly increase the chances of open circuiting the whole system. To reduce the consequences of this the wiring should be arranged in loops so that cut-outs can be installed which automatically short circuit and disconnect a broken loop.

The cost of insulation and equipment rises rapidly with the higher voltages. This must be balanced with the cost of additional circuits necessary to maintain low vorlages. On overhead lines some systems successfully operate arc lamps up to 8,000 volts. Underground circuits are seldom operated at more than 5,000 volts as any, breakdown in their insulation is more difficult to repair.

It is of great advantage to be able, in a series circuit, to operate the lamps on one street from one wire of the circuit alone without it being necessary to have the return circuit on the same street. (Fig. 2.) This may save 50 per cent. of the total wire required. Little or no additional wiring in such single wire circuits is necessary to create loops.

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* Abstract of a Paper read before the American Institute of Electrical Engineers.

Line reactance may usually be ignored. Its only effect is to slightly reduce the load carrying capacity of the regulator. For overhead lines this reactance drop at 60 cycles in single wire circuits is approximately 50 per cent. and in return wire circuits 25 per cent. respectively of the resistance drop. Variations of the lamps themselves from their rated voltage have a greater effect on the total regulator capacity.

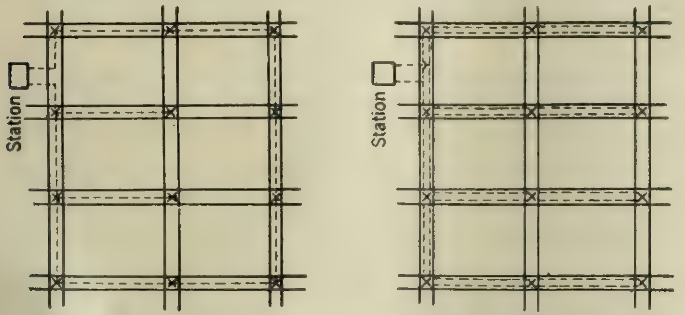


Fig. 2.—Diagram of a Series Circuit on Streets Showing the Saving of Wire that may be Made by using a Single Wire Circuit.

The operation of the street lighting lamps from dark until dawn or over some other fixed period, involves special conditions of control preferably from a single point. Where a separate circuit is run for street lighting the series system has thus many advantages as regards installation costs and regulation.

Lamp Characteristics.

It is well worth while to make special lamps for series operations with a view to higher efficiency.

In direct-current series arc lamps the wasteful sustaining resistance necessary to the multiple arc is omitted and the constant-current regulating device itself sustains the arc without material loss of power. Consequently, the direct-current arc lamp electrical efficiency is approximately 70 per cent. for the multiple and 95 per cent. for the series lamp. Similar figures for an alternating-current system of enclosed carbon arc lamps were 90 per cent. and 95 per cent. respectively.

The efficiency of series incandescent lamps is much better than that of multiple lamps, being for a 100-candle power., 6·6-amp. series lamp, 20 per cent. higher than for a 110-volt lamp of similar candle-power.

The improvement, from the illumination standpoint, achieved in the metallic flame, or luminous arc lamp introduced about 1907, was such that many of the direct-current series circuits formerly abandoned have since been re-installed. Where incandescent lamps only are used there is no need for direct current and a change to alternating current is desirable. This only involves the replacement of the station apparatus by a constant-current regulating transformer. Frequency has but slight effect on series circuits. Apparatus has been available for all commercial frequencies except that arc lamps were never satisfactory on 25-cycle circuits.

Apparatus.

In the simplest and most commonly used series systems, a special constant direct-current generator or a moving-coil transformer for alternating current is required.

In the old direct-current arc lighting machine, special designs utilised the reactance of the armature to prevent excess current in the lamp circuits, brushes being shifted to obtain the necessary voltage up to the limits of the machine. Some of these regulators were extremely accurate and sensitive. The constant-current regulator commonly used for alternating current depends upon the electrical repulsion existing between the primary and secondary coils of a transformer under load to produce and maintain a constant current in the secondary or lamp circuit. Such a regulator can automatically maintain a fixed secondary current through any number of lamps, and with a wide fluctuation of the voltage on its supply circuit. Seeing that an increase of 3 per cent. in the current of the lamp circuit cuts the life of an incandescent lamp in half and thus doubles the renewal cost, such a regulator is a cheap protection for the lamps as compared with systems that do not compensate automatically for all variations. In suburban districts using many low candle power lamps the value of the lamps on the circuit equals that of the regulator controlling them. These lamps are renewed about three times per year. Accurate and reliable regulation is therefore vital. Renewals of four times per year would require excess lamps equal the value of the regulator. Wherever possible such regulators should be installed in a station.

Every series circuit must include devices to by-pass the current when the lamp itself is inoperative. The arc lamp has a mechanism arranged as in Fig. 3 so that a shunt coil connected across the arc causes a switch to be closed and the arc short circuited when the drop across it becomes excessive. Another coil in series with the arc and line acts to give the correct spacing of the carbons or electrodes. For the incandescent lamp a simple form of switch is incorporated in the socket. An insulating film is placed between the two sides of this switch. This film has normally only to withstand the drop across the lamp filament (about 10 volts). However, if the lamp burns out the full generated voltage of the regulator or generator is impressed upon the insulating film, causing it to puncture and short circuit the lamp filament. In a moving coil regulator this maximum voltage is approximately 25 per cent. more than the full load voltage. A switch in the socket operated by the insertion of the lamp short-circuits this film when the lamp is removed. Such film cutout sockets are simple and inexpensive, and enable men with little training easily to renew the lamps, even under trying conditions of lamp location and bad weather.

Devices other than lamps have seldom been used on street series circuits. On account of the dark until daylight schedule it is often desirable to operate lamps indoors and around places where the high voltage possible on a series circuit cannot be tolerated. Underground circuits are often included in this status on account of the great expense of high-voltage cable. In such cases a special series transformer or safety coil is used.

Instruments or meters of a special nature are seldom required for series circuits. A high grade ammeter should be in series with the lamps, for upon it depends the accuracy of the adjustment of the regulator and the life and candle power of all the lamps. Municipalities sometimes require a chart of the current in the series circuit and maintain curve drawing ammeters for this purpose In other cities a jack on a pole allowing the insertion in the circuit of a plug with ammeter fulfils all requirements.

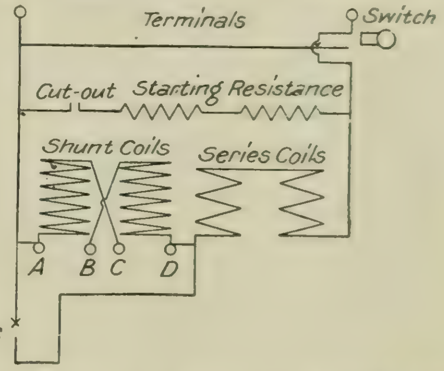


Fig. 3.—Schematic Diagram of Circuits in a Series Arc Lamp Showing Three Parallel Circuits.

1. Main circuit through the series coil and the arc.
2. Shunt circuit to pull the carbons together when the voltage across the arc increases.
3. Starting circuit consisting of resistance in series with a switch to cut it out when the arc burns.

The drop across the starting resistance through which the current first flows causes current to flow through the arc and series coil. This coil pulls the carbons apart opening the starting circuit. The shunt coil prevents the arc voltage becoming excessive and can close the switch, if necessary, in the starting circuit, thus maintaining a safe current path through the lamp.

Books Received.

"A Text-Book of Electrical Engineering." Translated from the German of Dr. Adolf Thomalen by G. W. O. Howe. (London: Edward Arnold.) Pp. xi. + 482. Fifth edition. 28s. net.

"Mesgeräte und Schaltungen für Wechselstrom Leistungsmessungen." By Werner Skirl. (Berlin: Julius Springer.) Pp. 278. M.26.

"The Engineering Inquiry." By Tomey Thompson (Bristol: J. W. Arrowsmith, Ltd.). Pp. 367. 7s. 6d. net.

"Engineering Directory." (London: "Engineering." Ltd.). Post free 1s. 2d.

"The Theory of Electric Cables and Networks." By Alexander Russell, M.A., D.Sc. Second Edition. (London: Constable & Company.) Pp. x. + 348. 24s. net.

The Electrical Equipment of a Dundee Shipyard.

(Concluded from page 280.)

LIGHTING DISTRIBUTION.

As explained previously, special tappings were brought out from the 500 k.v.a. transformers for lighting. These tappings, together with the neutral, are carried to the lighting board which is provided with selector and change over panels. The selector panel provides a means of changing from one transformer to another, and the change over panel provides an alternative direct current supply which can be used at night by the watchman, or when the lighting load is small. Fig. 4 shows the change over arrangement. This alternative supply which is at 400 volts three-wire direct current, is provided by the Corporation in addition to the high-tension supply and can be utilised on the direct-current power board, in the event of isolated direct-current machines working overtime, thus obviating the necessity of running rotary plant. The lighting mains are carried throughout the shipyard in the same way as the power mains, the disconnecting link boxes being of course in this case four way instead of three. Phase balancing is carried out in these link boxes, ample room being provided for this purpose. The entire lighting system is carried out in galvanised steel tube, supported by strong galvanised clips, all boxes having their lids secured by screws. Wood bushes were used on the ends of conduits, and in the inside of boxes, to obviate any possibility of damage to cable whilst pulling in. The distribution boxes for lighting, which are by Messrs. Kartret Engineering Company, are supplied with rotary switches in a separate case, below the box. Half-watt lamps are used throughout the entire installation, the fittings used being of the Benjamin Pattern.

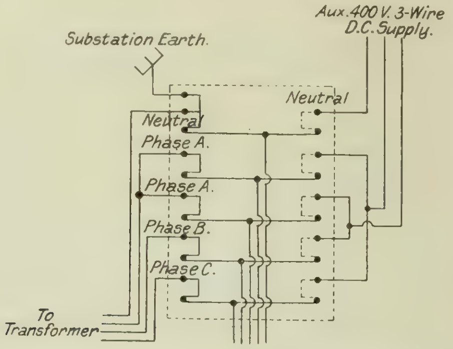


FIG 4.—5-WAY QUICK BREAK CHANGE-OVER SWITCH ON MAIN SWITCHBOARD.

SWITCHGEAR.

It would be impossible in the limited space available to describe in detail the design and operation of the different types of contactor switchgear in operation in the installation under review. In the circumstances, therefore, a general description of the type of gear employed should serve to indicate the methods adopted.

Automatic or semi-automatic contactor gear has been adopted almost exclusively for motor control. There are a few isolated cases where the old face plate starters have been retained, but these cases only serve to indicate the inefficiency of this class of control gear under shipyard conditions. This is not the case in the newer class of manually operated starting gear, such as that constructed by Messrs. Brookhurst. This type of starter has been fitted to all the direct-current motors operating in the sawmill, and has given general satisfaction, mainly on account of its robust construction, and the fact that it is fitted with a D.P. circuit breaker, the overload feature of which protects motor and starter from misuse during starting. The complete equipment is enclosed in a sheet steel case, properly ventilated, the only projections being the starter and breaker handles. The alternating-current motors on the other hand are all fitted with automatic gear, constructed by Messrs. Electric Control, Glasgow. This contactor gear is enclosed in a sheet steel case, and is fitted on the actual machine it is operating.

Triple pole oil switches, by Erskine, Heap & Company, are inserted on the mains, the paper insulated cable being carried through a trifurcating box directly into the switch. From the other side of the switch the wiring to motor and starter is carried out in steel conduit securely fastened to the machine. Special care has been taken to preserve continuity of this earth path between supply cables, switchgear, and motor. In the case of the motor, as with the switchgear, the conduit has been carried right into the connection box on the motor side, the hole in the connection box being tapped for the conduit. The ordinary system of rotor control has been adopted for all machines having one direction of rotation, such as punches, and shears, scarphing machines, &c. In the case, however, of plate edge planing machines, large mangles, and heavy plate rolls, eddy current controllers have been adopted. With time lags fitted to the oil switches this has proved a very successful method of control. In two cases, that of small mangles for light plate, Ellison reversing switches have been used with very good results.

CRANES.

No article on shipyard work would be complete without some reference being made to crane equipment. As this is quite a large subject in itself, a brief reference to the types used will, no doubt, suffice.

There are nine cranes in this Yard described in the following table :—

No.	Capacity.	Equipment	Maker.	Where used.
1	130 tons	400 volts D.C. 4 motor	Cowan Sheldon ...	Fitting out jetty.
2	70 tons	400 volts D.C. 4 motor	Babcock & Wilcox	Boiler shop.
1	15 tons	400 volts D.C. 3 motor	Babcock & Wilcox	Boiler shop annex.
2	5 tons	400 volts D.C. 3 motor	Babcock & Wilcox	Platers' shed.
2	5 tons	400 volts D.C. 3 motor	Babcock & Wilcox	Stacking ground.
1	2 tons	400 volts D.C. 1 motor	Babcock & Wilcoc	Sawmill.

In addition to the above cranes there is of course the usual complement of ground winches and electrical derricks for ship construction. This equipment is, of course, all semi-portable and suffers accordingly, no amount of scheming being able entirely to overcome the wiring troubles.

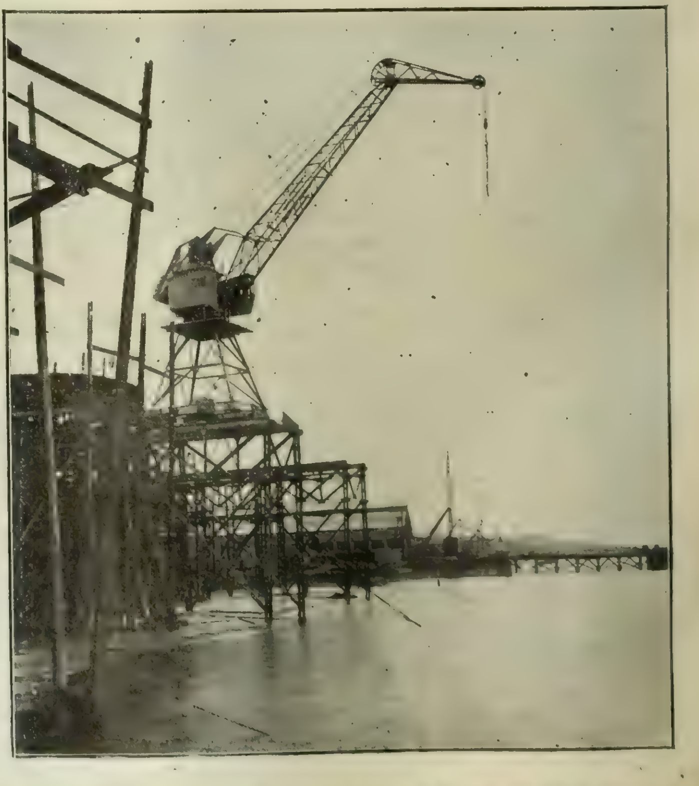


FIG. 5.—SHOWING GANTRY CRANE BY BABCOCK & WILCOX IN STANNEFGATE YARD.

GENERAL.

Reference might be made before concluding a description of this yard to the main earthing arrangements at the sub-station. Provision is made on the cable rack in the sub-station cable tunnel, for carrying a 0·5 sq. in. asbestos covered V.I.R. earth cable. Tappings are taken off where required for machines, switchboard frames, &c. This cable goes right round the tunnel, terminating at either end in a brick built manhole 9 ft. deep. The earth plate, which is of galvanised iron, is buried in 3 ft. of coke, and is always under water. Disconnecting links are provided, where the cable leaves the rack for test purposes.

"Stannergate" or "East Shipyard."

The East Yard presented a much simpler problem both with regard to lay-out and actual work. This was mainly due to the fact that the installation was keeping pace with the construction of the yard. There was another important factor, however. The installation at the New Yard began concurrently with the decision in 1918 to abandon the direct-current system in the old yard. It was decided in the circumstances to make the new yard installation entirely alternating current. The scheme, therefore, resolved itself into a simple arrangement of 440 volts three-phase 50 periods for power, and 200 volts single phase for lighting. The installation was carried out on exactly the same lines as at the old yard, omitting of course the 400 volt direct-current system for power, but retaining the emergency 400-volt three-wire direct-current supply given by the Corporation. This emergency supply is used during the day for running the only direct-current machines in this yard, viz., 5 h.p. for Wadkin woodcutter and 10 h.p. for boring out stern tubes. As both these machines required a large speed variation, this was considered the simplest plan. At night, of course, the direct-current supply takes the general yard lighting.

Owing to the absence of rotary plant and direct-current switchgear the sub-station in this yard is considerably smaller. Two 500 k.v.a. transformers have been installed and provision has been made for an additional two, when the need arises. The transformers and switchgear are duplicates of those installed at the old yard. A slightly different policy has been adopted in this yard in connection with compressor plant. Owing to the extended use of compressed air for purposes such as forge hammers, it was decided to introduce larger units. The unit at present in operation is a duplicate of the 300 h.p. set working at the old yard. This equipment, although working very satisfactorily, is barely sufficient to deal with present requirements, and would, of course, be totally inadequate for future extensions. To meet this demand, a 650 h.p. 6,000 volt Synchronous motor set, also constructed by Messrs. Metropolitan-Vickers, is at present being installed. The motor is self-synchronising, and is started by closing a pilot switch which controls the contactor gear, but unlike the 300 h.p. low volt set it will not be expected to stop and start with variations of air pressure. The usual unloading devices will be fitted, and the peak load will be taken up by the smaller set. Fig. 7 shows interior of the sub-station. The hydraulic pump house which is built as an annex to the sub-station contains at present 1-100 h.p., three throw-vertical type pump, directly coupled to a 100 h.p. Phœnix motor.

General.

There are several features in this yard, which, while not actually new, are considered worthy of mention Compressed air hammers have been installed in the smith's shop, and have proved very efficient. Another feature of this shop is the absence of smoke. Patent hearths have been introduced, the smoke being carried away by an exhaust fan through underground ducts to the chimney outside the shop. These hearth are all supplied with air by separate three-phase 440-volt blowers. The whole of the hearth equipment is by Messrs. Keith Blackman. The line shafts in the joiner's shop are all direct coupled to the driving motors, whose speed is 720 revs. per min. The shafts, which are situated below the floor in tunnels, are 2½ in. diameter, and run in Skefko ball bearings.

In connection with the crane equipment, which is all by Messrs. Babcock & Wilcox, mention should be made of the 5-ton gantry cranes, a photo of which is shown in Fig. 5.

Mr. J. A. Robertson, M.I.E.E., of Salford, was consulting engineer for both installations, which were carried out by Messrs. W. C. Martin & Company, Glasgow, under the supervision of Mr. H. R. Griffiths, Resident Engineer, to whom we are indebted for the information given in the above article.

It is announced that the British Industries Fairs for 1921 will be again held at London, Birmingham and Glasgow, but arrangements are being made to provide increased space, &c. The London Fair (which will be held at the White City) and the Birmingham Fair will commence on Feb. 21 and close on March 4, and the Glasgow Fair will take place from Feb. 28 to March 11. The scope of the Fairs will be practically the same as this year, and the London Fair will be confined to fancy goods, scientific and optical instruments, glass and china, &c. At Birmingham there will be interesting exhibits of electric lighting fittings, motors and accessories, cooking and heating stoves, brass-foundry tools, general hardwares, metal tube and fittings, non-ferrous metals and alloys, ornamental metal work belting, motor cycles, &c.

Correspondence.

THE POLICY OF THE E.P.E.A.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: As there has been some misrepresentation of the attitude of the E.P.E.A. during strikes of other Unions I shall be glad if you would give me an opportunity to make our position clear. In order to meet the needs of all grades of staff men it was necessary to lay down in our constitution as a definite principle that we would always adopt constitutional methods in our dealings, and if extreme action was ever resorted to it would be only after every other method had been tried and had failed and our members concerned had agreed by a very large majority that such action was the only other alternative available.

Further, in the interests of the industry from which we obtain our livelihood it is not desirable that it should be involved in every dispute in every industry, and because we are not able to remain neutral when a strike is in operation we intend to use whatever influence we possess to get disputes, which do not primarily effect our industry, settled peaceably before our industry is involved. If on account of one of the parties rejecting a peaceable method of settlement, or refusing to make use of the regularly constituted machinery for the purpose, the dispute spreads to the Electricity Supply Industry, then the responsibility must rest with the recalcitrant party and the E.P.E.A. will act in a way calculated to promote a settlement by negotiation and will throw its weight into the scales on to the side of the party which consents.

When the present dispute between the E.T.U. and the Engineering and National Employers' Federation threatened to reach a deadlock this Association urged the two parties to refer the matter to arbitration and asked the Ministry of Labour to intervene and prevent it spreading. The Minister of Labour offered to set up a Court of Investigation and the E.T.U. agreed to accept it, but the employers' side refused.

We have stood all along for the adoption of constitutional methods of settling disputes as against the irrational method of relying on brute force with its consequent injustices. We have persisted in this attitude, although we have learned by bitter experience that some employers, relying on our reluctance to use drastic methods except as a last resort, are quite ready to repudiate obligations to which they were parties till after their staffs have resigned. We have had several hundred cases in the last year and a half, and within the last few weeks the Town Clerks of Rochdale and Nottingham have each repudiated on behalf of a group of undertakings their liabilities to the findings of a duly constituted Joint Board on which they were represented.

In spite of our experience with a large proportion of employers in the Electricity Supply Industry that the only moral obligations which they recognise are those which can be enforced upon them, we still maintain that the attempted settlement of all disputes by constitutional methods must be supported, and that the findings of Arbitrators, National Councils and Boards must be accepted and carried out, and their authority upheld if the Industry to which we belong is to enjoy any degree of peace and prosperity.

We are neither an organisation of strike breakers or extremists, but a staff men's union which is honestly trying without fear or favour to deal with others as we should like to be dealt with ourselves.—I am, &c.,

London, W. Arthur Jones.
Sept. 13, 1920. General Secretary E.P.E.A.

[We have omitted certain portions of Mr. Jones' letter in which he has elaborated his argument.—Ed., *E.*]

THE E.P.E.A. AND THE E.T.U.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: It has come to our knowledge that a principle of the highest importance is now at stake, which, if accepted, would destroy the independence of the Electrical Power Engineers' Association and cause it, in fact, to be merely (in the matter of votes) an inferior section of the Electrical Trades' Union.

It has been publicly stated by the Secretary of the Electrical Power Engineers' Association that it has been decided in the present dispute between the Electrical Trades' Union and the Engineering Employers' Federation to throw our weight on the side which agrees to arbitration—in this case with the Electrical Trades Union. It has, however, been overlooked that the dispute was precipitated by the action of the Electrical Trades' Union at Penistone, who are now prepared to refer the case to arbitration. With the merits of this dispute the electricity supply industry has nothing whatever to do.

It has also come to our knowledge that the Executive Council of the Electrical Power Engineers' Association hold the view that because we are a Trade Union we must throw in our lot with *any other* Trade Union in any strike that may develop, provided the grounds seem to us to be just. In other words, we declare beforehand our sympathy with the men as against the employers. We, the undersigned, cannot accept so radical an alteration in the policy first enunciated by the Electrical Power Engineers' Association or so drastic a *forfeiture of our independence*, and we cannot believe that the vast body of the more intelligent and highly trained engineers in the electrical profession can accept it either.

It should be borne in mind that the senior power engineers have, in many cases, given their support to this (Electrical Power Engineers' Association) movement largely to improve the status and remuneration of the junior members. Under the proposed new scale of salaries the junior members have benefited far more than the senior members. We consider that the Institution of Electrical Engineers is also vitally interested in this question. Mr. C. H. Wordingham, as president, strongly advocated the formation of the Electrical Power Engineers' Association, and we then understood that it was to be conducted on lines very different from those that are now being adopted.

If the more responsible members of the Electrical Power Engineers' Association would make their voices heard and would refuse to be coerced into actions that they disapprove of, it may not yet be too late to save the situation.—We are, Sir, &c.,

A Group of Senior Power Engineers.

[We thoroughly endorse the views put forward in the above letter. We wish, however, that the signatories had seen fit to append their names.—Ed. *E.*]

SHORTAGE OF SCIENTIFIC WORKERS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I have read with appreciation the leading article in your issue of August 20th entitled "The Shortage of Scientific Workers." It is, indeed, to be hoped that "both the education authorities . . . and the captains of industry" (and, may I add, Government departments and local authorities) "will see their way clearly to offer sufficient financial inducement to attract men to the ranks of scientific workers."

This much is certain—that it is from the scientific workers themselves that the real stimulus must come. During the war the nation was stirred to the depths by the achievements of its scientific workers, though it knew so very little about them. Scientific men have been slow to take advantage of the opportunity thus afforded for making the nation realise the supreme importance of the endowment of scientific research. Scientific workers must combine, the individual must be prepared to forsake his "splendid isolation" for the welfare of the community of which he is so important a member; he must realise that he is not free of responsibility for the present position of the scientific workers. Although "living while working," he must not accept a wage which has a tendency to lower his status and prevent the best of the rising generation from sharing his labours and responsibilities. It is a truism that "there is little hope for universal betterment of society by the mere advance of technical industrial progress, and by the unchecked play of the motive of every man for himself." Whatever advance towards "living" is achieved by the great mass of the people is due to the restriction of blatant individualism by the force of organisation.

Scientific workers have a remedy at hand for the improvement of their conditions. All those employed in the practice of science, either in the public services or in education, must unite by joining either the National Union of Scientific Workers or one of the sectional associations of chemists or engineers, and stand loyally together, claiming a reasonable competence for all qualified workers, with such conditions of employment as will ensure their exercising their full influence upon the destinies of the nation and of the world. I am, &c.,

Aug. 31. A. G. Church,
Secretary National Union of Scientific Workers.

DEVELOPMENTS IN HIGH-TENSION INSULATORS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In your issue of September 10th, under "Developments in High-tension Insulators," a statement is made that during recent years much work has been done in the United States, and things are going forward more quickly there than in this country, particularly in refining the methods of manufacture and assembling.

As one who has had something to do with the subject in question during the past 12 years, I suggest that this statement has been made without much knowledge of the facts of the case. I quite agree that a vast amount of work certainly has been done in the States, and beyond question great advance is the result; but close investigation will show that British manufacturers have also achieved something with which they have no particular reason to be dissatisfied. Engineers in charge of overhead transmission lines do not always extol the virtues of the American product and look with scorn on our efforts.

British porcelain still has a reputation of which it is not altogether ashamed, and influencing our designs the initiated may be able to discern a spark of regard for the laws which govern the electrostatic field.

So far as the methods of manufacture are concerned, it is impossible for me to make a comparison, as I have never seen those employed in the United States; but I do say, without fear of contradiction, that great improvements have been made in England during the past 10 years, and that at the present time the advance is continuing with considerable rapidity.—I am, &c.,

Tipton, Sept. 13. N. E. P. Harris.

The Electricians' Lock-Out.

As announced in our last issue the Minister of Labour has decided, in order to get an impartial and authoritative statement on the points at issue in the Penistone dispute to exercise his powers under Part II., sec. 4, of the Industrial Courts Act, 1919, and to appoint a Court of Inquiry into the causes and circumstances of the dispute. The Right Hon. Sir David Harrell, G.B.E., K.C.B., K.C.V.O., has been appointed Chairman of the Court, and Mr. H. W. Meikle, Ministry of Labour, tagu House, Whitehall, S.W.1, will act as Secretary. The other members of the Court are Mr. J. N. Bell, Colonel J. M. Denny, Mr. John Hodge, M.P., Mr. T. B. Johnston, Mr. Owen Parker, and Mr. W. F. Purdy. The Court is "to inquire into the causes and circumstances of the dispute which has led to a strike of the members of the E.T.U. employed at the establishment of Cammell Laird & Company, Penistone, and to a lock-out of the members of this union in the employment of members of the Engineering and National Employers' Federations, with special reference to the position of foremen as regards trade union membership in the engineering industry."

The Court will sit at St. Ermin's Hotel, Westminster, S.W.1, and the first sitting took place on Tuesday.

There was a full attendance of the members of the Court. The Engineering and National Employers' Federations were represented by Sir Allan Smith, and the Electrical Trades Union by Mr. Rowan, the general secretary. Considerable progress was made in eliciting the facts which led up to and were connected with the strike of the members of the E.T.U. at Penistone. Nine witnesses were examined, including foremen, shop stewards, and the chief electrical engineer and manager. The Court sat again on Wednesday, but representatives of the Press were not admitted.

Heating and Cooking Notes.

A New "Plexsim" Electric Iron.

For many years past Messrs. Simplex Conduits, Ltd., have enjoyed a reputation for the manufacture of "quality" electrical materials. It is not surprising therefore to find that the new "Plexsim" iron manufactured by this company is in every detail a "quality" article, yet the price is reasonable. The iron is highly finished in nickel plate and is sent out complete with three yards of flexible cord and lampholder adapter. The iron weighs 5½ lb., this weight having been selected after making a careful investigation into the weight of iron which seemed to be most used for household purposes. The iron has been specially designed to prove reliable throughout a long working life, in fact the manufacturers give a perpetual guarantee regarding the life of the element. The underlying ideas in designing the iron have been firstly to provide an element with as large a radiating surface as possible in order to keep the temperature as low as possible and yet to obtain the desired amount of heat; and, secondly, to provide that the heating element is pressed into even and intimate thermal contact with the sole of the iron, thus reducing the risk of uneven heating of the element. Naturally if the thermal contact is not even, then parts of the element are liable to become over-heated, a factor which has accounted for a large number of element failures in the past. It is quite an easy matter to replace the element, should it be necessary, and if a failure occurs the manufacturers will either post a new element to the contractor, on receipt of the old one, or alternatively the complete iron may be sent back and the makers will fit the new element. In either case no charge will be made beyond the cost of carriage or postage. The iron is shown in Fig. 1.

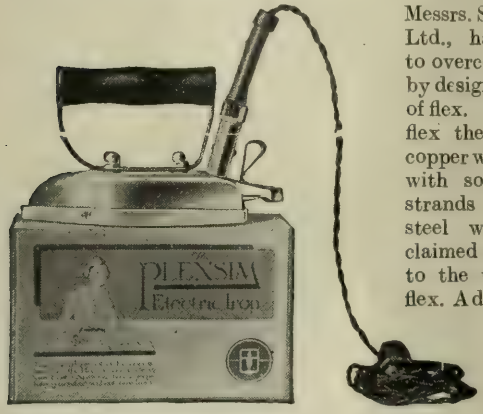


Fig. 1.—"Plexsim" Iron.

The flexible cord has in the past been another cause of trouble with electric irons, and Messrs. Simplex Conduits, Ltd., have endeavoured to overcome this difficulty by designing a special type of flex. In the "Plexsim" flex the fine strands of copper wire are interwoven with somewhat stronger strands of hard spring steel wire, which it is claimed adds considerably to the useful life of the flex. A double spiral spring guard is fitted to the connector to keep the wire out of the way when the iron is in use. It is interesting to note that the terminal joint and connector sockets are made and spaced to the sizes defined by the engineering Standards Committee. A stand device is fitted to the back end of the iron, so that the iron may be stood on end when hot but not in use. Undoubtedly this iron is a thoroughly sound job, carefully thought out, and well made and finished.

The "Plexsim" Selling Campaign.

Secondly, after having produced a good article, Messrs. Simplex Conduits have planned a definite selling compaign to ensure distribution to the trade, and to arouse the interest of the public. Each iron is supplied, complete with flex, &c., in a carton or box with decorative labels printed in colours. These boxes will also serve to attract attention by forming part of window and counter displays, and also when sold are likely to be used by the purchaser as a means of dispatching goods to friends, where the labels serve as propaganda for electricity and electric ironing. A good box in these days is rarely discarded. In addition, special window and counter display cards have been designed and will be loaned to those stocking "Plexsim" irons, together with leaflets overprinted with the retailer's name and address. In each box a booklet is enclosed (on which the makers' name does not appear) which draws attention to other electric household appliances which save time and labour. In the larger towns a special staff of "Plexsim" demonstrators will canvass electric light users, and orders for irons so obtained will be credited to the retailer in the neighbourhood who stocks the "Plexsim" iron. Finally, an advertising campaign will be carried on in the general Press. It is therefore to be seen that Messrs. Simplex Conduits, Ltd., have not only produced a good article, but are also prepared to devote their energies to helping the trade to sell it, without in any way encroaching on the profits which the retailer rightly expects to make. Initiative and enterprise of this character certainly deserves success, and we hope that Messrs. Simplex Conduits, Ltd., will reap the reward to which their efforts entitle them.

New Edi-swan Cooking Apparatus.

We have received particulars of three pieces of apparatus recently produced by the Edison-Swan Electric Co., Ltd., viz., a boiling plate, saucepan, and fish fryer. The boiling plate illustrated in Fig. 2 consumes 1,000 watts, and is 8 inches in diameter. The top and base are of cast iron, the top surface being ground and polished bright to provide close thermal contact with the base of the cooking utensil. The base is finished in black enamel.

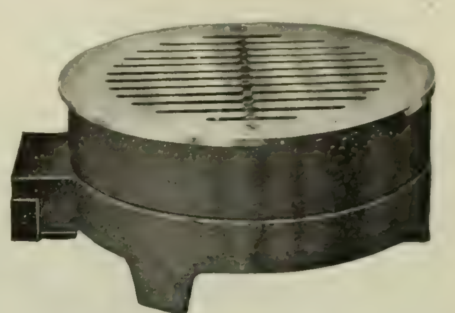


Fig. 2.—Ediswan Boiling Plate.

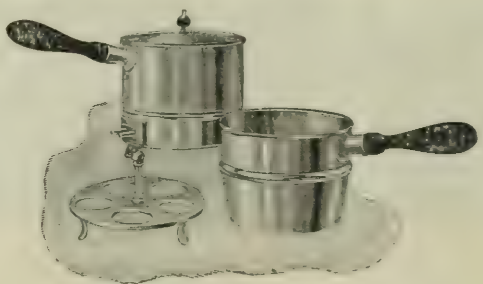


Fig. 3.—Ediswan Saucepan.

The combination saucepan is shown in Fig. 3. It is made of polished copper, tinned inside, and has a capacity of two pints and a loading of 500 watts, without heat regulation. The container portion has a capacity of 1½ pints and is serviceable for steaming purposes, heating milk foods, porridge, &c.

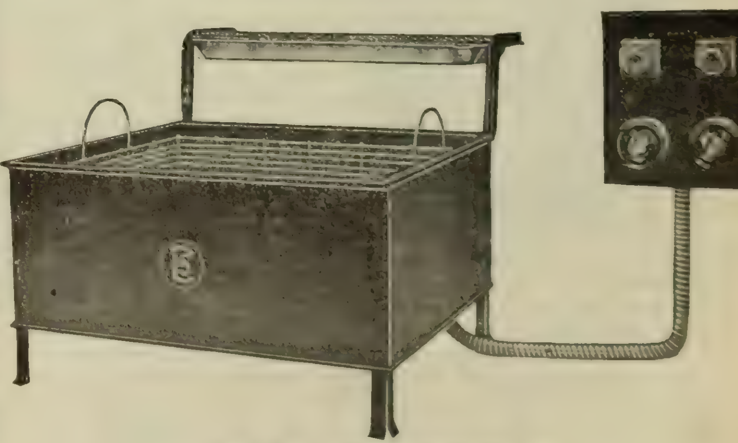


Fig. 4.—Ediswan Fishfryer.

The fish fryer illustrated in Fig. 4 is constructed of steel plates welded together and supported on a sheet metal casing, which forms a stand. It is loaded to 5·8 kw., and heat control is provided by means of two three-heat rotary snap switches. The frying-pan portion can be readily lifted up from the stand when it is desired to gain access to the elements and connections. Starting from cold the apparatus is ready for service in about 20 minutes after switching on.

The Machine Tool Exhibition.

The Machine Tool and Engineering Exhibition, which, as we announced last week, was opened at Olympia on September 3rd, is not one to which any electrical engineer would go to discover what is happening in the fundamentals of his own industry, for only about one-tenth of the stands exhibit electrical apparatus, and a great deal of this is not of the first importance. On the other hand, it would be difficult to find a heavy machine tool in the Exhibition which is not electrically driven, while the methods of drive adopted are very various, ranging from the simple belt drive either off shafting driven by a motor or direct from a belt by a special motor on the particular machine, to the highly specialised electric drive designed as an integral part of the machine tool itself. Between these two extremes are chain drive from separate motors and drive by gearing.

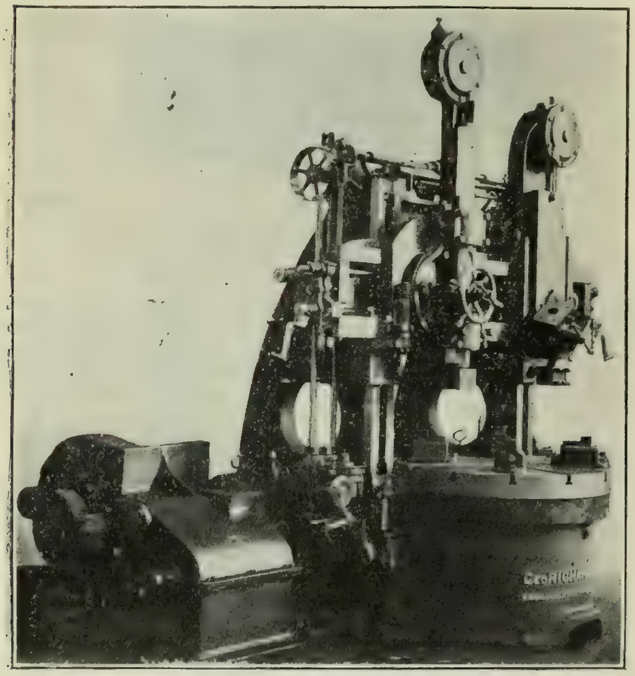


Fig. 1.—Electrically Driven 4-ft. Boring and Turning Mill. (Messrs. George Richards, Broadheath.)

A Stirk Equipment.

The outstanding machine in which the motor and electrical arrangements form an integral part is undoubtedly that on the stand of Messrs. John Stirk & Sons, Ltd., of Ovenden road, Halifax, a firm which, established in 1866, early realised the obvious advantage of electric drive for obtaining the best results for high-speed steels. The exhibit contains a 5 ft. by 5 ft. by 16 ft. Stirk "hilo-plane," a machine planer now exhibited in public for the first time, although examples have been in use for the past five or six years. This machine is entirely electrically controlled, having, in addition to electrically-controlled operated table mechanism, electric control of tool boxes and both automatic feeds and quick power traverses. Included in the patent features is the Stirk patent split field drive, which is claimed as the simplest reversing motor system. This drive is extremely interesting. As is well-known, the earliest automatic reversing motor drives consisted of a direct-current motor reversed by reversal of the armature current, and controlled by one form or other of self-acting starter. Save in special cases, however, this system has almost entirely given place to some variety of Ward-Leonard control. It has been found that for heavy planers the best method of accomplishing reversal of the planing table is to couple a motor direct to the machine gearing, and to supply it with current from a special generator provided for the purpose. By manipulation of its magnetic field this special generator may be made to generate at variable voltage and alternate polarity, the final motor being independently excited. The variation of generator voltage gives variable speeds, and the alteration of polarity causing a corresponding reversal of direction of rotation. Prior to 1915, the chief example of this system was the well-known Lancashire patent drive, in which the generator field connections were reversed by means of a three-pole change-over oil switch operated by dogs and levers from the planing machine table. The Lancashire-Stirk drive now fitted to the Stirk planes is an improvement on the Lancashire drive, the principal difference being the Stirk patent disc and master switch actuating a set of five contactors which constitute the reversing switch proper and take the place of the oil switch. The Stirk patent split field drive is a decided contribution to the planer drive problem. The equipment consists of a motor generator, reversing motor, master switch, starter for primary motor, contactor and generator panel for generator, and stop and inching buttons. The patent disc and master switch actuate two contactors, which, without any other switchgear whatever, will provide a quick return reverse to the table motor. This apparent impossibility is accomplished by the division of the shunt field windings of both generator and final motor into two sections. In the case of the generator, these sections are connected to oppose each other, so that alternative polarity results from the alternative excitation of the two sections. The two sections of the motor field are connected to agree, and one is permanently excited. The second section is excited during the cut stroke only, and a slow cutting speed and a quick return are thereby provided. The natural range of the system may be extended indefinitely by the variation of the generator voltage, and the standard equipment embodies two shunt regulators, enabling cutting and return speeds to be varied independently.

Machine Tools Generally.

We illustrate some other examples of direct electrical drive of a more simple character (Figs. 1 & 2). These are typical of dozens of other machines, the precise application of the motors varying with the ideas of the different makers and the facilities for attaching the motors afforded by the idiosyncracies of the various designs. The Sunderland gear planer is direct coupled to a 10 h.p. B.T.-H. motor running at 1,000 revs. per min. The starting and stopping is effected by push button control, the starter being located at the top of the superstructure which has been erected at the Exhibition for carrying the line shaft for driving the other machines on the stand of Messrs. J. Parkinson & Son. Another example is the Parkinson milling machine, the motor in this case being carried on the top of the column, the drive from the motor to the machine pulley being by means of a Hendry laminated endless belt. This machine can also be arranged with push button control if desired. The 4 ft. vertical boring and turning mill is driven, through gearing, by a 13 h.p. B.T.-H. direct-current variable speed motor, the control gear being supplied by Brook, Hirst & Company, of Chester. On other stands there are numerous examples of machine tools driven in various ways by Crompton, B.T.-H., G.E.C., Lancashire, and Crypto motors, and our illustrations are merely intended to show typical machines of the direct drive type, leaving out those driven by chains or belts, the motors being varying distances away from the machines themselves. Various methods of control are adopted, including Igranic, B.T.-H. and others, which we refer to below.

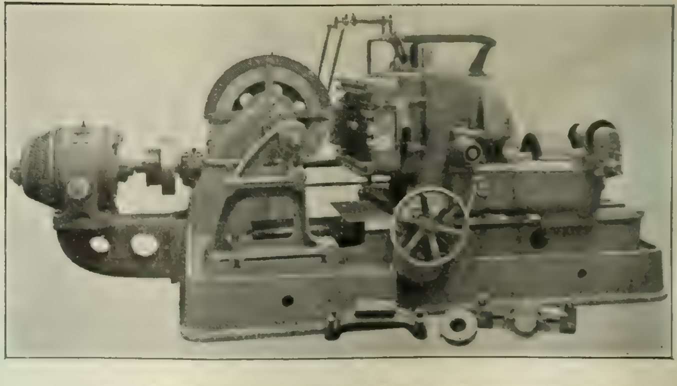


Fig. 2.—"Sunderland" Gear Planer showing Drive. (Messrs. J. Parkinson & Son, Shipley.)

Electric Control.

The call for increased output and the necessity for reducing the time taken to train operatives has stimulated interest in the many forms of automatic control gear which have been developed to enable machine tools to be most easily and safely controlled, and there is a great deal of interesting apparatus of this nature to be seen at Olympia, either on the actual machine tools, made by firms not exhibiting as such, or on stands where the apparatus is seen in detached form. In the latter category is the Igranic Electric Company, Ltd., of 147, Queen Victoria-street, London, E.C., who show numerous types of Igranic control, many of which can also be seen in actual operation on other stands. Automatic starters for motor-driven machines are more and more supplanting the older manually operated form of rheostat, and rightly so, because they avoid the many breakdowns caused through mistakes or hastiness in operation. The new Igranic Type No. 105 counter e.m.f. starter is designed for small motors up to 2 h.p. and for direct current up to 250 volts. It meets, it is claimed, the need for a simple and reliable form of automatic starter for small motors at a reasonable cost. It is provided with a single-pole main contactor switch with magnetic blow-out, and a single step starting resistance, which is automatically cut out of circuit by a second contactor when the motor has attained approximately one half normal speed. The rate of acceleration is automatically governed by load conditions. This form of starter can be controlled by practically any form of master switch, such as tumbler switch, knife switch, pressure regulator time switch or float switch. In the control of pumps, compressors and other types of machines an attendant is rendered unnecessary. Type No. 1,100 alternating-current "Conspede" motor starting panel, contains the features of the well-known direct-current "Conspede" panels which have been on the market for a number of years. Designed for use with three-phase slip-ring motors, it consists of a double-pole contactor switch for the stator circuit so interlocked with a rotor starter that only one handle is required to control both rotor and stator circuits. It is also provided with an overload device which is operative under starting as well as running conditions, and consequently gives to the panel the "loose handle circuit-breaker" feature. The patented interlock also ensures that the main contactor switch is instantly tripped if the handle is moved in the slightest degree backwards. When desired, a triple pole knife switch can be provided for isolating purposes in a locked chamber. A typical "Igranic" contactor is shown in Fig. 3.

Magnetic Separators.

The **Rapid Magnetting Machine Company**, of Lombard-street, Birmingham, which claims to be the only firm in the British Empire specialising in magnetic separators, has a selection of four machines.

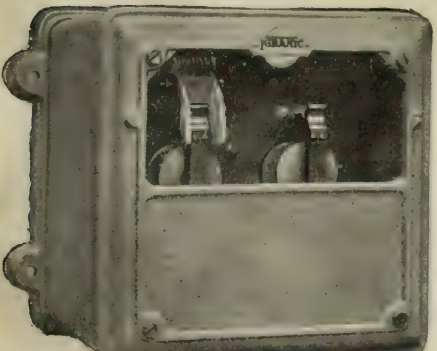


Fig. 3.
Typical Igranic Contactor.

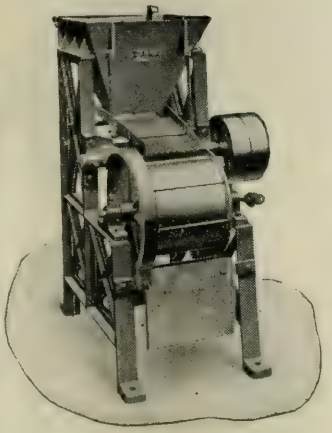


Fig. 4.
A "Thompson-Davies" Separator.

Probably the most important for the mineral mining industry is the Rapid (Thompson-Davies patent) electromagnetic ore separator for treating feebly magnetic ores such as wolfram-tin, zinc blendes, tin sands, magnetic sands, corundum, &c. Prior to the war, the manufacture of apparatus for such purposes was a virtual monopoly of Germany. The feature of the apparatus is the ease of tuning up whilst the machine is in motion. The most delicate setting can be made in a very short time, and as the effect of any alteration can be instantly seen, there is no time lost in experiment by trial and error. The current consumption is very low, and is controlled by rheostat to each magnet. Two machines very largely used in the metal trades are the standard type drum separator, which will successfully treat a mixture of 99 per cent. of iron and 1 per cent. non-ferrous metal, and type BB, which is specially suitable for treating quickly metal containing only a small percentage of iron. Mention may also be made of an electro-magnetic drum in connection with which is a patent feed belt fitted with "feelers," which, becoming magnetised by induction, add 50 per cent. to the efficiency of the apparatus. An illustration of this separator is given in Fig. 4.

(*To be concluded.*)

"Crabtree" Switches.

In the early days of electric lighting those who were fortunate enough to be able to employ the new method used to go about telling their friends of its convenience owing to the easy way it was possible to light and extinguish lamps without using matches, tapers or other fearsome apparatus. In these days of almost universal electric lighting this convenience still exists, but it has become so much a matter of course that its really great advantages are often forgotten. What is still more often not realised is that a great deal of time and ingenuity have been put into the design and manufacture of suitable switches, and that the modern equipment used for this purpose is a very great advance on the crude apparatus which was formerly employed, although in superficial appearance it may not differ very much from the earlier designs. How true these statements are may be gathered from an examination of the switches which Messrs. J. A. Crabtree & Co. are now placing on the market for the use of all those who use electric light in their homes, offices and manufacturing premises.

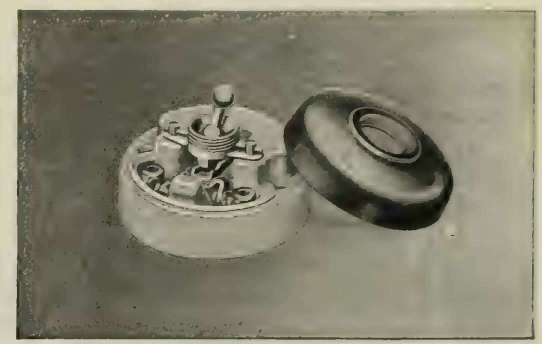


Fig. 1.—"Crabtree" 5-ampere Sunk Switch with special Quick Break Action.

This switch has several interesting features, as will be seen from the following description of its details. It is, of course, fitted with a quick make and break, and like every truly great thing simplicity is the keynote of its action. In design it consists simply of a handle and switch arm rocking on a common pin and provided with the necessary spring mechanism. This paucity of moving parts reduces, it is claimed, the breakdown risk to a minimum. An important point to notice in this connection is that the movement is unaffected by vibration, and the switch itself is locked both in the "on" and "off" position. As an illustration of the care taken in choosing the most suitable materials for this switch we may mention that the pivot pin is of phosphor bronze, and though this is a relatively expensive material Messrs. Crabtree have found that it is quite the most suitable for this particular part and they have taken the interesting departure of introducing it into switch design.

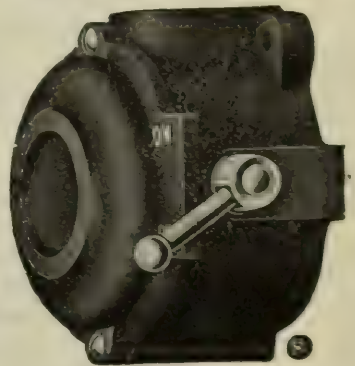


Fig. 2.
A "Crabtree" Ironclad Switch.

The springs too require special mention. They are manufactured by one of the leading spring manufacturers in the country, and are made on the same lines and of similar material to the springs used in the shell fuzes during the war. Messrs. Crabtree consider that the type of spring adopted in this movement is one of the most satisfactory known. With a spring carried (as in the Crabtree switch) on a central supporting pin, the whole effective length of the spring is used, and in the very unlikely event of it fracturing under service it is still supported by the central pin, and therefore continues to operate. Some tests made on switches with the spring cut in two show that under these arduous conditions it will still function in a satisfactory manner. The chance of a spring breaking is, however, very remote, it having been found that on test, while an ordinary flat switch spring gave out at from 20,000 to 50,000 operations, a compression spring of the kind used in the Crabtree switch operated over three million times and was still full of life when the tests were stopped.

The insulation used in these switches is pure mica. This avoids the use of fibre, which deteriorates with the heat, and of china links which are liable to fracture. The contacts are of copper with spring parts remote from the arching tips, there thus being no chance of the arc softening the clips. The manner in which the latter are sunk into the base gives, it is claimed, a maximum arcing distance to a cover. The bases are of highly vitrified English porcelain of particularly stout design.

The 5-ampere sunk switch of which we give an illustration has been experimentally tested on 10 ampere 250 volt heater circuits and was found to function satisfactorily, while as much as 90 amperes has been satisfactorily passed through the switch, and it has been further determined that its burning out current is no less than 200 amperes.

It should be pointed out in connection with the switches that the underslung movements used render them eminently suitable for switch-plate work, thus obviating any risk of drawing the arc to the cover. The low depth of the switch permits of their use in shallow switch boxes which need only be 1 in. inside depth, thus reducing the work of excavation to a minimum. Special fixing ears are provided on the switch, which thus becomes self earthing when used on ordinary conduit boxes.

It is interesting to note that Messrs. Crabtree & Co. are specialists in the manufacture of this class of switch and have as a matter of fact by following this policy of specialisation built up a large business in this class of goods. There is no doubt that there will be considerable developments along these lines in the near future.

A type of switch made by Messrs. Crabtree which is more suitable for factory work is the ironclad switch shown in Fig. 2. In this switch the positive snap "make" and "break" is particularly noticeable, thus giving a much more definite "on" and "off" position than is usually possible with switches of the ordinary type. In fact, the attention throughout to detail in the manufacture of these switches makes them worthy to be placed in the highest class and should bring them a wide market in places where quality apparatus is the only kind that is worthy of consideration.

Electricity Districts.

The North-West Midlands Electricity District also now been defined by the Electricity Commissioners, and includes the following areas :—

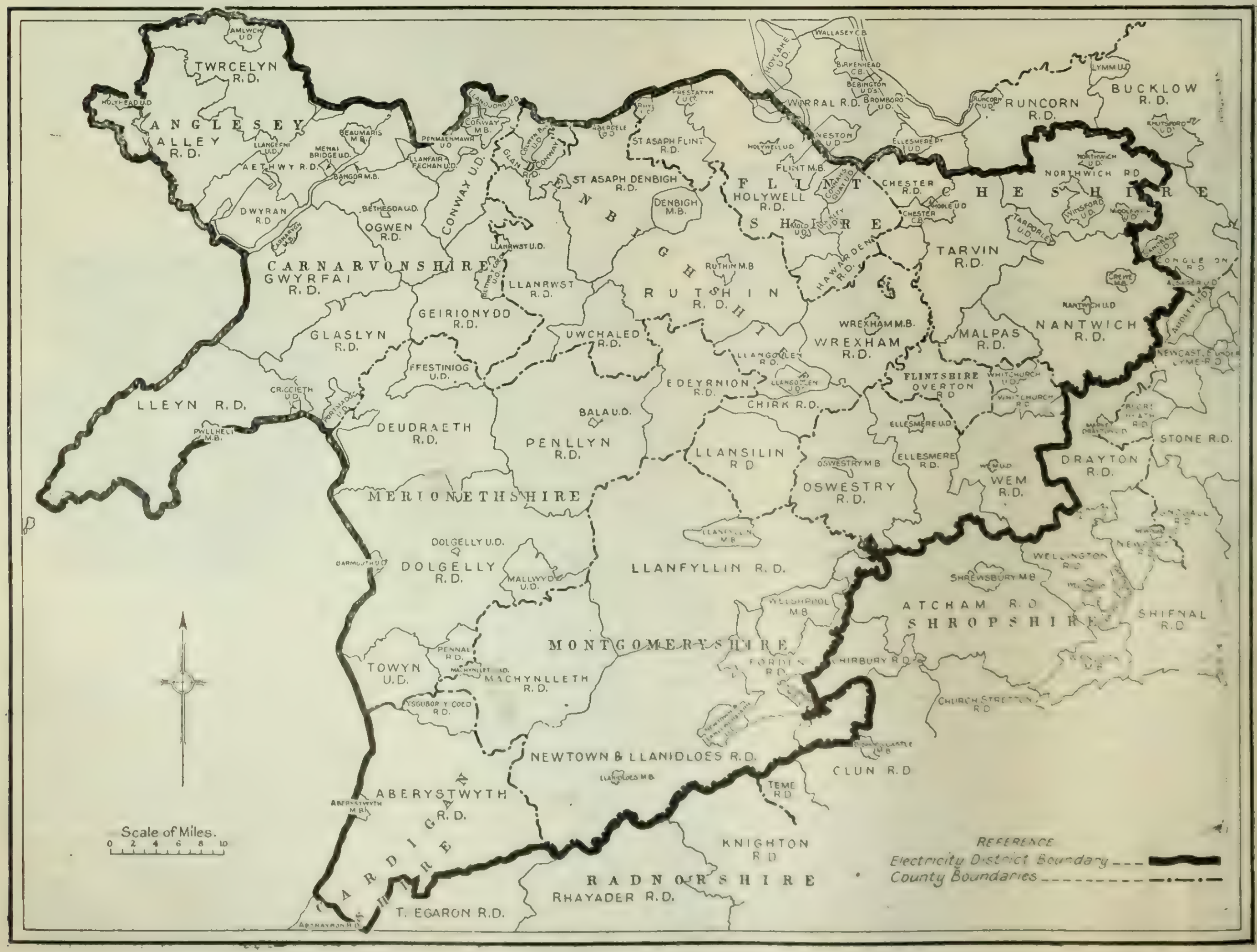
So much of the County of Chester as is included in the Municipal boroughs of Congleton and Macclesfield ; the urban districts of Alsager, Bollington, Buglawton, Sandbach and Yeardsley-cum-Whaley ; and the rural districts of Congleton, Disley and Macclesfield.

So much of the County of Derby as is included in the urban district of New Mills and the rural district of Hayfield.

So much of the County of Salop as is included in the Municipal boroughs of Bridgnorth, Shrewsbury and Wenlock ; the urban districts of Church Stretton, Dawley, Market Drayton, Newport, Oakengates and Wellington ; the rural districts of Atcham, Bridgnorth, Chirbury, Church Stretton, Drayton, Newport (Salop), Shifnal and Wellington ; the parishes of Lydham, Mindtown, More, Norbury, Ratlinghope, Shelve and Westnor in the rural district of Clun.

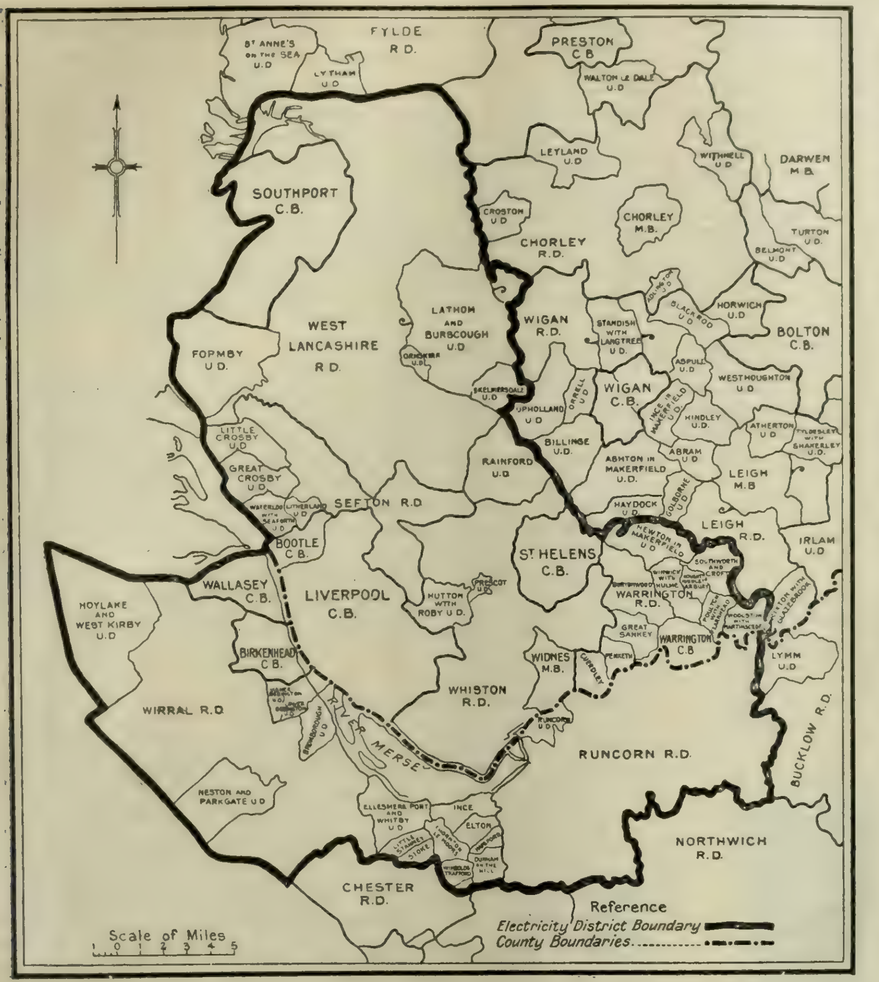
So much of the County of Stafford as is included in the county boroughs of Stoke-on-Trent, Walsall, West Bromwich and Wolverhampton ; the Municipal boroughs of Lichfield, Newcastle-under-Lyme, Stafford, Tamworth and Wednesbury ; the urban districts of Amblecote, Audley, Biddulph, Bilston, Brierley Hill, Brownhills, Cannock, Coseley, Darlaston, Kidsgrove, Leek, Perry Bar, Quarry Bank, Rugeley, Sedgley, Short Heath, Smallthorne, Stone, Tettenhall, Tipton, Uttoxeter, Wednesfield, Wednesfield Heath otherwise Heathtown, Willenhall and Wolstanton United ; the rural districts of Blore Heath, Cannock, Cheadle, Dudley, Gnosall, Kingswinford, Leek, Lichfield, Mayfield, Newcastle-under-Lyme, Seisdon, Stafford, Stoke-on-Trent, Stone, Tamworth, Uttoxeter, and Walsall and those parts of the rural district of Tutbury known as Tutbury Rural District detached No. 1, and Tutbury rural district detached No. 3 ; and the parishes of Blymhill and Weston-under-Lizard.

Objections and representations may be made on account of the inclusion of any area in, or the exclusion of any area from, the district so provisionally determined, and must be made in writing to the secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, by the 31st January, 1921, by which date any authorised undertakers, local authority, or persons interested may submit in writing a scheme for effecting improvement in the existing organisation for the supply of electricity, including the formation of a Joint Electricity Authority for the district.



Map Showing North Wales and Chester Electricity Area.

The accompanying maps show the areas of the Mersey and West Lancashire and the North Wales electricity districts which have already been provisionally determined by the Electricity Commissioners. A list of the local authorities comprised in these districts appeared in our issue for July 23.



The Australian Import Trade.

In a recent issue we gave some extracts from a Report by H. M. Senior Trade Commissioner on the general aspects of the trade and industries of the Commonwealth of Australia. In his annual Report for 1919 Mr. S. W. B. McGregor deals more fully with the financial, commercial and industrial position and criticises some of the methods of British traders. As Mr. McGregor is an engineer of wide experience we think that, though some of his strictures may be undeserved, it will be useful to reproduce some of his views as set out in the "Board of Trade Journal." Candid but friendly expressions of opinion are useful and we hope that British manufacturers and exporters will give Mr. McGregor's Report the careful attention it deserves.

At the outset he utters a warning that although there is in Australia a sentiment in favour of British goods, based largely on the fact of British goods being the best value for the price paid, it is well to bear in mind the deep-rooted conviction of many Australians that the British manufacturer is intensely conservative, unenterprising, generally out of date, and rapidly losing his hold on the world's markets. These allegations are directed against the manufacturer rather than the merchant, and particularly against manufacturers connected with the machinery (including electrical), motor car, small tools, hardware and allied trades. The accusation of want of enterprise usually arises, amongst other reasons, from the apparent reluctance of the British manufacturer to increase his output to cope with increasing business, and an alleged indifference to the special requirements of the Australian trade.

It is suggested that, with many notable exceptions, the fault lies largely with inadequate scientific commercial organisation in the average British manufacturer's business. Another matter that appears to be often lost sight of is the failure of some manufacturers to realise their responsibilities in regard to the maintenance of British trade prestige overseas and their duty to British trade as a whole. In the majority of cases the commercial community in overseas centres is a comparatively concentrated and small one. Every fault or act of folly perpetrated by the home manufacturer or merchant, therefore, becomes talked about and magnified out of proportion to its real significance. Examples of this rae the sending out from home of ill-equipped and unsuitable repre- sentatives and the conduct of correspondence in a slipshod manner.

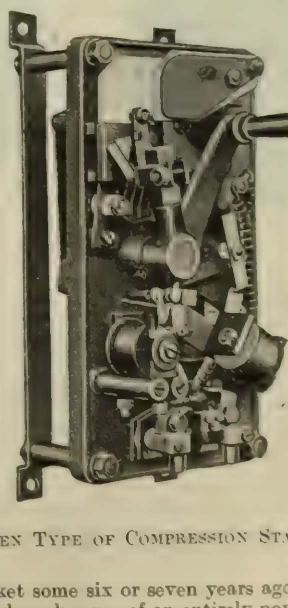
Recommendations.

Apart from the basic recommendation that every British manufacturer carrying on overseas business should have an adequate commercial organisation, the following detail points may be emphasised:—Manufacturers should exercise greater control over the sale and distribution of their products, without necessarily interfering with established channels of trade. Arrangements should be made for a periodical re- sponsible personal investigation of overseas markets. Greater care should be exercised in the selection of local agents and representatives, and also in the selecion of representatives sent out from the home country, while such representatives should be accredited through the Department of Overseas Trade, London, to H.M. commercial officers overseas. Greater consideration should be given to the immense distances and cost of travelling in Australia; also to the considerable general expenses involved in carrying on an agency business. Greater skill and care in the conduct of correspondence is desirable, and home firms should refrain from sending out gloomy or pessimistic forecasts of their own or the country's trade. Greater care and thought should be given to catalogues, publicity matter and advertising.

The Australian Association of British Manufacturers and their Representatives is able to offer valuable help and guidance in the development of United Kingdom exports. Its membership has now increased to 295 representatives in Australia and 466 manufacturers in the United Kingdom. The statistics given show that the value of competitive imports from the United Kingdom decreased from 63·2 per cent. in 1913 to 46·6 per cent. in 1918-19 (or a loss of 16·6 per cent.), the United States increased from 11·8 to 29·3 per cent. (a gain of 17·5 per cent.), and Japan increased from insignificance to 11·08 per cent. Under normal conditions Mr. McGregor thinks that Great Britain should regain a large proportion of the trade lost during the war, and he recommends, in view of possible difficult times ahead, that the various countries forming the British Commonwealth should draw more closely together for mutual support, whilst every individual manufacturer and merchant should strive for the utmost efficiency in production and distribution.

Compression Type of Starters.

The Compression Starter & Switchgear Company, Ltd., of Stockport, have taken over from Messrs. Ferranti Ltd. the manufacture and supply of the compression type of continuous-current motor starters, which was placed on the market some six or seven years ago. The unique design of this starter, which makes use of an entirely novel principle and gives it advantages over other types, was described and illustrated in The



Open Type of Compression Starter.

Electrician of July 3, 1914. The principal features are (1) that the whole of the resistance material remains in circuit throughout the process of starting up; (2) a perfectly even reduction of resistance is obtained and hence there is no sparking except when the circuit is finally broken on the first contact when stopping the motor; (3) the resistance will withstand a temperature up to 1,200°F. without injury; (4) all connections are accessible from the front; and (5) the replacing of the resistance unit can be carried out on site at a low cost and in a few minutes. The resistance element of the starter consists of a column of graphite and nickel discs interspersed, contained in a tube of special heat-resisting insulating material which is enclosed in a steel case. The complete resistance is mounted on the back of an iron face plate, and compression of the column of discs is effected by a powerful system of toggle levers connected to the operating lever. Our illustration shows the front of an open-type starter. The switch is mounted on the front of the face plate and is of the radial pattern, having one inner and two outer contact segments only. The main brush is laminated and the circuit is broken by auxiliary renewable sparking contacts in the fields of a powerful magnetic blow-out, which gives the switch the characteristics of a circuit breaker. The starter is the result of some years of experimental work, including the severest tests under working conditions. It is claimed that it is more reliable and has a very much longer life than a wire-wound starter working under the same conditions. The company have standardised a complete line of these starters up to 50 h.p. in open, semi-enclosed, and totally enclosed weather-proof types.

B.T.-H. Switchgear.

In a pamphlet (4,154a) recently issued by the British Thomson-Houston Company, Ltd., illustrated particulars are given of the design and construction of their ironclad oil-break switchgear of the non-draw-out type, and intended for use on alternating current circuits in mines, factories, mills and all industrial situations where totally enclosed apparatus is necessary. The maximum capacity covered by the apparatus in the list is 800 amperes and the maximum voltage 3,000. Up to 3,000 amperes the switches are designed for either wall or pedestal mounting, and the limiting feature is the continuous carrying capacity of the overload trip coils which are in series with the load. For larger capacities, for which pedestal mounting is employed, the switches have secondary trip coils wound for five amperes, operated through current transformers, and the limiting feature is therefore the continuous carrying capacity of the switch as set out in the table given. The various parts are carefully designed and well constructed, and they meet all the requirements of the Home Office as to the use of electricity in mines and factories. A detailed description of the various standard types of switches, with dimensions, drawings, diagrams of wiring connections, price reference numbers, &c., is contained in the pamphlet from which consume rscan readily select the type most suitable for their requirements, Owning to exigencies of space we can give a couple of illustrations. Fig. 1 shows an O.D.A. type switch with 3-coil trip and ammeter, with switch in closed position; and Fig. 2 a pedestal switch containing starting rheostat for slip ring induction motor, the door being closed.

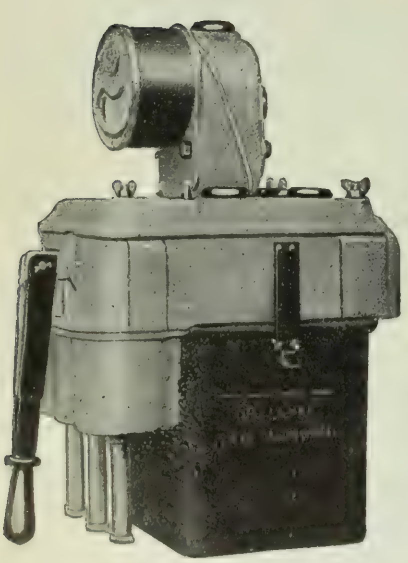


Fig. I.

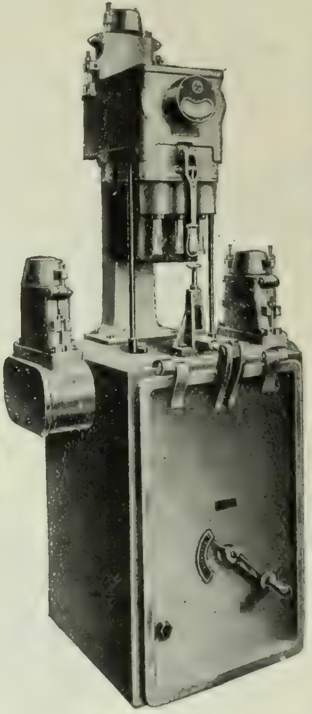


Fig. II.

Commercial Topics.

Registration of Patent Licences, &c.

Sec. 16 of the Patents and Designs Act, of 1919, deals with the registration of assignments of patents, licences, &c., and sub-sec. 4 provides that a document or instrument in respect of which no entry has been made in the Register of Patents shall not be admitted in evidence in any court in proof of the title to a patent or to any interest therein unless the court otherwise directs. The First Schedule of the New Patents Rules provides that upon application for entry of name of subsequent proprietor or, for entry of notices of a mortgage, licence or other document, in the Register of Patents, if made within six months from date of acquisition of proprietorship or interest, or the coming into force of the Rules, the fee payable in respect of one patent is £1. If, however, application be made after six months, the fee payable is £10. The Patents Rules came into operation on April 1 last, and in order to avoid payment of the increased fee applications for registration in respect of dealings effected prior to that date should be made at the Patent Office not later than the 30th inst.

* * * *

Standard Plugs in Canada.

H.M. Trade Commissioner in Toronto (Mr. F. W. Field) states that the Regulation and Standards Committee of the Association of Municipal Electrical Utilities of Ontario reported at the June convention that the sale of appliances and satisfaction in the use of same by the public had been hindered owing to the confusion in existing plugs and receptacles. As there was no standard practice covering the design of plugs and receptacles for permanent installations, and as there was a great need of having plugs and receptacles whose parts are interchangeable, they recommended as follows:—

1. Receptacles shall have parallel contacts suitable for both parallel and tandem caps; (2) Plug bases shall have parallel contacts for contacts suitable for both parallel and tandem caps; (3) Caps shall have parallel contacts; (4) contact dimensions of caps shall be as follows: Outside, 0·560; inside, 0·436; width, 0·250; thickness, 0·062.

* * * *

Water Rates and Manufacturing Costs.

The latest indication of a further increase in manufacturing costs is in relation to charges for water. The Report of the Departmental Committee on the Metropolis Water Act (1902), which foreshadows Parliamentary action to authorise increased charges, states that the Boards' expenditure has in recent years largely exceeded its revenue, and it is recommended that the deficiency be met by water consumers by fixing the charges at such a point that the revenue will, when the present deficiencies have been cleared off, be sufficient to meet the expenditure, while reserving the ultimate rights to have recourse to the rates in order to meet deficits. It is, therefore, recommended that the maximum rate for domestic supply should be raised from 5 per cent. to 10 per cent. of the rateable value of premises supplied, with a proviso that the rate shall not be raised above 7½ per cent. without the authority of the Minister of Health. They think that the Board should be empowered to impose in all cases of supply by measure a charge equal to the estimated average cost per 1,000 gallons of all the water supplied. This is estimated at the present time to be 9¼d. per 1,000 gallons. The London Chamber of Commerce, which opposed the Metropolis Water Board Charges Bill in 1907, and secured substantial concessions in the charges for trade supply, is making enquiries from members as to their views, and is formulating traders' views, with a view to putting them before Parliament.

Institution Notes.

The Industrial Welfare Society has arranged a Lecture Conference for Welfare Supervisors at Balliol College, Oxford, for Sept. 17 and 20. The conference is the first of its kind to be held, and an interesting programme has been prepared.

The 19th annual meeting of the Municipal Tramways Association was held at Cardiff on Wednesday and Thursday. Ald. Jir J. W. Courtis, chairman of Cardiff Corporation Tramways Committee, president of the association, occupied the chair. A report of the proceedings, together with abstracts of the Papers, read will appear in our next issue.

The Birmingham & District Electric Club held their first meeting of the session at the Grand Hotel, Birmingham, on Saturday last, when a Paper was read by Mr. R. Gregory upon "Some Considerations in regard to Low Tension Switchgear." The Paper dealt particularly with the automatic protection of electrical machinery and analysed each class of protective gear. Mr. Gregory assured his audience that during the past few years much progress had been made in accuracy of design, robustness of construction and range of patterns.

At the opening meeting of the Old Students' Association of the Royal College of Science on Tuesday, Prof. H. E. Armstrong made some severe comments on the university system of London. He said he had had 50 years' experience of it, and during the period the talk had ever been of examinations, but never of learning. London had been without educational ideals, and a more cursed system was never devised. Its methods of teaching had been hopelessly stereotyped, and the teachers had not been free to teach nor the students free to learn. The one concern had been to maintain the standard of the examination, as if there could be a fixed standard when the examiners were always being changed, and knowledge grew from day to day. There had been no understanding of the students' nature. What was needed was special kinds of university education to meet the requirements of specific classes. The Imperial College must be autonomous, and its courses must be carefully adjusted to suit the peculiarities of its students

Electricity Supply.

Lurgan Urban Council has applied for sanction to borrow £25,000 for an electric supply scheme.

Dover Council have received sanction to a loan of £20,067 for new plant for the electricity undertaking.

The Sabden Parish Council has resolved to obtain a report on the proposal to generate electricity by water power.

Application has been made by Shipley Urban Council for sanction to a loan of £7,000 for meters and house services.

Cheltenham Corporation have applied for authority to borrow £13,630 for additional cables, transformers and street lighting equipment.

Cheriton Urban Council have asked the Folkestone Electricity Company for an estimate of the cost of converting the street lamps from gas to electricity.

Truro City Council is negotiating with Messrs. Herd & Smith as to an electric supply scheme. The firm offer to form a local company and find the necessary capital.

Newhaven Urban Council, being unable to obtain electricity for public lighting from the L.B. & S.C. Railway Company, have approached Brighton Corporation for a supply.

The insurance on the plant at the Sunderland Corporation electricity works is to be increased by 50 per cent. to meet present day values. The Council has applied for sanction to borrow £6,000 for consumers' services.

Gravesend Corporation has taken up a loan of £45,000 at 7 per cent. from the Pearl Assurance Company for electric supply purposes. The sum is to be repaid by half-yearly equated instalments of principal and interest.

Bury St. Edmunds Corporation have purchased surface condensing plant at Govan electricity works for £500, and an order has been given to Callenders' Cable and Construction Company for cable for the Grove Estate at £520.

The Taunton Electricity Department's accounts for the year ended March 31 show gross profit £2,388 (compared with £3,556 in previous year) and, after meeting capital charges, &c., there was a deficit of £1,362.

Blackpool Corporation has decided to apply for sanction to borrow £30,000 for new mains, distributors, transformers and services required by the electricity undertaking, and £4,250 for doubling a length of tramway track in New-road.

Nelson Council have increased the charge for electric current for lighting by ½d. per unit and for power ⅛d. per unit. The salary of the electrical engineer and tramways manager (Mr. G. Nayler) has been increased from £601. 7s. 6d. to £750 per annum, of which sum £297 10s. is to be considered as war bonus.

The accounts of York Electricity Department for the year ended March 31 show revenue £78,090 (compared with £57,371 in the previous year. The expenditure was £59,409 (£43,570), leaving gross profit £18,680 (£13,801). The net profit was £2,992 (compared with a deficit of £3,604). Units generated were 13,470,229 and sold 11,359,216.

Replying to questions, Coun. Firth stated at Oldham Council meeting last week that the Electricity Committee were inundated with applications for current, and everyone had to wait their turn, no preference being shown. Until they had the necessary machinery installed, the Committee were unable to accommodate people as quickly as they would like to do.

The accounts of the Sunderland Electricity Department for the year ended March 31 show revenue £137,240, and expenditure £90,718 leaving gross profit £46,522; and after providing for capital charges, income tax, &c., the net balance was £12,830, the bulk of which is to be applied to writing off superseded machinery and plant. Units sold were 19,364,143 (18,604,843).

Aberdeen Corporation have been authorised to borrow a further sum of £128,000 for extensions of the electric supply undertaking, and the Electricity Commissioners will be prepared to consider the borrowing of any further sums required when the total cost of the proposed works has been ascertained. It has been decided to increase the amount for motors, service cables, &c., to £14,500, thus increasing the total amount to be borrowed to £156,000.

For some time past interesting experimental tests have been going on in Hove as to the relative merits of electricity and gas for street lighting, and at the last meeting of the Council the chairman of the Lighting Committee (Councillor Payne) presented a long report on the matter. There were 14 half-watt electric lamps and 30 gas lamps, each of 400 c.p., and after considering the whole of the facts the Committee recommended the adoption of electric lighting in some of the busiest streets, at a total cost of £1,800. The report was adopted.

Stafford Corporation have made an agreement with Messrs. W. H. Dorman & Company for the supply of electricity to the company's factory in Foregate-street and to their proposed new factory at Littleworth. The agreement is for seven years, from March 1, 1921, and the Company will lend the Corporation such sums, not exceeding £5,000, as may be required for laying a h.t. cable to Littleworth, this sum to be repaid to the company by way of rebate of 20 per cent. on the amount of the annual accounts for current supplied to the factory.

The accounts of the Newcastle (Staffs.) Electricity Department for the year ended March 31 show an increase in revenue from sale of current from £3,793 to £6,284, the total increase of income being £2,471, and working and general expenses were £2,416 (compared with £2,459), leaving gross profit £2,207 (£1,382). After providing for capital charges and income tax, the net profit was £414 (compared with a deficit of £285). In addition, a sum of £496 was paid out of revenue for special expenditure. During the year the undertaking was linked up with the Hanley station, and a small portion of the supply taken in bulk. It is hoped to have a further 230 kw. Diesel set running by December.

The Worcester Electricity Committee is experiencing great difficulty in maintaining a proper staff owing to dissatisfaction with the salaries paid. At the meeting of the City Council last week the chairman of the Committee (Mr. W. J. Hill) said that practically the whole of the technical staff were leaving. They could not get an adequate staff unless they were prepared to pay at least as much as other undertakings paid On the other hand Mr. Fairbairn said if the Council accepted the policy of the Joint Industrial Council with regard to the electricity supply industry, other officials would come forward for large increases. The ratepayers could afford the money.

Ultimately, the Committee was authorised to deal with the position, and pay such salaries as may be necessary to get a proper staff.

An official inspection of the power stations in Edinburgh was made by the Electric Lighting Committee on Tuesday. At the new Portobello station substantial progress has been made, and the steel construction work for the turbine house is now complete. At the outset there will be three turbo-generators of 10,000 kw each, but there will be room for extensions to 100,000 kw. The erection of the boiler house will commence in about six weeks. The first turbo-generator will be ready at the end of December and the last by the end of February.

The convener, Mr. Bruce Lindsay, subsequently entertained the members of the Committee and Corporation officials to dinner. During the year ended May 15 the department sold for lighting practically 10 million units; for power, over 13 millions; for public lighting over one million; and for traction, 150,000. The total units sold were 24,401,273, an increase of 18·6 per cent. over the previous year. There was a satisfactory increase in private lighting of 17·9 per cent. The total horse-power connected during the year was 27,510.

It is proposed to raise the charges as follows: Private lighting, from 4d. to 4½d., and power from 1⅝d. to 1⅞d. per unit.

The accounts of the South Shields electricity supply department for the year ended March 31 show revenue £66,377 (compared with £42,169 in previous year) and the gross profit was £23,239 (£11,425). Interest and sinking fund required £16,354 (£16,540) and the net result was a profit of £3,514 (against a loss of £7,287). Maximum load was 3,794 kw. (2,709 kw.) and load factor 20·9 (24·3) per cent. Kelvins generated were 8,848,001 (7,479,550) and sold 6,962,929 (5,766,398). Costs per kelvin sold were 2·01d. (1·93d.) including interest and sinking fund.

In his report the borough electrical engineer (Mr. E. Moxon) says he is of the opinion that the next year's working will see the peak of the total costs per kelvin, and he anticipates that the increased economies that will be obtained when the new plant is running will more than meet any increased standing charges due to increased capital expenditure. He also feels that items making up the running charges will, by that time, be on the down grade and when the time comes to pass he hopes the department will be able to announce a reduction in the charges for electricity. Immediately the department is again in a position to meet all demands likely in the ordinary way to be made upon it, Mr. Moxon proposes that a vigorous campaign shall be instituted through the show-rooms, and by means of advertisement and special propaganda work, to secure new consumers of electricity for all purposes and, at the same time, to induce existing consumers to use electricity for other purposes than lighting. The committee should discuss the advisability of setting up a department for the hiring out of domestic electrical appliances and so popularise the use of electricity in field at present almost neglected.

Personal and Appointments.

The Postmaster-General has appointed Mr. W. T. Leech and Mr W. E. Parsons to be Assistant Secretaries to the Post Office.

Prof. Dr. Haber has been appointed professor of Chemistry at Berlin University in succession to the late Prof. Fischer.

The following appointments of Royal Engineer officers have been made to the School of Electric Lighting: Chief instructor, Major P. S. Watkins, D.S.O.; instructors, Captain and Brevet Major S. O. Alabaster and Captain and Brevet Major H. S. Griggs, O.B.E.

Mr. W. H. Blythe, research electrical engineer, Brooklands, and Mr. John H. Havelock, Blackpool, chief instructor in engineering, R.A.F., have been appointed travelling teachers in mechanical and electrical engineering by Glamorgan Education Committee.

Motherwell Council has appointed Mr. W. D. Brassington, burgh electrical engineer, at a salary of £500 per annum. There were over 50 applicants, and the following were selected for interview:—Messrs. Brassington, D. H. Davies (Heywood), James Edgar (S. Shields), James Gibson (Motherwell), W. S. Johnston (Rigg Power Station, Gretna) and J. W. Slorach (Glasgow). Mr. Edgar, however, withdrew his application.

The Council of Swansea University College have appointed Mr. Frederick Bacon, M.A., A.M.Inst.C.E., M.I.Mech. E., M.I.E.E., professor of engineering at £900 a year. Prof. Bacon has been Drapers' Professor of Engineering at the University College of Cardiff since 1913. From 1916 to 1919 he was engaged on technical war service with the Admiralty, with the rank of lieutenant, R.N.V.R., and after the Armistice was retained as engineering adviser to the Anti-Submarine Division. Mr. R. G. Isaacs, B.Sc. (Eng.), A.M.I.E.E., has been appointed lecturer in electrical engineering, and Mr. J. Lloyd Davies, B.Sc. (Eng.), assistant lecturer in electrical engineering at the College.

Electric Traction.

At last week's meeting of MANCHESTER City Council, a recommendation from the Tramways Committee that fares should be increased by reducing the distance from 1½ to 1¼ per 1d. fare was adopted. A working arrangement for through running of cars will be made with Blackpool Corporation.

The purchase of the BLACKPOOL, ST. ANNE'S and LYTHAM ELECTRIC TRAMWAYS is to be completed by St. Anne's Council on Oct. 31 for £135,000, plus £5,000 for compensation to various officials.

Wallsend-on-Tyne Council has urged the N. E. RAILWAY COMPANY to provide better electric train services, but the company state that they are doing their utmost to accelerate the delivery of more rolling stock when services will be improved.

Some time ago GLASGOW CORPORATION authorised the construction of 150 new tramcars. Of these, 12 are practically completed and 11 are in course of construction. The cars in course of construction are to be proceeded with, but the building of the remaining 29 cars has been postponed.

The accounts of the SHEFFIELD TRAMWAY UNDERTAKING which were approved by the Council recently, show traffic revenue £824,000 (increase £170,950), and working expenses £679,000, the net profit being £57,412 (decrease £5,808). The income on the motor buses was £75,000, and the exenditure £71,000. Passengers carried on the tramways were 151,633,534 (163,799,188).

It will be recollected that a STRIKE of BRIGHTON CORPORATION TRAMWAYS EMPLOYEES recently took place over the question of grading, and after being out for three or four weeks the men resumed work pending consideration of their application. The Tramways Committee recommended that the men's demands be conceded, but the Council declined to adopt this course, and they have decided to adhere to the decision of the local Whitley Council, which placed the Brighton tramways in Grade 2.

The accounts of the ABERDEEN Corporation Tramways Department for the year ended May 31 show revenue £169,731 (compared with £140,901 in previous year), working expenses £141,852 (£108,451), and gross profits £27,879 (£32,450). After providing for interest, sinking fund, depreciation, renewals, &c., the net result was a deficit of £5,203 (compared with a profit of £6,837). Passengers carried were 48,856,688 (42,218,849) and car miles run 2,440,087 (2,215,795). Revenue was 16·69d. (15·26d.) and working expenses were 13·95d. (11·75d.) per car mile.

An official inquiry was held at Newcastle-on-Tyne on Tuesday and Wednesday by Major Hall, R.E., into the SPEED and OVER CROWDING of TRAMCARS. The Inspector made a tour of various routes. The object of the investigation is said to be the desirability of adopting a uniform rate of speed, especially in the more congested areas, and to eliminate the practice of overcrowding. The speed of the Newcastle tramcars varies from 4 miles an hour on junctions up to 16 miles. It is no doubt very desirable to get rid of overcrowding, but this can only be done by obtaining more rolling stock, and perhaps to some extent by permitting a higher speed. It was unnecessary to go to Newcastle to get evidence of overcrowding, for plenty of bad examples of it can be seen every day in London. However, we hope that some good will result from the inquiry, and that it will lead to a more comfortable tramway service.

Telegraph and Telephone Notes.

It is reported that TELEPHONE COMMUNICATION will be established shortly BETWEEN CUBA and the UNITED STATES, Cuba and Porto Rico and between Cuba and South America.

According to "The Times," the Postmaster-General has decided to equip an experimental AUTOMATIC TELEPHONE EXCHANGE, of the Western Electric Company's panel type, in London. The necessary equipment from the U.S.A will not be available before next spring, and it will be some months before the trial can be made. Naturally, like a Government Department progress will be made in a leisurely way.

The Admiralty recently revised the REGULATIONS GOVERNING APPOINTMENTS TO NAVAL WIRELESS STATIONS, and they have now directed that the commanding officers at 19 stations abroad, together with the chief petty officer telegraphists and petty officer telegraphists, are to undergo a special course in the type of apparatus fitted at oversea wireless stations before proceeding abroad. This course will be taken at the Signal School Portsmouth. All commissioned officers who are appointed as commanding officers of wireless stations abroad are also to undergo a special course of instruction in oil engines.

We learn from "The Times" Trade Supplement that the International Telephone and Telegraph Company, which is a merger of the Cuban Telephone and the Intercontinental Telephone and Telegraph Companies, has recently been organised with a capital of $25,000,000 for EXTENDING the TELEGRAPH SERVICE between Cuba and Central and South American countries. The Cuban Telephone Company has placed orders in the United States for thousands of new telephones for installation in Habana, the existing exchange not having kept pace with the growth of the city. Owing to heavy demands in the States for telephone equipment considerable delay has been caused in the supply of material to Cuba, and British suppliers who can give early delivery might, it is said, have an opportunity of doing good business.

Imperial and Foreign Notes.

The new electric power station in BANGALORE (India) was formally opened on July 20.

Electric supply is to be given in MANLY (N.S.W.) from Sydney Council's power house.

Schemes for electricity supply in BEAUFORT (Victoria) and in CASINO (N.S.W.) are under consideration.

The question of establishing electric supply works is also under consideration by AVOCA (Victoria) Council.

Heytesbury Shire Council is considering a report by Mr. G. W. Stewart on electricity supply for COBDEN (Victoria).

LONGFORD (Tasmania) Council is considering a proposal for erecting for hydro-electric works. At present a suction gas plant is used.

AUCKLAND (N.Z.) Corporation intend to increase the capacity of their electric generating plant by 12,000 kw., and the charges for current are to be increased.

The municipalities of the HUON (Tasmania) district have asked the Government hydro-electric department to provide a supply of electrical energy for the district

WOLLONGONG (N.S.W.) Council has received permission to borrow £11,000 for electric supply works. Energy will be taken in bulk from the power house of the Public Works Department.

A report is being prepared upon the practicability of using the tidal flow of the River Tamar for the generation of electricity required by manufacturers in the BELL BAY District of Tasmania.

Oxley Shire Council recently decided to ascertain the opinion of municipalities in VICTORIA in regard to an invitation to the Government to take up the Kiewa hydro-electric scheme, or to allow private enterprise to conduct it. A deputation will wait on the Premier during the annual municipal conference in October.

In a Paper on "A Project for Providing the Punjab with a Cheap Supply of Electric Power," recently read before the Lahore Engineering Congress, Mr. F. L. Milne stated that the electric plant installed in India was only 0·742 watts per head of population, compared with 33 watts in the British Isles, 148 in Canada, 61·8 in Australia and 56·9 in South Africa. India had not the same incentive as other countries to exploit the water power available, because her industry was mainly agricultural, labour rates were low and her people had few wants. Two schemes were dealt with in the Paper, viz., the Bhahra Dam on the Sutlej and the Upper Bari Doab on the Ravi river. From the former 60,000 kw. could be obtained at a cost of R. 313 per kilowatt, and from the latter 10,000 kw. at R. 716 per kilowatt. As the Sutlej project was much cheaper and more favourable than the other it should be taken in hand first and developed for an output of 10,000 kw. He thought water power in the country should be nationalised and made a monopoly under a single control.

As we announced in our issue of the 3rd inst., the English Electric Company has secured an important contract for electrifying the ARTHUR'S PASS SECTION of the MIDLAND RAILWAY of NEW ZEALAND. In a cable to the Department of Overseas Trade H.M. Trade Commissioner at Wellington states that the contract was obtained on the merits of the tender in the face of strong American competition. The section is the first to be converted to electric traction, and forms the connecting link between the Government railway system of the east and west coasts of the South Island. On the section there is a tunnel over five miles long with three steel bridges. A great portion of the line is on a grade of 1 to 33, and the summit is about 2,400 ft. above the sea level. The contract includes the provision of the power plant, the tunnel lighting installation, the overhead transmission line, rolling stock, &c. The system to be used is 1,500 volts direct-current overhead contact. The power house will be at Otira station which is 1,260 ft. above sea level, and the power will be generated by geared turbine direct-current sets. The boilers, it is proposed, should be operated on dust fuel in order to utilise the product of a number of local coal mines at which coal is raised, which is too fine for ordinary consumption.

The Governor-General of ALGERIA has appointed a Commission to examine the possibility of adopting ELECTRIC TRACTION on the EXISTING RAILWAYS, and for investigating a scheme for the supply of electrical energy for industry and agriculture. The investigation will include the possibility of utilizing the falls of Oued-Agroum for providing energy for an electric line between Sétif and Bouge.

The Cie Generale de Telegraphie sans Fil, Paris, has claimed the GERMAN WIRELESS STATION AT EILVESE, HANOVER, on the ground that the Hochfrequenz Maschinen Gesellschaft, of Berlin, in 1912, sold Prof. Goldschmidt's foreign patents to a French group, and ceded it the right to take over the Eilvese wireless station by Dec. 31, 1914. Owing to the war the French company was unable to exercise this right by the date named, but, relying on the terms of the Peace Treaty, the French Government has informed the German Government that the agreement in question has now come into force. As we go to press we learn that the French Company has accepted 3,000,000 marks for its claim.

In a circular recently addressed by the directors of the ELEKTROBANK, of Zurich, to the bondholders (outstanding about 100 millions) and shareholders, they are asked to agree to the transformation of their securities into 6 per cent. preference shares of the same nominal value. The existing share capital of 75 millions will be written down to 18·75 millions ordinary shares, in order to cover the German and Italian currency losses amounting to at least 56 millions. The investments of the Elektrobank (Banque pour des Enterprises Electriques) are chiefly in enterprises controlled by A.E.G., of Berlin.

The French Law authorising the establishment of a high tension ELECTRIC TRANSMISSION NETWORK IN THE LIBERATED REGIONS has now been promulgated. From our contemporary, " La Revue General de L'Electricité," we learn that it is proposed to connect the big existing or projected electricity stations in the Nord and Est regions by means of 120,000-volt transmission lines for the purpose of mutual aid. Though the Law has only just been passed work has been proceeding for some time and has made substantial progress. In the 1919 budget 40,000,000 frs. were voted and in the 1920 budget 70,000,000 frs. have been appropriated, and the total cost is estimated at 135,000,000 frs. The work is being carried out according to the degree of urgency, and in the first instance the following (among others) places will be connected: Pont-á-Vendin, Douai, Valenciennes, Lille, Cambrai, Jeumont, Laon, Reims, Epernay, Verdun, Longwy, Briey, Nancy and Chambray; then a line will be erected between Paris, Saint Just, Arras and Pont-á-Vendin, and a big generating station will be erected at Hirson (Aisne). It is thought that the Paris transmission line will be found useful in case of strikes and in other emergencies.

Miscellaneous.

We are informed that the PATENT OFFICE LIBRARY is now open to the public daily, except on Sundays, Good Friday, Christmas Day, Whitsun Eve and Bank Holidays. On and after the 1st inst. the hours of opening will be from 10 a.m. to 9 p.m.

Owing to a fire at the South signal-box at CREWE station on Friday last considerable damage was done to the electrical plant, with the result that 365 signals, covering all trains entering Crewe Station, were put out of action, and the points could not be moved. The whole of the telephonic and telegraphic installation was also destroyed.

Notice is given that Christopher Hage, the British & Overseas Engineering Syndicate, Ltd., and the Poulsen Wireless Telegraph Company, Ltd., have applied for an EXTENSION OF THE TERM OF LETTERS PATENT, No. 15,999 of 1903, for " Production of Alternating Currents," granted to Valdemar Poulsen, and on the 20th prox. the High Court will be asked to fix a day for hearing the application.

The fourth INTERNATIONAL COMMERCIAL MOTOR EXHIBITION will be held at Olympia from Oct. 15 to 23. The exhibition is organised by the Society of Motor Manufacturers and Traders, Ltd.,and will be the largest of its kind. It is estimated that 400 vehicles of all types will be shown, and the exhibits will reveal the great advance made in an industry which has become one of the main arteries of industrial life. Developments in steam and electricity as propelling forces will surprise many superficial observers, who have taken for granted petrol to be the only motive power. Pneumatic tyres, specially designed for industrial vehicles, will be exhibited for the first time.

The first annual sports meeting (under A.A.A. Rules) of FULLER'S UNITED SOCIAL & ATHLETIC ASSOCIATION was held on Sept. 4 at Goodmayes. About 1,500 were present. The programme contained open, closed and invitation events, and provision was made for the ladies and young people. Inter-departmental events were keenly contested. Among visiting competitors were teams from the Sterling Telephone Company, the Hart Accumulator Company, and the Roneo Company. Prizes were distributed by Mrs. G. A. Fuller, and several of the directors, including Messrs. G. A. and L. Fuller and Mr. Gordon, were present. A pleasant and successful afternoon was spent, and the Association hopes that this will be the first of many similar events.

On the 6th inst. the employees of Messrs. J. H. Holmes & Company, electrical engineers, in order to commemorate the approaching wedding of Mr. Oliver Holmes to Miss M. Crompton, presented a silver salver together with a set of fruit knives and forks to Mr. Holmes, and a pair of silver flower vases to Miss Crompton. The presentation was made by Mr. R. Robinson who referred to the friendly relationship existing between employers and employees. Mr. Alfred Holmes said he looked upon many members of the staff as close personal friends, and his two sons in the business did likewise. Personal harmony was of great importance at the present time, and he urged them, if at any time they should have a grievance to come to him and talk it over.

More than 400 firms who are directly affiliated with the trades represented will participate in the SHIPBUILDING, ENGINEERING and ELECTRICAL EXHIBITION which opens in Kelvin Hall, Glasgow, on Nov. 8, and continues until Dec. 4. About 25,000 invitations have been sent to foreign buyers, and all buyers who attend the exhibition will be specially entertained by the Corporation. At present everything points to the fact that the exhibition will be a huge success. Mr. James M. Freer, the General Manager, announces that all the available floor space has been taken, and judging from the enquiries received, as much floor space again could have been utilised. A special cinema hall, with a seating capacity of 2,500, has been provided and educational films will be shown daily.

The annual GARDEN PARTY and SPORTS MEETING of the Elliott Social Association, in connection with Messrs. Elliott Brothers (London), Ltd., was held on Colfe's Grammar School Ground at Eltham Green on the 4th inst., when about 700 members and friends spent an enjoyable time. The representatives of the company included Mr. W. O. Smith (President E.S.A.), Sir Keith Elphinstone, K.B.E., and Messrs. L. W. and R. O. Smith, with their wives and friends. Lady Elphinstone, who opened the proceedings with a happy speech, was presented with a bouquet of pink carnations. There were 23 events in the sports programme, including running and walking races, inter-departmental tug-of-war (ladies and gents), slow cycle and obstacle races, &c. Messrs. Siemens Brothers of Woolwich sent a tug-of-war team to compete with Elliott's, and after a struggle the latter team won. Music and various entertainments were provided. Sweets, cigarettes, ices, fruit and mineral waters were obtainable at a stall in charge of ladies from Century Works, and teas were provided in marquees from 4.30 and onwards. The prizes, which numbered 67, were given by the directors of Messrs. Elliott Brothers, and distributed by Mrs. R. O. Smith, who was presented with a bouquet of pink carnations. After the prize distribution dancing was indulged in till 9 p.m

IMPORTS.—The following are official values of electrical machinery' material and apparatus imported into this country (*a*) during July, 1920 and (*b*) the aggregate figures from Jan. 1 to July 31, with increase or decrease compared with corresponding periods of 1919 :—

Electrical machinery, (*a*) £95,240 (increase £4,527), (*b*) £594,270 (increase £215,498) ; telegraph and telephone cables, submarine (*a*) nil, (*b*) £50 (increase £50) ; other than submarine, (*a*) £545 (decrease £47), (*b*) £4,178 (decrease £4,267) ; telegraph and telephone apparatus, (*a*) £15,807 (decrease £19,432), (*b*) £85,817 (decrease £85,022) ; other electrical wires and cables, rubber insulated, (*a*) £300 (decrease £258), (*b*) £11,404 (increase £7,880) ; with other insulations, (*a*) £16,947 (increase £15,523), (*b*) £62,729 (increase £52,302) ; carbons ,(*a*) £8,967 (increase £5,854), (*b*) £69,272 (increase £52,075) ; glow lamps; (*a*) £5,247 (decrease £1,349), (*b*) £24,600 (decrease £187,292) ; arc lamps and electric searchlights, (*a*) £841 (increase £813), (*b*) £3,681 (increase £3,653) ; parts of arc lamps and searchlights (other than carbons), (*a*) £378 (derease £7,689), (*b*) £6,979 (decrease £37,692) ; batteries, (*a*) £8,719 (increase £6,449), (*b*) £41,487 (increase £13,837) ; meters and measuring instruments, (*a*) £9,769 (increase £6,490), (*b*) £46,641 (increase £24,107) ; switchboards, (*a*) £100 (increase £42), (*b*) £1,093 (increase £79) ; electrical goods and apparatus unenumerated, (*a*) £74,638 (increase £35,573), (*b*) £378,795 (increase £130,580). Total of electrical machinery, material and apparatus other than uninsulated wire, (*a*) £237,498 (increase £46,496), (*b*) £1,330,996 (increase £185,788).

EXPORTS.—The exports of electrical machinery, material, &c., (*a*) during July, 1920, and (*b*) from Jan. 1 to July 31, with increase or decrease compared with corresponding periods of 1919, were as follows :—

Electrical machinery, (*a*) £201,962 (increase £4,739), (*b*) £1,161,128 (increase £314,810) ; including railway and tramway motors, (*a*) £2,983 (increase £34), (*b*) £22,294 (decrease £5,528) ; other generators and motors, (*a*) £114,203 (increase £15,987), (*b*) £666,821 (increase £208,896) ; and electrical machinery unenumerated, (*a*) £84,776 (decrease £11,282), (*b*) £472,013 (increase £111,442) ; telegraph and telephone cables, submarine, (*a*) £44,039 (decrease £63,226), (*b*) £1,081,240 (increase £731,912) ; other than submarine, (*a*) £86,218 (increase £58,236), (*b*) £578,537 (increase £375,296) ; telegraph and telephone apparatus, (*a*) £109,713 (increase £76,481), (*b*) £665,862 (increase £476,001) ; other electrical wires and cables, rubber insulated, (*a*) £176,586 (increase £88,134), (*b*) £924,218 (increase £547,275) ; with other insulation, (*a*) £209,502 (increase £103,089), (*b*) £1,217,315 (increase £785,935) ; carbons, (*a*) £16,933 (increase £15,336), (*b*) £68,569 (increase £63,535) ; glow lamps, (*a*) £28,045 (increase £10,053), (*b*) £131,131 (increase £46,511) ; arc lamps and searchlights, (*a*) £3,334 (increase £3,105), (*b*) £12,307 (increase £5,526) ; parts of arc lamps and searchlights (other than carbons), (*a*) £2,551 (increase £2,348), (*b*) £7,946 (increase £432) ; batteries, (*a*) £60,351 (increase £35,349), (*b*) £283,916 (increase £17,489) ; meters and measuring instruments, (*a*) £34,001 (increase £14,694), (*b*) £219,160 (increase £104,128) ; switchboards, (*a*) £7,656 (decrease £1,553), (*b*) £51,711 (increase £25,497) ; electrical goods and apparatus unenumerated, (*a*) £185,907 (increase £92,972), (*b*) £969,054 (increase £344,693). Total of electrical machinery, material and apparatus, other than uninsulated wire, (*a*) £965,699 (increase £434,287),(*b*) £7,371,094 (increase £3,838,040)

Business Items, &c.

The new address of the Iron and Coal Trades Review " is Bessemer House, Adelphi, Strand, W.C. 2.

Messrs. Oscar A. Cox & Company, Brazilian mercahnts, have removed to Winchester House, Old Broad-street, E.C. 2. Telephone: London Wall 1686.

The Weston Electric Company, Ltd., have appointed as their sole agents for Portugal the Empreza Electrica Lusitana, Ltd., Rua da Conceicao 153, 1° Lisbon, and Rua Ferreira Borges 14, 1°, Oporto.

Claud Pollard and Elsie Ingham (trading as the Premier Electrical Engineering Company), 19, Bull Close-lane, Halifax, have dissolved partnership. Debts by Elsie Ingham, who continues the business under the same name as hitherto.

Owing to continual expansion, the Cambridge & Paul Instrument Company, Ltd., have found it necessary to centralise their business organisation in London, and they have established head offices and showrooms at 45, Grosvenor-place, S.W.1. (Telephone: Victoria 7640). The showrooms, which are conveniently situated, will contain a wide and varied selection of instruments, both scientific and industrial, and users of such will be welcomed at any time during business hours. A permanent exhibition of this nature will make a wide appeal; it will enable the company to place the fullest information before the foreign visitor on a tour of inspection, as well as prospective buyers in this country, thus enabling them to inspect the particular apparatus in which they may be interested before making a decision.

Catalogues, Price Lists, &c.

A new catalogue and price list of BRITISH-MADE TOOLS, including stocks, dies, taps, drilling machines, &c., has been issued by Messrs. Iva Miller & Company, Ltd., 92-4, Paul-street, Finsbury, E.C. 2.

Messrs. Hindle, Son & Company, of Haslingden, have issued a pamphlet giving particulars of the HINDLE ELECTRIC BALING PRESS, which was described in a recent issue of this Journal. Though four standard types of press are referred to the firm are prepared to supply electric presses to meet special requirements.

A useful brochure on DIESEL and SEMI-DIESEL ENGINES, with particular reference to these prime movers, has been issued by Prices' Company, Ltd., of Battersea. It is written mainly from an historical standpoint, and it should prove of considerable interest to engineers and others concerned with the working of Diesels and large oil engines. There is a limited number of copies, and readers who desire one should apply to the company.

A number of new price lists have been issued by Messrs. MATTHEWS & YATES, LTD., of Swinton. List No. 22/4 gives a specification and No. 22/5 is a temporary price sheet of Cyclone d.-c. motors for continuous running. The motors are of the enclosed ventilated type and the range of brake horse-power and speeds has been re-arranged. List No. 131 is a description of a compact and adaptable unit heater for engineering and other works and is very suitable for temporary heating; while No. 129 describes the company's hot air blast bottle dry apparatus for manufacturing chemists, &c.

A revised edition of a well-illustrated pamphlet of 20 pages on the SIEMENS QUENCHED SPARK SYSTEM of wireless telegraphy for ships has just been issued by Messrs. Siemens Bros. & Company, Ltd. The essential requirements for a ship station are compactness of apparatus, simplicity of operation and robustness, combined with sensibility, and it is claimed that these are fulfilled by the company's standard spark sets. The pamphlet sets out the advantages of the system, and gives lists of British ships and other stations equipped with quenched spark apparatus, together with descriptions of standard spark sets for use on board ship, &c.

The economical use of a commodity such as water, gas or oil, depends upon the accuracy with which it can be measured, and the British Thomson-Houston Company, Ltd., announce that they have developed a FLOW METER which, without the use of weighing tanks, scales or other apparatus, will determine accurately the amount of steam, air or fluid flowing in a system of piping or closed conduits of any diameter and under any conditions of pressure or temperature met with in commercial practice. In an illustrated descriptive list recently issued by the company particulars of the construction and general principles of the B.T.-H. flow meters are given. The meters are covered by a patent.

A new catalogue of electric cables and wires has been issued by the SUN ELECTRICAL COMPANY, LTD., of 118-120, Charing Cross-road, W.C.2. The publication is of a convenient size, and includes all the cables and wires customarily used by the trade for lighting and power work. It gives the price per yard of all cables on the usual basis, and also comparative tables of the old and new standards for cables and flexible wires equivalent. The current-carrying capacity of all cables at both I.E.E. standard and at 1,000 amperes per square inch specifications of the various grades of cable, and other useful information are added. Copies will be sent to contractors and other interested parties.

For the purpose of developing their export trade many firms have had their catalogues translated into French, Spanish and Portuguese. Messrs. FERRANTI, LTD., have far outstripped these in enterprise for they have prepared and circulated a set of abbreviated catalogues in seven languages—in English, French, Italian, Spanish, Portuguese and Dutch, and one covers the Scandinavian countries. The catalogue, which is well printed and illustrated, is confined to the firm's three main lines, viz., house service meters, switchboard instruments and static transformers. Ferranti manufactures are known far and wide for their excellence, and we have no doubt that good results will ensue from their extensive propaganda work.

The first section of the new catalogue of Messrs. Hyatt, Ltd., 24, Devonshire-street, London, W. 1. deals with the applications of the HYATT ROLLER BEARINGS. A full description is given of the construction of the Hyatt bearing together with the dimensions of standard fittings, sizes, and capacities. There are a number of photographic reproductions and illustrations, including illustrations of a few of the many applications of the Hyatt bearing. The cast of power in a modern factory is an important item and every effort should be made to eliminate all sources of power loss. It is claimed that not only has the use of roller bearings resulted in enormous savings in fuel, oil and labour, but, with the right type of bearing, the reliability of line shafting is considerably increased

Bankruptcies and Liquidations.

An application for the discharge of Geo. Edward Bonner, electrical agent, 105, Fox-lane, Palmer's Green, Middlesex, will be heard on Oct. 22 at the Court House, Upper Edmonton.

Claims against Wm. T. Smith, electrical and mechanical engineer, Victoria-street, and 60, Hampton-street, Bolton, are to be sent by Sept. 25 to Mr. G. J. Gibson, Official Receiver, Byrom-street, Manchester.

A scheme has been sanctioned for the pavment of 5s. in the £ to the unsecured creditors of Wm. Thos Smith, electrical and mechanical engineer, Victoria-street and 60, Hampden-street, Bolton, after payment of fees, costs and preferential debts, and the receiving order has been discharged.

Tenders Invited and Accepted.

CARDIFF Corporation want tenders for electrical installation work in 788 cottages at Mynachdy. Specifications from City Electrical Engineer.

NUNEATON Corporation want tenders by Sept. 20 for h. and l.t. switchgear, connecting cables and accessories. Specifications from the Borough Electrical Engineer.

The METROPOLITAN ASYLUMS BOARD require tenders by 2.30 p.m., Sept. 29, for extensions of telephone installation at Grove Hospital, Tooting Graveney, S.W.17.

KENSINGTON (London) Guardians require tenders for six months' supply of electric fittings and lamps, engineers' fittings, &c. Forms of tender from the Clerk, Marloes-road, London, W.8.

Tenders are invited (by Sept. 20) for steam, exhaust, circulating water and other pipes work at IPSWICH Corporation electricity works. Specifications from Mr. F. Ayton, chief engineer and manager.

LONDON County Council invite tenders (by 4 p.m. Sept. 20) for supply of 1,500 tons of mild steel conductor rails of plain tee section. Forms of tender from the Chief Engineer, County Hall, Spring Gardens, S.W.

SOUTHAMPTON Guardians want tenders by Sept. 20 for wiring, &c., in the proposed Children's Homes at Shirley. Specifications, &c., from Messrs. Gutteridge & Gutteridge, 9, Portland-street, Southampton.

The time limit for the receipts of applications invited by the Government of the UGANDA PROTECTORATE for a concession of a portion of the Ripon Falls of the Nile has been extended to Feb. 19, 1921.

BRADFORD Corporation require tenders for electric wiring in connection with housing schemes. Particulars from the City Architect, Town Hall, Bradford.

LINCOLN Corporation require tenders by 11 a.m. Oct. 8 for spray cooling plant. Specifications, &c., from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W.1.

ST. HELENS Corporation require tenders by Sept. 30 for a natural draught cooling tower for the electricity department. Specification from Mr. B. T. Hawkins, borough electrical engineer.

LITTLEBOROUGH Urban Council want tenders by Sept. 22 for two 700 k.v.a., three 500 k.v.a., and two 180/200 k.v.a. transformers, with e.h.t. switchgear and cable connections. Particulars from Mr. W. C. C. Hawtayne, 9, Queen Street-place, London, E.C.4.

Tenders are required by PERTH Corporation by Sept. 22 for the electric lighting work in connection with the adaptation of premises in King Edward-street, Perth, for a fire brigade station. Schedules, &c., from Messrs. Smart & Stewart, 42, Tay-street, Perth.

KILMARNOCK District Council of Ayr County Council require tenders for electric lighting work in 50 houses at Bogend, Dundonald, Fenwick, &c. Firms wishing to tender should apply to Mr. T. C. Stewart, Clydesdale Bank-chambers, Kilmarnock.

The SOUTH AFRICAN RAILWAYS & HARBOURS DEPARTMENT, Johannesburg, require tenders by Oct. 25 for metal filament lamps for train lighting. Specifications may be seen at the Department of Overseas Trade, 73, Basinghall-street, London, E.C.2.

The VICTORIAN RAILWAY COMMISSIONERS require tenders by Oct. 27 for the supply of an electric travelling crane with buffing jib (contract 29,090). Specification, &c., can be seen at the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W.1.

SHEFFIELD Electric Supply Committee require tenders (by Oct. 12) for the supply of two 10,000 kw. steam turbines, condensing plant, pipe work, &c., alternators and exciters. Specifications from the general manager and engineer, Mr. S. E. Fedden, Commercial-street, Sheffield.

Tenders are invited for six months' supply of electrical fittings, &c., to the MIDLOTHIAN AND PEEBLES DISTRICT ASYLUM, Rosslynlee. Forms of tender from the Clerk, 19, Heriot-row, Edinburgh, to whom tenders by Oct. 2.

MANCHESTER Electricity Committee invite tenders (by Oct. 8) for the supply of five 8,500 k.v.a. three-phase transformers and fans, &c., and also three 6,000 k.v.a. three-phase transformers and fans, &c. Specifications from the secretary (Mr. F. E. Hughes), Town Hall, and further particulars may be obtained from the chief engineer and manager (Mr. S. L. Pearce), Dickinson-street, Manchester.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the AUSTRALIAN COMMONWEALTH Postmaster-General's Department: Instruments and parts (schedule 499) for Queensland (Oct. 6); telegraph and telephone instruments (schedules 546 and 549) (Oct. 20), and telephone instruments (schedule 548) (Nov. 3) for S. Australia. Tender forms from the office of the High Commissioner, 406, Australia House, Strand, London, W.C.2.

MARKET DRAYTON Urban Council have accepted the tender of the local electric supply company for street lighting, at £4. 10s. per annum.

YORK Housing Committee has accepted the tender of the Corporation, electricity department for wiring the dwellings at Tany Hall, at £3,702.

BLACKBURN Guardians have accepted the tender of Messrs. C. T. Briscoe & Sons for the electric lighting of the Infirmary at £1,357 14s. 5d.

On Tuesday NEWPORT (Mon.) Corporation accepted the tender of Messrs. Escher, Wyss & Company for a turbo-alternator. There was considerable opposition, as it was contended that the contract should have been given to a British firm who paid trade union rates of wages.

In reply, it was stated that the Swiss tender was thousands of pounds cheaper than any other, while Mr. F. Quick, a Labour Member, said the British price was due to a ring among British engineering firms.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1918 Specifications.

141,653 Siemens-Schuckertwerke. Energy-regulating arrangement for electric circuits. (13/6/17.)
148,582 Eccles & Jordan. Ionic relays. (21/6/18.)

1919 Specifications.

125,068 Nobs. Wooden stakes, posts, poles and the like for electrical and other purposes (27/3/18.)
147,243 Warburton. System of control for maintaining the relative speeds of a number of electric motors. (20/1/19.)
147,247 Thompson. Manufacture of carbon electrodes. (8/3/19.)

The firing or burning of the electrode is effected in a muffle or the like without the packing materials hitherto employed, the electrode being subjected during the firing or burning to the action of producer gas.

147,249 Austin & Adkins. Electric cells or batteries. (22/9/19.)
147,250 Davey & Green. Electric coin-operating bioscope. (1/4/19.)
147,252 Hesketh. Thermionic valves. (5/4/19.)

The thermionic flow between the filament and the sheath of a thermionic valve is controlled by an electric field transverse to the electric field for maintaining such flow.

147,264 Pearson & Johnson & Phillips. Telephone cables. (9/4/19.)
147,269 McKenzie, Holland & Westinghouse Power Signal Co. & Proud. Electric signalling and indicating apparatus. (14/4/19.)
147,270 Le Chatelier. Electrodes for electric welding. (14/4/19.)
147,293 B.T.-H. Co. (G.E. Co.) Electric incandescent lamp and similar articles, and methods of and apparatus for manufacturing the same. (17/4/19.)

Relates to means for exhausting an electric incandescent lamp bulb or other sealed envelope which consists in joining an exhaust tube within a stem tube adapted to be sealed into the envelope and forming a passage through the joint communicating with the interior of the envelope and the exhaust tube.

147,303 Norton. Electric switches. (22/4/19.)
147,316 Moore, Rivers, Burden & Hawes. Electric fuses. (10/5/19.)
147,320 Lea & Ree. Electromagnetic wave signalling system. (24/5/19.)
147,338 Jacomps. Electro-deposition of metals. (23/12/19.)
148,600 Brown. Magneto-electric generators. (26/3/19.)
148,605 Wood. Electro-mechanical propulsion and control of submersible vessels. (15/4/19.)
148,625 B. T.-H. Co., Whitcher & Taylor. Protective Gear for turbo-alternators. (26/4/19.)
148,632 Round. Transmitters for telephony. (28/4/19.) (Cognate application, 26,374/19.)
148,645 Hyde. Electrodes for use in electric welding. (1/5/19.)
148,651 Tilling-Stevens, Ltd., & Silcock. Electrical resistance controls for vehicles. (5/5/19.)
148,655 Warburton. Controlling-means for controlling a series of electric motors. (12/5/19.)
148,659 Morris & Haviland. Electrical precipitation of particles from gases. (15/5/19.)
148,667 Johnson & Phillips & Porteous. Manufacture of electric cables containing conductors conveying currents in parallel. (23/5/19.)
148,676 Snell. Commutators or current distributors for internal combustion engines. (17/6/19.)
148.679 Crowther. Electrical transformers. (27/6/19.)
148,686 Foster. Device for measuring electrical resistance. (7/7/19.)
148,691 Electrical Improvements, Ltd., & Beard. Electric reactance coils or transformers. (25/7/19.)
148,693 B. T.-H. Co. (G. E. Co.) Electric heating devices, and methods of making the same.) (30/7/19.)
148,695 Godfree. Magneto-electric generators for use in connection with internal-combustion engines. (5/8/19.)
148.700 Preston. Electric lampholders, fitments and the like.
148,703 Jackson, Mellersh. (Submarine Signal Co.) Electro-magnetically-operated vibrators. (25/9/19.)
148,708 Western Electric Co. & Polinkowsky. Machine switching telephone exchange systems. (1/5/18.) (Divided application on 7309/18.)
148,712 Tweedie. Portable electric lamps. (5/11/19.)

1920 Specifications.

148,725 Imray. (Bosch Akt.-Ges.) Terminal connections for electric conductors. (13/2/20.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

March 23, 1920.

8,497 Holland. Electric pocket lamps, &c.
8,503 Barrow & Dayley. Safety globe for miners' electric lamps.
8,518 Barrows. Terminals for cables.
8,526 Schattner. Incandescent lamps.
8,563 B.T.-H. Co. (G. E. Co.). X-ray apparatus.
8,579 Allan & Engelbach. Electric heating apparatus.
8,587 Martinetto. Voltage regulation of transformers. (21/2/19, Italy.)

March 24, 1920.

8,625 Gabriel. Portable electric lamps.
8,657 Western Electric Co. Amplifying systems. (28/3/19, U.S.).
8,662 Dennett. Electric motors.
8,683 Quilter. Thermionic devices.
8,693 B. T.-H. Co. (G. E. Co.). Condenser systems.
8,694 Landis & Gyr A.G. Measuring electric current. (25/3/19, Switzerland.)
8,711 Scovill Mfg. Co. Automatic control mechanism for electric furnaces. (26/6/18, U.S.)
8,715 Park Royal Engineering Works & Joyce. Fuses.
8,719 Stock. Production of metals in electric furnace.
8,829 Terry. Electric heaters.

March 25, 1920.

8,755 Davis, Hudson & Co. & Hudson. Electric switches, ceiling roses, &c.
8,768 Kay & Jennings. Telephones.
8,778 Renaudin & Burlat. Magneto-electric apparatus. (26/3/19, France.)
8,780 Appleton. Electric lighting on motor cycles, &c.
8,793 Holslag. Electric arc welding systems.
8,801 Siemens & Co. Geb. Searchlights. (1/8/17, Germany.)
8,806 Telephone Mfg. Co. & Palmer. Selector switches for telephones.
8,807 B. T.-H. Co. (G. E. Co.). Protective devices for electric circuits and apparatus.
8,823 Fredriksen. Electric fluid-heating apparatus.
8,833 Macrorie & Shearing. Thermionic valve circuits for wireless telegraphy and telephony.

March 26, 1920.

8,837 Norton. Switches.
8,868 Young. Motors and dynamos.
8,878 Western Electric Co. Electric signalling systems. (14/11/14, U.S.)
8,886 Telephone Mfg. Co. & Palmer. Telephones.
8,897 Sykes Interlocking Signal Co. & Tarrant. Controlling transmission of electrical impulses.
8,914 Siemens Schuckertwerke. Alternating-current machines. (29/3/16, U.S.)
8,919 B.T.-H. Co. & Carter. Electric, &c., locomotives.
8,923 Cowper-Coles. Apparatus for manufacture of copper cable tubes by electro-deposition.
8,970 Coffield. Electric washing machines. (9/10/17, U.S.)

March 30, 1920.

9,180 Gough-Turner. Means for obtaining electricity from the atmosphere, &c.
9,221 Kluytmans. Electric heating and cooking apparatus.
9,222 Western Electric Co. Oscillation generators. (1/6/15, U.S.)
9,223 Western Electric Co. Electrical transmission systems. (18/5/14, U.S.)
9,225 Automatic Telephone Mfg. Co. Telephone systems. (28/5/19, U.S.)
9,238 Metropolitan-Vickers Electrical Co. Protective apparatus for multi-phase alternating-current circuits. (4/4/19, U.S.)
9,250 Syndicat Electro-Staal. Manufacture of iron from iron ores.
9,251 Try & Son & Lovelock. Electrolytic deposition of iron, &c.

March 31, 1920.

9,264 Hansen. Morse tapping instruments.
9,272 Jelley. Universal joints for power transmission systems, &c.
9,273 Briscoe & Co. & Akers. Switches to prevent starting of engines.
9,279 Empson. Means for electrically detecting dissolved matter or impurities in water, &c.
9,326 Western Electric Co. Electric transmission systems. (1/2/18, U.S.)
9,337 Maxwell & Shergold. Fuse holders.
9,341 Wilderman. Cells for electrolytic decomposition of alkaline salts.
9,345 Siemens-Schuckertwerke. Varying field strength of electric machines. (26/4/17, Germany.)
9,346 Siemens-Schuckertwerke. Control of field strength of electric machines. (7/6/17, Germany.)
9,352 B.T.-H. Co. (G. E. Co.) Protective devices for electrical circuits and apparatus.
9,373 Sun Electrical Co. & Beaver. Fittings for electric lighting, &c.
9,389 Ford. Electromagnetic induction micrometers.

April 1, 1920.

9,433 Mathieu. Thermionic relays or amplifiers.
9,437 Leitner. Electrolytic rectifiers.
9,438 Raworth. Electric propulsion of trains, &c.
9,445 Electrolytic Zinc Co. Electrolytic treatment of ores containing zinc, &c. (4/4/19, Australia.)
9,446 British L. M. Ericsson Mfg. Co. & Crowe. Electrical indicators.
9,452 Schraeder. Cooling electrical apparatus.
9,453 Schraeder. Means for carrying off heat generated in electrical apparatus.
9,460 Metropolitan-Vickers Electrical Co. & Juhlin. Electric machines.
9,486 Dubilier Condenser Co. Series condensers. (11/4/19, U.S.)
9,487 B.T.-H. Co. Magneto-electric machines.
9,496 De Forest Radio Telephone & Telegraph Co. Self-supporting induction coils. (4/4/19, U.S.)

Companies' Reports, &c.

The directors of the Brough Electric Lighting Company, Ltd., have declared a dividend of 5 per cent. for the past year.

The directors of the British Insulated & Helsby Cables, Ltd., have declared an interim dividend of 9d. per share, less tax.

The directors of Claud Hamilton, Ltd., have declared a final dividend and bonus of 15 per cent. for the past year, carrying forward £14,082.

The regular quarterly dividends of 1 per cent. on the preferred stock and of 1½ per cent. on the common stock of the Mackay Companies have been declared.

An interim dividend of 2½ per cent. has been declared by the Waste Heat & Gas Electrical Generating Stations, Ltd., in respect of the half-year ended July 31.

The directors of the Tyneside Electrical Development Company, Ltd., have declared an interim dividend of 3 per cent. on the preferred ordinary shares for the past half-year.

The directors of the Globe Telegraph & Trust Company, Ltd., have declared a quarterly interim dividend of 3s. per share on the preference and 5s. per share on the ordinary shares, less tax.

The directors of Messrs. Bruce Peebles & Company, Ltd., have declared a dividend at the rate of 7½ per cent. per annum (less tax) on the 7½ per cent. preference shares for the half-year ended June 30.

The Eastern Telegraph Company, Ltd., announce the payment on 15th prox. of dividend at the rate of 3½ per cent. per annum (less tax) on the preference stock for the quarter ending 30th inst., and the second quarterly interim dividend of 2½ per cent. on the ordinary stock (tax free), in respect of profits for the year ending Dec. 31, 1920. The transfer books of the ordinary stock will be closed from Oct. 7 to 14, inclusive.

The report of Royce, Ltd., for the year ended March 31 states that, after paying or providing for all trade expenses, depreciation of buildings, &c., and after charging repairs and replacements to revenue, and making provision for estimated amount payable under the Finance Acts, the profit was £14,764. With £4,731 brought in the total is £19,495, and the directors recommend a dividend of 5 per cent. on the ordinary shares, carrying forward £14,403. Extensions to the works are in course of preparation.

Mr. A. H. P. Stoneham, who presided over the recent annual meeting of the Kalgoorlie Electric Tramways, Ltd., stated that the gross receipts for the past year were £33,354, against £33,960, the profits being £7,040, against £6,101. Following the announcement of new discoveries of gold on the Hampton Plains, near Kalgoorlie, there had been a rush for the new find. There had been a feeling of confidence in the town, and the directors had hoped that the year would result in a substantial increase in profits, but unfortunately a miners' strike caused the mines to be closed for some months. There had also been an outbreak of influenza and they had had trouble with their own employees

New Companies.

ADVANCE ENGINEERING COMPANY, LTD. (169,755).—Private company. Reg. August 20. Capital £10,000 in £1 shares. To carry on the business of mechanical, motor, electrical, consulting and general engineers, &c. First directors are: J. V. Coonan, W. F. Hall (managing), H. R. Hall, D. N. Livingstone and W. E. Shuttleworth. Reg. office: 195, High Street, Hull.

ASSOCIATED ELECTRIC TRADERS, LTD. (170,092).—Private company. Reg. Sept. 7, capital £10,000 in £1 shares (3,000 preference), to carry on the business of wholesale and retail importers, exporters and manufacturers of and dealers in alabaster bowls, electric light fittings, shades, lamps, switches, &c., and to adopt an agreement with J. Leitch. Reg. office: 2, Percy-street, Tottenham Court-road, W. 1.

BREW & REEVES, LTD. (169,998).—Private company. Reg. Sept. 1, capital £250 in 1s. shares, to carry on the business of engineers, electricians, &c. The permanent managing directors are: E. H. Reeves (chairman) and Charlotte Knight. Reg. office: 147-9, Beulah-hill, Upper Norwood, S.E. 19.

BUENOS AIRES TOWN [& DOCKS TRAMWAYS, LTD. (170,069).—Reg. Sept. 4, capital £500,000 in £1 shares, to enter into an agreement with Claude W. H. Lowther, John G. B. Stone, the Beaver Trust (Ltd.), Sir W. Plender and Buenos Aires Port & City Tramways (Ltd.), to acquire and carry into effect contracts or concessions for the construction, maintenance, operation, control of railways, tramways, &c.

CUTTING & MUIR, LTD. (170,164).—Private company. Reg. Sept. 10. capital £5,000 in £1 shares (2,500 10 per cent. cumulative preference). to take over the business of electrical and mechanical engineers carried on by G. B. Cutting and T. Muir at Ipswich, as Cutting & Muir. First directors are T. Muir and G. B. Cutting. Reg. office: 29, St. Matthews-street, Ipswich.

ELECTRIC DISTRIBUTING COMPANY LTD. (169,982).—Private company. Reg. Aug. 31, capital £2,000 in £1 shares, to carry on the business of manufacturers of and dealers in electricity, motive power, &c. Reg. office: 1, Lofthouse-court, 35, King-street, Manchester.

EXCELALL METAL WORKERS, LTD. (170,098).—Private company, Reg. Sept. 7, capital £4,000 in £1 shares, to take over the business of electrical and mechanical appliances manufacturers, stampers, piercers, &c., carried on by Pressparts, Ltd., and to adopt an agreement with W. G. Hill. First directors are E. B. Alldridge, A. C. Lee and G. R. Groves. Reg. office: Excelall Works, Sampson-road North, Birmingham.

D. HULETT & COMPANY, LTD. (169,979.)—Private company. Reg. Aug. 31, capital £5,000 in £1 shares, to carry on the business of manufacturers of and dealers in gas, oil and electric lamps and apparatus, &c. First directors are: W. E. Stapleton (permanent chairman and managing director), T. A. Stapleton and G. V. Symmons. Reg. office: 57-8, Chancery-lane, W.C. 2.

I. S. M., LTD. (169,986).—Private company. Reg. Aug. 31, capital, £3,000 in £1 shares. Manufacturers of and dealers in machine tools, small tools, engineers' requisites, electrical machinery, &c. First directors are: E. Jay (permanent governing director) and M. Vernon-Ward. Solicitors: Raphael Zeffertt & Co., 17, Coleman-street, E.C.

JACOBS & D'RANE, LTD. (170,028).—Private company. Reg. Sept. 2, capital £1,000 in £1 shares, to carry on the business of electrical, mechanical, automobile and general engineers, tool makers, &c. First directors are: H. O. Jacobs, B. J. D'Rane and H. E. Warne (and secretary). Solicitor: W. S. Sharpe, 12, New Court, Carey-street, W.C.

KELVIN-HARDY ELECTRIC COMPANY, LTD. (169,932).—Private company. Reg. Aug. 27, capital £2,000 in £1 shares (one life governor's, carrying half total voting power), to carry on the business of manufacturing electrical engineers, electricians, &c. Life governor: G. A. Edwards. Reg. office: 41, Castle-street, Liverpool.

NORTH-EASTERN WELDING COMPANY, LTD. (11,390).—Private company. Reg. in Edinburgh, Aug. 21st. Capital £10,000 in £1 shares. Fusers of metal (electrically or otherwise) for welding or repairs, metal workers and manufacturers, boiler makers, electrical engineers, &c. First directors are: Stewart H. Fullerton and A. Proctor. Secretary: J. T. Simpson. Reg. office: 146, Union street, Aberdeen.

STAR-PORT, LTD. (169,801).—Private company. Reg. August 21. Capital £100,000 in £1 shares. To acquire certain patents belonging to O'Neil's Recorder Syndicate, Ltd., and relating to the navigation of ships and otherwise, and to carry on the business of mechanical, electrical and general engineers and contractors, manufacturers of signalling apparatus, &c. Reg. office: 16, Philpot-lane, E.C.

UNICASTOR, LTD. (170,036).—Private company. Reg. Sept. 2, capital £6,000 in £1 shares, to carry on business as railway, electrical, mechanical and general engineers, &c. Permanent directors are: S. L. Forbes, W. H. Southorne and T. B. Laring. Reg. office: 110, Cannon-street, E.C. 4.

WHITE'S (LUTON), LTD. (169,933).—Private company. Reg. Aug. 27, capital £2,000 in £1 shares, to take over the businesses of electrical and mechanical engineers, &c., and makers of straw hat and other machines carried on as M. White & Co., at 57, Guildford-street, Luton, and of cabinet makers, &c., carried on as "The Luton Woodworking Co."

H. P. R. WIRELESS, LTD. (169,943).—Reg. Aug. 28. Capital £3,000 in £1 shares, to acquire from H. P. Powell Rees his rights in the business of a manufacturer and vendor of wireless telegraphy and telephony receiving instruments, &c. First directors are: H. P. Powell Rees and W. T. Wallace. Reg. office: Regent House, Kingsway, W.C.

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 4, 1880.)

LARGE ORDER FOR TELEGRAPH WIRE.—Messrs. William Cooke & Company (Ltd.), of Sheffield, have just secured the largest Government order for telegraph wire that has been given out for many years. The order amounts to about £20,000, and the wire is intended for telegraph purposes in India.

THE GRANTS AT THE BRITISH ASSOCIATION.—The following grants were made at the late meeting to further experiments in relation to electrical subjects:—To Prof. G. C. Foster, £100, subject, Electrical Standards; to Dr. O. J. Lodge, £5, subject, High Insulation Key; to Mr. J. M. Thomson, £10, subject, Inductive Capacity of Crystals and Paraffin.

THE ELECTRIC LIGHT IN THEATRES.—"La Nature" contains a letter from M. E. Vignes, insisting upon the advantages of introducing the electric light into the interior of theatres. The writer looks forward to the time when the cheerful illumination to be seen on the *place de l'Opéra* will be extended to the interior of the edifice itself, and when the hygienic and aesthetic advantages of the electric light, together with the immunity it affords from explosions and fire, will be secured not only for the great Temple of Music, but also for the smaller theatres, where a heated and vitiated air is now breathed, and where the attempt at ventilation is often a mortal danger.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—"The Aeroplane Tests and Running Costs"; "Development in Wing Design," by Douglas Shaw; and "Soaring Flight in Guinea."

"Cabinet Maker":—"Modern American Tables"; "How Retail Furnishers Advertise"; and "Seats for Factory and Workshop Operatives: Home Office Recommendation."

"Chemical Age":—"Tungsten," by Julius L. F. Vogel, M.I.E.E., M.I.M.M.; Papers at the Annual Autumn Meeting of the Institute of Metals.

"The Fruit-Grower":—"Autumn Planting"; "Railway Rates and Manures"; and "Market Varieties of Apples (illustrated)."

"The Gas World":—"Station Gas Meters," by F. H. Parsons; "The Gas Regulation Act"; and "Coin Meters in Holland."

"Hardware Trade Journal":—"Independent Gas Lighting and Heating Systems"; "Hints on Retail Organisation"; and "Labour Saving in the Foundry," by Joseph Horner.

"Ways and Means":—"Facts Concerning Coal," by E. C. Brunker; "A Colonial Romance," by John H. Harris; and "Works School: American Experience," by J. George Frederick.

Prices of Metals, Chemicals, &c.

TUESDAY, Sept. 14.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£108 0 0	£1	—
Electro Wirebars...	,,	£118 0 0	£1	—
H.C. wire basis......	per lb.	1s. $4\frac{9}{16}$d.	$\frac{1}{8}$d.	—
Sheet	,,	1s. $5\frac{7}{8}$d.	—	—
Phosphor-bronze Wire—				
Phosphor-bronze wire, basis	,,	1s. $9\frac{9}{16}$d.	$\frac{1}{8}$d.	—
Brass 60/40—				
Rod, basis	,,	0s. $10\frac{3}{4}$d.	$\frac{1}{8}$d.	—
Sheet, basis	,,	1s. $4\frac{3}{4}$d.	$\frac{1}{4}$d.	—
Wire, basis	,,	1s. $4\frac{1}{8}$d.	$\frac{5}{8}$d.	—
Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£37 0 0	—	£1 10 0
Foreign or Colonial	,,	35 5 0	—	£1 0 0
Tin—Ingot	,,	273 0 0	£6 10 0	—
Wire, basis	per lb.	0 3 $6\frac{1}{2}$	1d.	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 6d.

Sodium Chlorate.—Per lb. $5\frac{1}{4}$d.

Rubber.—Para fine, 1s. 8d.; plantation 1st. latex, 1s. $7\frac{3}{4}$d. per lb.

The metal prices are supplied by British Insulated & Helsby Cables.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" *are at* 8, *Bouverie Street, London, E.C.*4. *Telegrams: Benbrotric, Fleet, London. Telephone: City* 9853 (4 *lines*).

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Notes.

Electric Traction on Railways.

We understand that the Departmental Committee of the Ministry of Transport, which has been considering certain questions relating to electric traction, under the chairmanship of Sir Alexander Kennedy, is about to issue its report, in which the whole situation will be closely reviewed, and among the recommendations made will be the important one that electric railway material should be standardised—at least sufficiently to allow interchangeability of rolling stock. This, of course, means a decision on the burning question as to the relative merits of direct-current and alternating-current working, and the information which we have thus gleaned, therefore, does little more than whet our appetite and stimulate our interest in what the report will contain. Considering the composition of the Committee, the fact that they have been able to come to a decision at all on this point is not without its surprising side.

Electricity Supply in Nottingham.

The decision of the Electricity Commissioners on the rival schemes for electricity supply in the Nottingham district, put forward respectively by the Nottingham Corporation and by the Derbyshire and Nottinghamshire Electric Power Company, has now been made public. The Commissioners accept the Corporation's scheme and refuse the scheme of the Company, but give no reason for this course, except that their decision has been taken "having regard to all the circumstances." We should not be surprised to learn that these circumstances mainly centred round finance, though the site chosen by the Corporation at Clifton Colliery has advantages as regards coal supply over that of the Company at Colwich, while certain details in the design of the latter station seem to have been open to criticism. During the evidence given at the inquiry it appeared that the Corporation were more imbued with modern ideas on electricity supply than were the Company, and this difference in attitude may also have been taken into account. We are not sure, however, that to many the most important part of the Commissioners' decision will not be found in the provisos which accompany it. The application is granted subject to the Corporation supplying the Company with such energy as it requires and agreeing to hand the station over to the Joint Electricity Authority, if such a body is formed in the area. In other words, the Corporation is made an electrical trustee for the district, which is as it should be.

The Municipal Tramways Association.

Economic and financial questions connected with the tramway industry received much attention at the Annual Conference of the Municipal Tramways Association held at Cardiff last week, and the way the subjects dealt with both in the Presidential Address and in the various Papers allow a good idea of current expert opinion to be obtained. The finance of tramway undertakings is a subject with many heads on each of which there is a good deal to be said. As Sir John Courtis, Councillor Higham and Mr. Priestly pointed out, the time has now come when fares must be so adjusted that each passenger pays his proper share of the cost of his transport, and that the revenue bears its proper relation to the expenditure. This is a change of front that we are glad to see. Too often in the past have municipal tramway undertakings been looked upon as an advertisement for the not easily apparent virtues of the town, as baits for catching votes, and as a means of aggrandisement of town councillors. But we do not agree with Councillor Higham that the penny fare should go; indeed we think it should be retained for short distances, and the policy of attracting long distance passengers at the expense of the shorter distances can easily be carried too far. The former is a "peak" traffic, while the latter persists all day. Indeed we think that the policy recently adopted by the London County Council of offering reduced fares in the middle of the day has much to recommend it, especially as it seems likely to bring the 'bus fares down in competition. Mr. Priestly's suggestions to charge non-residents at a higher rate is too idealistic to be meant altogether seriously, and the same adjective may be applied to Mr. Murray's proposal for free trams.

Fuel Costs and Co-operation.

But the financial condition of a tramways undertaking depends as much on the way it spends its revenues as on the way in which it collects them. And we are therefore glad to see that the subject was also considered from this point of view. Mr. A. L. C. Fell gave some startling figures of increased cost and decreased quality of fuel, pointed to the need for a chemist in the generating station, and insisted on the co-operation of all branches of the undertaking in wise expenditure, and in insuring that the outgoings are kept as low as possible consonant with efficiency, which after all is wise expenditure epitomised. There is food for thought and, not only for thought but, for action in all this.

Sound v. Unsound Finance.

We have just said that in the past the scale of fares on many municipal tramways was determined by other than economic considerations. The same is true of the sinking and depreciation funds. These have too often been starved, as Mr. Dalrymple points out, in order that the rates might be aided or increases in fares avoided. This was always bad finance, but now that matter is almost Biblical in its clear-cut distinction of right from wrong, and affords a lesson which everyone can easily draw in these days of increased cost of labour and material. It is, however, only fair to add, as Mr. R. L. Horsfield does, that there were undertakings who made proper provision in this respect, and that even in their case increased costs now mean the rapid depletion of accumulated funds, and a consequent reduction in the efficiency of the undertakings.

The Future of Tramways.

It is no doubt true that the majority of these troubles might be overcome by the introduction of an economic fare, by careful management, and by sound finance, but not altogether. What we have said about repairs applies equally well to new construction, and as Mr. R. S. Pilcher points out, it would seem that in future extensions will have to be made by employing 'buses on outlying and unremunerative routes, and by the gradual abandonment or change of operation of certain routes, which, though now remunerative, will not remain so when further expenditure becomes necessary. In this connection we should like to put in a word for the electric 'bus. Its use in connection with the facilities available on all electrically operated tramway undertakings might well form the solution of many of the present problems.

Altruism and Obstinacy.

During the past week the issues in the miners' dispute have been narrowed. Mr. Smillie has abandoned his altruistic ideas, and the discussions have concentrated on the wages' claim. This may be conveniently divided into two parts, the one relating to an immediate advance of wages, and the other to a proposal that further increases should depend upon improved production. The two are really quite separate, except that they are equally distasteful to the miners' leaders. The whole trouble is that these leaders have placed themselves in a position from which they cannot retreat without loss of prestige. That a strike should be permitted on the issue as it now stands is unthinkable on any grounds of reason, and we hope that, black though the outlook is and definite as Mr. Smillie's statements are at the time of writing, it will be averted by the counsels of such wise trade unionists as Mr. J. H. Thomas—and, in justice it may be added, many of the miners' leaders—who clearly realise what a coal strike would mean to the country and to trades unionism.

Electricity Supply and the Crisis.

Supposing, however, that a strike does occur, what will be its effect on the electrical industry? Trade must almost completely stop before many days are past, and in an equally short time most factories will have to close, not by way of reprisal, but simply because they will find it impossible to carry on. Fortunately, the seriousness of the position is to some extent mitigated by the fact that most electricity supply undertakings have several weeks' stock of fuel in hand, and are determined to give a lighting supply as long as their resources last. Among the many replies we have had to the *questionnaire* we sent out on this matter, we have only found one exception to this rule. That this is the right policy to follow we have no doubt, and it will be made easier by the reduction in power demand which must inevitably occur. It is, however, not a cure, but only a mitigation of the evil.

A Policy Enforced.

We have been told that our remarks last week on the attitude taken up by the E.P.E.A. in the recent Penistone dispute (now happily settled) are likely to do a good deal of harm to a body for whose aims we have the greatest sympathy. This is regrettable, but we are not ourselves so certain that any such result will occur. But to make ourselves quite clear we may add that we endorse the Association's desire for constitutional action wherever possible and are pleased to record the satisfactory outcome of its intervention in the recent dispute, an intervention which was equally welcomed by both sides. And if, in addition, we point out the difficulty of the policy which the Association has laid down for themselves in these matters it is with the desire to help rather than to criticise. In fairness it should be added that this aversion to any but constitutional action is sometimes taken advantage of by those who should know better. As is well-known the Joint Boards for the Electricity Supply Industry have recently made awards giving increased salaries to members of the E.P.E.A. Nevertheless some undertakings have repudiated these awards, although they were of course represented, and were therefore bound by the ordinary rules of arbitration to accept the decisions so given. There can be no excuse for this sort of thing. Morally it is wrong, while in every-day life it helps to contribute to that ever growing fire of irritation which is threatening to consume industry, employers and employees alike. Its effects on the policy of the E.P.E.A. is obvious. They feel they must in future strike to enforce their claims. To do so successfully they must be assured that other unions will not break their strike. But before they can receive this assurance they are bound to give a similar one to other unions. And once more there is a whirlwind of trouble threatening to engulf both guilty and innocent.

The Worcester Trouble.

The latest example of the attitude of which we complain is to be found at Worcester where the Electricity Committee has refused to put into operation the increased bonuses granted last March by the National Joint Board. The result is naturally dissatisfaction amongst the staff culminating in wholesale resignations. To fill the vacancies the Electricity Committee is advertising for candidates to state the salaries they require, an action which has resulted in the E.P.E.A. placing Worcester upon its black list. It is hard to conceive the mental processes which direct such a policy as that being followed by the Committee, but it is obvious that while it will do the Corporation no good it will help to drive moderate men into the arms of the extremists.

Street Lighting at Hove.

The decision reached by the Lighting Committee of the Hove Corporation, as a result of the competition between electricity and gas which they recently inaugurated for street lighting purposes, is one that the electrical industry will naturally approve, especially as substantial grounds, notably the advantage of electricity as regards costs of maintenance and installation, are put forward in support. At the same time the inquiry had some curious features. In the early part of 1919 the electricity department was granted permission to light a section of the streets experimentally with electricity, and a similar concession was granted to the gas company. The method of testing was to be identical in each case, and the illumination was to be ascertained by " photometer tests and close observation." In each case the candle-power of the lamps was stated to be 400. It appears, however, that the Committee afterwards agreed that the photometer tests were " quite useless," and discarded the results on the advice of the gas company's expert ! The report goes on to say that the Committee took for comparison the following points : Uniformity and sufficiency of illumination, obstruction by posts, height of source of illumination, general convenience, and cost of installation and maintenance. The decision in favour of electricity was based partly on the preference given to the method of central suspension suggested for the electric lamps, and partly on the lower installation and maintenance costs (£214. 10s., as compared with £502. 14s. per annum). We do not quarrel with the decision, but we must own that the ignoring of all photometric tests—which precludes any possibility of judging the comparative illumination on a scientific basis—seems singular. The Committee, while quoting the statement of the gas company's expert that there was no appreciable difference in the illumination, held the opinion that electric lighting gives a more uniform light. We presume that, as photometric tests were discarded, this view is based on " close observation." It would surely have been more satisfactory to have based their opinion on accurate tests, such as could doubtless have been obtained by taking independent expert advice.

The Creation and Disposal of Output.

There is ample evidence that despite industrial unrest and all its effects on production, there will be during this and future years an increasing output of domestic heating and cooking appliances. New firms have commenced to manufacture this class of apparatus, and the old-established firms released from war work have again commenced operations. But, as we discuss below, supply authorities are in many cases unable to obtain the generating plant to meet additional demands for supply, and it therefore seems as though the electrical manufacturer is looking for an increased demand which the supply authority will not be able to supply. It is obvious that the only way to popularise cooking and heating is to create a wide demand for it, and so to cheapen production. But it has to be borne in mind that the propaganda necessary to create a demand which implies a change of habit or mode of living takes time to be effective, and it is therefore essential that there should be no stifling of demand because of the present temporary conditions. In this connection it is well to point out that the majority of smaller appliances such as kettles, irons, &c., do not create peak difficulties, and it is extremely doubtful whether radiators and cookers do either. Again, despite the fact that lighting rates have risen considerably, it is doubtful even now whether in many instances they are really remunerative. For this reason the best way to improve the domestic lighting revenue is to promote the use of heating and cooking appliances, and thus improve the demand of each individual consumer. Doubtless a fair proportion of the increased output of apparatus will be exported, but much of it will be left for the home market, and it is to be hoped that now apparatus is available, supply authorities will not cramp the demand by pursuing a " refusal of supply " policy.

The Connection of Apparatus.

Some supply authorities have a regulation laying down that no apparatus can be connected without permission. This is, of course, necessary, both for the protection of the supply authority and the consumer. But it gives rise to one of those unfortunate positions where a rule is necessary, but where its undue enforcement tends to retard progress. If every consumer who purchased an iron, kettle, toaster, or even standard lamp complied with this, filled up a new application form and an inspector called the supply engineer would soon have more work than he could do, consumers would be discouraged, and the sale of small appliances would be retarded. As a result the rule is often broken, and its breakage is winked at by the supply authority. In this way the protection of both parties disappears, and the way is open for unscrupulous people to push the sale of unsatisfactory apparatus direct to the public.

The Need of Good Design.

It should therefore be borne in mind by every manufacturer that each piece of apparatus of small consumption which is sold for use direct off a lampholder, should be well made, electrically and mechanically, the terminals should be adequately housed and protected from accidental contact. The sale of badly designed apparatus which fails to perform its allotted task, or which permits the operator to get an electric shock, or which consumes too much current for safe usage off a lampholder, is in reality an obstacle to development. At a recent exhibition we examined a washing machine which the zealous operator assured us could be used off a lampholder by anyone. On looking into details we found that it was easily possible for water to leak and come in contact with the live parts of the motor. If this occurred when the operator's wet hands were in contact with the tub, probably in a place with a damp floor, it is quite likely that with a 250 volt circuit the result would be a fatal shock, as apparently no provision was made for earthing the device. On inquiring further we were unable to ascertain that any particular desire existed to sell this machine through supply authorities, so that unless a contractor intervened in the sale, it would be most improbable that any provision for earthing would be made when installing the apparatus. Therefore while efforts to promote trade by manufacturers direct with the public are advantageous due regard must always be given to the reliability and suitability of the apparatus they are offering.

Electricity and Housing Schemes.

So far there has not been much progress made with the " All-Electric " home in connection with housing schemes. In several instances even electric lighting has been omitted, a fact to be regretted, because there is no doubt that where building costs are a serious matter and ceilings are low, electricity is undoubtedly pre-eminent as an illuminant. In some cases, of course, remoteness of electricity supply accounts for gas lighting having been used. Where electricity is used for lighting, provision has not been made for heating and cooking. This may be largely due to inadequate figures being available for placing before authorities in charge of housing schemes. Glasgow, Newcastle and Liverpool are notable examples where matters have progressed further than lighting only. It is to be hoped that some one authority at least will experiment, say, with a dozen all-electric houses, or alternatively that a group of manufacturers will, in conjunction with a housing scheme, agree to supply and fit, say, twenty-four houses with lighting, cooking and heating appliances. After a period of a year or so figures would then be available regarding running and repair costs. Valuable information could be obtained regarding load factor, demand, &c., and the industry would be able to quote definite results when arguing their case. Building operations and also housing schemes are likely to continue for some considerable period, and the fact that success has not been obtained on the first stage does not imply that better results will not be obtained later. If a trial area was chosen where company supply existed, the industry could bear the cost of the whole scheme, the supply company being paid for the current used, and the manufacturers supplying and maintaining the apparatus. The cost would not be a large one for the industry to stand, and the information obtained would be extremely valuable in its bearing on future progress and development. Looking at it from the broad point of view this scheme could be operated quite well by the B.E.M.A. or the E.D.A. or both in conjunction.

Super-Organisation and Super-Power.

"They order these things better in France" is probably no truer now than it was when Sterne first wrote it; and we are certain that, in spite of what we are asked to believe to the contrary, it is not true about the United States. We are confirmed in this supposition by the publication of the organisation of the staff which has been recently appointed under the auspices of the United States Geological Survey to go into the question of the power resources between Boston and Washington under the chairmanship of Mr. W. S. Murray. The organisation consists of an advisory board on which is represented the various railways, certain electrical and related associations and (wonderful to chronicle) technical journals. The staff includes some 26 persons and the work will be divided into departments, one dealing with railways, another with power and transmission, and a third with industrial matters. The whole question is to be given the widest publicity in the technical press. It seems rather a large noise to make about quite an ordinary piece of work, but the advantages gained by beating the big drum are never lost sight of in the United States.

A Question of Letters.

One of the latest, if not the last, infirmities of noble minds is the prevalent desire for letters which can be placed after their names, a desire, be it noted, from which engineers are no freer than other people. The subject is, perhaps, one which is more suitable for philosophic than for technical discussion, and it is only mentioned here because the action which has recently taken place in Canada connects it with a more important subject in a curious way. The legislature of Alberta has sanctioned all engineers, resident in the province for five years and holding membership of a professional association, being registered and placing the magical letters "R.P.E." for "registered professional engineer" after their names. We are second to none in wishing to see the status of the engineering profession raised and the engineer taking a greater part in the world's affairs. But we are sure that such a consummation will not be brought about by such means. The great dangers in these matters are neglecting to keep the true end in view and a tendency to allow ourselves to be drawn off into byways by such as, for instance, the pursuit of letters.

Co-ordination the Key-note.

The course which our future plans and actions must take, in order that they may be crowned with success, is ascertainable to some extent from past history. And it is equally true that more useful information as to this future action is obtainable from our failures and false starts than from our successes. If, then, we draw a line at any point, look around, consider what we have done and how we have done it, and what remains to do and how best that may be achieved, we are performing a most useful act. Such an act we aim to perform in this issue of The Electrician. The lessons to be learnt may not be on the surface, but the facts are. And we think we have placed ourselves and our readers in a position to draw useful deductions from them.

The Consumer's Point of View.

We must start with the proviso that we have dealt with all questions from the point of view of their effect on the consumer. Particular manufacturing, contracting and, to a lesser extent, supply problems we are not concerned with, as we wish to present the view of the stage as seen by the public and are not for the moment influenced by what may be occurring behind the scenes, important though that undoubtedly is.

The Future not in Doubt.

There is no doubt about the present or the future of electricity as applied to power purposes, whether we consider the 20,000 h.p. rolling mill or the sewing machine. Electric power is to be found in every modern factory; and its supply is the main concern and source of revenue of the majority of electricity supply undertakings. But the problems which have to be dealt with under this heading have become more commercial than technical; or, in other words, the business has been built up and with judicious management will develop by itself. The same may be said of electric lighting, for which there is an ever-increasing demand. Nevertheless from being the principal way in which electricity was consumed it is now taking a secondary place, and with the development of the domestic load will be still further displaced.

It is true we might have written this much seven years ago at the time when we published our last special development number, for the changes which have taken place since that time are more in quantity than in quality, and the development of electric power and lighting is in the future likely to proceed along the same well-defined lines.

The Electrical Industry and the Domestic Load.

The same lack of change is, we fear, equally to be found in the attitude with which the domestic load is regarded by the electrical industry in general. There is the same air of hesitancy, the same desire that some one else should make the first start, the same tendency to academical discussion of engineering and commercial technicalities, instead of a getting on with the joint businesses of educating the public and selling the apparatus manufactured. Curiously enough all this is combined with a firm belief in the future of domestic electricity and a lack of appreciation of the fact that no development can occur without hard work. But while in 1913 this attitude was a real mirror of the condition of things, in 1920 it is almost camouflage. For there is now what there was not before, a general realisation that the domestic load is the load of the future. With this change has appeared an anxiety on the part of the public to know more of what electricity can do to solve their household problems. These, together, offer the electrical industry a chance which it would be foolish not to seize with both hands.

How is this chance to be seized? The articles which we publish in this issue supply the answer. By the co-ordination and the co-working of all branches of the industry to the one end of pushing the development of domestic electricity by every means in our power. This is the lesson the past provides as a signpost for future progress.

The Need for Domestic Engineers.

The end we have in view is not going to be realised without some trouble; it would be hardly worth attaining if it were. Mr. Llewelyn Atkinson indicates a number of very real difficulties which will first have to be overcome owing to the presence of domestic conservatism, and it would seem that one of the early steps that will have to be made is towards the opening of something like a school of domestic engineering where the feminine of the "young idea" may be taught how to use labour-saving apparatus in the best way. There already exists both at Kensington and elsewhere schools of domestic science; and science and engineering have always been closely connected, so this step should not be difficult.

Propaganda.

But hand in hand with any such scheme, and even preceding it, must go a campaign of propaganda, inaugurated by some central body and supported by the whole electrical industry, to educate the public as a whole in the domestic electric idea. With this education must go the mass production of the necessary apparatus and equipment, and the organisation of a really great selling campaign.

It will be urged that such centralisation would adversely affect the activities of individual firms and that the smaller the firm the more harmful the effect of such a campaign would be. But this need not be the case. We propose a campaign, it is true, whose watchword may be "Make Electricity your Domestic Servant," but that need not prevent any manufacturer asserting that "Jones' Hotplates are the Best."

Fortunately we have machinery which is already revolving slowly for carrying out this most necessary work. The British Electrical Development Association is that machinery, but the pressure necessary for it to operate on full load is not yet available. This should be altered without delay. Sectional ideas must give place to the building up of that general goodwill whose importance Mr. T. C. Elder rightly emphasises. Manufacturers must design for safety and use and manufacture in bulk. Contractors must persuade the public of the benefits derivable from the use of electrical apparatus. Station engineers must assist development by supplying cheap energy at simple tariff rates. Then we may expect to obtain as domestic consumers of electricity that 90 per cent. of the population who so far do not realise its utility. This does not say that we must relinquish any of our present activities, for as Mr. G. K. Chesterton says, "Real development is not leaving things behind, as on a road, but drawing life from them as from a root."

The Central Station and the Domestic Load.

We have stated above, as emphatically as we are able, that co-ordination of effort by all branches of the electrical industry is the first preliminary to the proper development of the domestic electric idea. We have added that this does not mean that each branch of the industry has no longer its own duties to perform; indeed, as a result of co-ordination, the performance by each branch of its particular duties will become more important. Though we do not wish to make invidious distinctions, where all have duties of such importance, it may be truly said that in many ways the central station engineer is the one by whom this development of domestic electricity may be most profoundly influenced owing to the close touch which he necessarily keeps with the public. It is indeed a position of responsibility, for he can do much both to encourage or discourage consumers and to bring to the general counsels useful information as to the lines the campaign should take.

Enthusiasm Replaces Apathy.

This being so, we are glad to see that even in the last six years the attitude of the average station engineer to the domestic electric idea has changed from apathy to distrust and then to enthusiasm. This enthusiasm is all the more striking as it must be admitted there have been many good reasons why the station engineer should be cautious. There have been certain real obstacles to progress. The conditions pertaining during the past six years have prevented the proper extension of the generating plant and at the same time have caused an increase in power consumers at more than the normal rate. The result is, in many cases, a reluctance to take on fresh responsibilities until matters settle down, and in others the absolute impossibility of connecting fresh consumers.

Networks and Tariffs.

But were sufficient generating plant available there would still in many areas be complications owing to the effect the domestic load may have on the network. In some cases, notably at Bradford, where the mains have been generously designed, little difficulty is anticipated from this cause. In others, such as Stoke-on-Trent, there must be extensions before this load can be safely dealt with. On the other hand, Lieut.-Col. Vignoles thinks that this question has been exaggerated, and that owing to the high diversity of the domestic load the present mains will be able to deal with the demands for some time to come.. It is obviously a question which must be settled quickly by each engineer himself.

The question of tariffs is also one which is not without its difficulties. It is a matter to which Major Richardson has given a good deal of attention and we are glad to see that he pleads for simplification. This, however, is a subject upon which everyone has his own ideas, and a working compromise, or better, a real change, will not be arrived at without difficulty. It is a point on which nationalisation might really be useful.

Contractors and Showrooms.

It is not so long ago since a certain number of station engineers were inclined to be hostile to the contractors established in their districts. As a first step towards co-ordination we are glad to see that this attitude has changed and that practically all station engineers now realise that contractors can be turned without any great difficulty into the best canvassers for the undertaking. In this connection the attitude, or rather attitudes, taken up with regard to the establishment of a showroom is intersting. There would seem to be almost as many opinions against as for. But this statement must be modified by another that many showrooms were closed down during the war owing to the reasons outlined above; and that for the same reasons their need has not been felt had matters been otherwise. We think, however, that this is only a temporary state of things, and we agree with Mr. Hardie when he insists that a showroom is not only desirable but absolutely necessary. There is no reason to elaborate the reason for this, for it follows naturally from the scheme of educating the public which we have suggested above.

For it must be realised in fact that the domestic problem is the hardest the station engineer has yet had to face. Power and lighting connections have come almost of themselves. That will not be the case with the domestic load. To develop it will require courage, enterprise and good hard push on the part of the station engineer.

Competition for Each and Co-operation for all.

By J. W. BEAUCHAMP.

In all industries a clear outlook over a few years ahead is most urgently needed and at present particularly difficult to attain; uncertainties in regard to labour and taxation and the conflicting claims of home and foreign demand are common to every business. In the case of the electrical industry these conditions are further complicated by the close natural relation between the activities of those who produce and apply electrical machinery and apparatus, the development of electricity supply and the policy of the numerous and mixed bodies which control it.

Fortunately the services which electricity is able to render are so great and valuable that to a large degree the demand for it rises superior to the manifold obstructions and difficulties offered to the user by timorous finance and lack of vision on the part of many who produce apparatus or control the separate monopolies in the supply of energy—in this country so great in number and so bewilderingly diverse in technique and policy.

Market and Effort.

In the past the makers of machinery and appliances do not appear to have realised at all clearly how their market and welfare depended upon the efforts of those responsible for the electrical welfare of the different areas; excluding, for the moment, private generating plants and considering the whole equipment of the public supplies and of the consumers premises, it becomes obvious that something like one half of the users' expenditure on electrical energy is represented by the cost of suppliers' machinery, cables and their upkeep—the other moiety covering fuel and operation expenses. Similarly, the consumer's expenditure on current using devices of all kinds does over their normal period of life exceed the other half of this bill for energy. In short then the ultimate user's expenditure upon the full service of electricity is divided into two parts—payment for manufactured appliances and machines and payment for fuel and operating labour, the former being about twice the value of the latter.

As the use of electric power increases and its cost is reduced these numerical relationships are likely to be still further accentuated, and one of the greatest branches of engineering will become more and more dependent for its prosperity upon the policy adopted by those who control the public supplies of electricity, a reflection which should lead the manufacturer and contractor to a much closer interest in supply work, more sympathy with its peculiar difficulties and a determination not to be left behind in any effort to secure that *abundant and cheap supply of electricity* which has been foreseen and promised but can only be brought about rapidly by a very considerable amount of foresight and financial courage.

Four Great Public Services.

There are four great public services which can only be carried out through permanent and costly works in roads and buildings. The removal of sewage and the supply of water, absolute necessities for which funds can always be obtained and in the provision of which there is no element of competition. The supply of gas and electricity. The former has been long established and has some advantages in the relatively cheaper and simpler forms of apparatus employed for its final use; the latter possesses almost uncanny powers of transmutation into light and heat and mechanical work, being as easily adaptable to the lightest and most trifling purpose as to the heaviest industrial task. These features, combined with easy application to transport and an increasing number of electro-chemical processes, put the electrical method of energy distribution in a class alone, and in the true sense remove it from direct competition of any kind, for it can only be pitted against substitutes which perform some of its offices by quite different means; electricity has the further peculiarity that it can be produced from any form of fuel or mechanical power and apparently is still capable of great reduction in cost, both on the best results obtained to-day and still more so upon the average; but as against this we have to face and deal with the fact that detail distribution is costly and consumer's appliances relatively expensive.

The Solution of Wider Use.

Modification of the many rules and restrictions still in force may help, but the real solution lies in wider use, increasing the units delivered per mile or ton of copper; and with regard to apparatus, much larger output and more general employment of those methods of manufacture, such as stamping and welding, which, calling for heavy initial expense on tools, yet offer the prospect of producing appliances which will take their place amongst the common range of tools and utensils and go their way when superseded from time to time by better types.

In such production there should be room for arrangement between manufacturers to prevent overlapping both in evolving new designs and in producing apparatus; not perhaps a simple matter but worth much attention before abandonment. Its solution would do a great deal to strengthen the position of the smaller firms as against large combinations and against imported appliances. It may be argued that such procedure will give standardisation at the cost of progress, but in many lines of work design is so far advanced that future changes, although probably considerable, may yet be expected to take place only at longer intervals than in the past.

The production of a satisfactory and inexpensive appliance of moderate life should for many purposes be the object aimed at in the hope of securing greatly increased outputs, and to some extent equating the durability of the apparatus to the longer steps of progress in design.

Two Main Considerations.

These two main considerations, the relative cost to the power user of manufactured articles as against the other items making up the complete service of electricity, and the limits imposed upon the manufacturer by any restriction placed on the demand for electricity, are sufficient to indicate that much closer working should take place between the leading sections of the industry.

The supplier has the right to call upon the manufacturer for support in the larger questions of policy and legislation. Joint efforts made to remove difficulties, assist in finance and in providing for some of the development work in connection with hiring of apparatus and making show-room displays, which appears to be so difficult in certain areas, would certainly prove to be a sound investment—such work carried out by the manufacturing interests would be more far-reaching in results than mere assisted advertising, which in too many cases only stimulates demand to be disappointed by local supply disabilities before it can mature into business.

Of recent years many of these difficulties, patent to those in the supply industry, have been more or less concealed from the other sections by the great demand for apparatus and wiring of all kinds; to-day the position is further complicated by a shortage of generating plant and of mains capacity which is almost national. Hence in most places demand is being checked by natural causes, and only when conditions become more normal—that is to say, when supply capacity again gets well in front of load—will become apparent where there is room for more energetic methods. In the interval, much good must arise from discussion of mutual difficulties between all partners in the business, and plans should be matured for an intensive cultivation of fields of work which are new or have been neglected of late, the more obvious being electric street lighting, which should now go ahead again with the help of modern lamps and of new applications of optical research carried out during the war.

Scientific Shop Lighting.

Now that lighting liberty is restored shop lighting calls for guidance to avoid the errors of the past, the more objectionable as the brilliancy of lighting units increase, and to produce schemes which shall conform with the character of the districts in which they are used and have some regard for the needs of traffic and the comfort of the public.

The principles and practice of street and shop lighting should be linked together to a certain extent if the best results are to be obtained.

Use of Electric Furnaces.

Industrially we can look forward to great development of the less well-known uses of electricity—the use of furnaces of small power for special operations, the heat treatment and melting of metals on a small scale and an immense increase in the use of arc and contact heating to replace bolted and rivetted work by welding, and particularly in conjunction with stamping and pressing processes, to open out many new methods of production requiring less reliance upon the foundry.

Other Industrial Uses.

One is rather apt to regard the industrial use of electricity as being confined to the provision of mechanical power, for which purposes in most places it needs little advertisement, new business being self-generated out of the satisfaction of the user; but quite a large and desirable further load awaits those who take advantage of the continuous quest for time-savers and quality improvers in industry.

There is room for a particular class of production engineer who will study the use of electricity in relation to the design of manufactured articles, one who can adapt his tools and methods to the possibilities offered by a form of energy which will not merely drive machinery but provide heat through the widest range of temperature and under complete control, offer for use the static force of the magnet, and in addition afford a means of measurement which is unobtainable with any other medium.

The Domestic Field.

In the domestic field much has already been accomplished. The " all electric house " is in being, the " partly electrics " are numerous and the users of lighting only become fewer. It is in this field, however, that the greatest progress is possible; given suitable methods of charging and liberal distribution facilities the homes of this country are capable of absorbing an immense quantity of appliances for labour saving and for heating.

The business calls for special treatment; errors are more serious and failures forgotten less easily than in the factory. The need of the moment is to set up a school of domestic engineering in which men and women can be trained in electrical methods and taught to regard the standpoint of purchaser and user; sympathetic, practical and patient must be the attitude of these exponents of domestic electrification, and in matters of economy, cookery and household work they must meet the potential users of the electric method on common ground; a not unpromising career for those who bring enthusiasm to it and one which should be open to a fairly wide range of aspirant.

In training people for this work, particularly for actual demonstration and instruction in the use of cookery and labour-saving appliances, there is much to be said in favour of selecting a social class similar to or not too much above those to whom the instruction has to be given, and upon whose friendly co-operation the success of the appliances may to a large degree depend.

The cost of labour-savers is still regarded very carefully in spite of the shortage and expense of domestic help; every housewife buyer of domestic appliances is more or less an expert in their use, a conservative by nature, and imbued with a profound distrust of anybody attempting to sell anything.

To bring about a revolution in home methods and persuade the middle-class housekeeper that it is worth while to spend the price of a fur coat on novel and little-known kitchen equipment is no light task—it will require enterprise and financial courage, the training of men and women helpers and persistent study as a subject by itself, but the return to the whole of the electrical industry will ultimately be large; the work may also bring in its train some of those great little things which matter in human life—bluer skies and happier lives.

The Need for United Action.

By Major H. RICHARDSON, O.B.E., M.C.
(President, Incorporated Municipal Electrical Association.)

In the development of that branch of the electricity business which is generally known as " heating, cooking and domestic applications," the time has now arrived for united action to be taken by the manufacturers, the electricity supply authorities and the local contractors. Up to the present time the experimental and trial stages have brought forth many ingenious products, several of which are practicable, and have already created a growing demand for themselves in spite of adverse circumstances. This preliminary state is now almost past, and British goods of a satisfactory type will soon be ready to take full advantage of a natural and healthy demand, bringing mutual benefit to the public, the manufacturing industry and the supply systems, provided that co-operation, broad-minded team work and efficient propaganda prepares the new field for that demand.

Lack of Co-ordination.

Hitherto, much valuable work of this nature has been done independently for this branch of work by different manufacturers, individuals and associations (particularly the Incorporated Municipal Electrical Association, among its many duties), but, as is natural in the beginning of things, there was not that co-ordination of the different interests which is necessary to ensure the best results in the shortest time. The I.M.E.A., realising this desirability, became a founder of the British Electrical Development Association, which, under Mr. Beauchamp's able guidance, has made such rapid strides that very soon it will be in perfect trim for its important work. In the meantime, the closest co-operation is maintained between the two bodies, and, in my opinion, the most efficient course to be followed is for all Associations and individuals interested in any branch of the electrical industry to assist the British Electrical Development Association in every possible way, including the giving of the necessary financial support. This being done, then the B.E.D.A. should be looked to for the efficient direction of a combined policy in all such work as the impending intensified development of the " Domestic Applications " branch of business.

The I.M.E.A. is leaving nothing undone which can help this work, though there has been such an expansion of duties for this Association to attend to that it is difficult to overtake every subject with that speed which one would like. Much has been done by the formation of committees to ensure thoroughness and promptness in dealing with the increased work.

Standardised Tariffs.

There is another important factor in connection with this development work which must be mentioned because of its vital effect on the subject under consideration. I refer to the desirability of standardised and suitable tariffs of charges for electricity. This is a matter primarily for the supply managers and engineers, but it must also interest the manufacturer.

I fail to see how any great demand can ensue from the public for even the best of domestic appliances unless the tariff for the electricity to be used is encouraging to the consumer, not only by being cheap, but by being couched in extremely simple everyday business language. To meet this requirement, scientific and individual accuracy must be sacrificed to sufficiently correct expediency which will obtain general and mutual satisfaction. The present multiplicity of complicated charges, varying in each town or district, is unnecessary, bewildering, and is a deterrent to the popular use of electricity.

I believe the Commissioners are already interested in the question of charges, and I hope that, in the end, the "flat-rate-per-unit" system and its evils will be abolished. In its place it should be possible to have, with the approval of the Commissioners, the adoption of a universal principle of charging for electricity, to be used by all supply authorities, though, of course, the actual prices charged under such principle would vary slightly in different districts according to the conditions. The subject tempts constructive suggestions, but this is scarcely the place for going into details, though I hope early representations will be made to the Commissioners.

The Work of "The Electrician."

The excellent example in initiative and propaganda expressed in this special issue of The Electrician is well-timed and appropriate, and I hope the work will go on to a triumphant success in this development, and to the increased prosperity of British manufacturers, especially as the relation between employers and employed are recovering that balance and common sense which characterises our race, and has made the Empire the greatest and most tolerant the world has seen, and this country—in spite of some internal criticism—more comfortable for the working man than any other country, and with much greater freedom.

Some Obstacles to the Domestic Use of Electricity and How They Must Be Avoided.

By **LLEWELYN B. ATKINSON, M.I.E.E., A.M.Inst.C.E.**

The development of a domestic electric load at the present time should have the fullest consideration, because it is a source of revenue which is as yet practically untapped. To tap it, however, there are certain difficulties which will first have to be overcome before a systematic campaign for the boosting of this side of the business can be profitably entered upon.

The matter can be looked at from several points of view; but one thing is obvious—that with the present construction of apparatus and the present design of average user the life of the station engineer would be a burden to him if the domestic load increased to any great extent.

Some experiences of my own may be given. At one time I occupied a house where we employed three servants, and careful observation and time keeping throughout a whole day showed that only three-quarters of one servant's time was being usefully employed; and it may safely be said that 75 per cent. of domestic work done at the present time in an ordinary house is unnecessary, and is due partly to a wrong design of the house and of the household arrangements themselves, and partly to a lack of method on the part of those carrying out the work, a state of affairs that must not be perpetuated in connection with electrical apparatus.

Trouble and Labour Saving Devices.

When later on I built and equipped a house for myself, I planned it with the assistance of my wife, so as to avoid most of the unnecessary labour, and I equipped it with many devices and arrangements for saving labour in domestic work.

Our experience shows that the increased employment of labour-saving devices of any kind on any scale in the household is going to give a great deal of trouble to those who will have to use them and a good deal of distress to the male members of the household, who will have to keep them in repair. It must be admitted that the ordinary woman has had no training in how to look after machinery, and is quite incapable of performing such simple operations as turning a screw in the right direction. This is the fault of men who have planned the education of women. She has not been taught, and does not realise that machinery must be kept clean and lubricated if it is to work properly, or else, perhaps, she goes to the other extreme, and washes down electrical apparatus with a hose, and over lubricates her sewing machine until it swims in oil. The result of my own installation is that I have spent many week-ends cleaning and repairing appliances; but generally all that required doing was to remove superfluous dirt. Where domestic servants are generally employed, as in this country, the problem is complicated by their presence, for they do not care to use machinery, as they thereby save time, and they do not see the point of saving anything which is not theirs.

For this reason comparisons with what has been done in the United States are not much good, as there the housewife is much more left to herself, though, of course, this condition is rapidly being approached in this country.

The Foolproof Kitchen.

At the present moment the household service problem is in a transition stage. Houses have been planned and equipment provided on the assumption that in middle and upper class families there will be an abundant supply of rather unintelligent female manual labour available. The processes are, therefore, such as to be entirely obvious, to require no knowledge of something inside and unseen, while the apparatus is of a kind that its strength is greater than required to meet the stresses a female can exert. We are trying to substitute apparatus of a finer type, capable of finer results for this; but to my mind a finer intelligence must go with it. James Swinburne, I believe, invented the term "foolproof" (what a fortune in royalties if he had patented it!). What we want is a foolproof kitchen—that is, one into which a fool cannot penetrate.

If once the transition stage is over, and all families have to do their own domestic work, then among educated people—that is, people of all classes who have had some scientific and mechanical education (others are not educated)—it will be possible to use appliances and methods, clean, taking little time, and causing little work, and giving the leisure that women demand.

The problem wants approaching as a whole. Are the methods we use right, or are we going to try and carry out by new means methods which were only right with the old means? The greatest drudgery to-day in a house is the washing up of table utensils. Think what is involved. A breakfast for six people requires, according to middle-class ideas, for cooking and service well into 100 pieces to be washed, dried and put away.

The New Domesticity.

There is a tremendous demand at the present time, owing to the ordinary conditions of living, for a table utensil washer. Present types involve the employment of very hot water and some means of swirling this water against the utensil, the idea being that in this way they are cleaned, and that owing to the heat of the water they dry by evaporation. This may be true in parts of the country where the water is soft, but in practice a plate will not dry clean in London, where there is 27 grains of lime to the gallon in the water. It is becoming the practice to do the whole of the dishwashing of a household once in 24 hours or twice a week to save unnecessary labour, but it is stated to destroy the glaze if they are left in a weak soda solution, as is desirable. But if this is the case, then let us alter the glaze. This is an example of beginning at the base of the problem. For centuries we have had to clean knives on boards or in rotary machines; now that has all gone, and we have rustless and washable steel knives. It may be that all articles should be of an electronegative metal, to be cleaned by being subjected, as a cathode, to a heavy current in a solution, so that the hydrogen evolved will blow off all the dirt. But, meantime, all we can do is to offer some types of apparatus to meet present methods. I believe that for this purpose a conference of engineers who have studied this question with women who understand the difficulties would be a good step with the view to settle what apparatus could be put forward with con fidence to meet real requirements, and to counter the failures of the past.

The Work of the B.E.D.A.

The Electrical Development Association and the British Electrical and Allied Manufacturers' Association are now co-operating in the collection of data of breakdowns of existing types, and are publishing these to the manufacturers concerned for their information—of course, without the mention of names. It is found that a large number of breakdowns are not due to mere accident, but to some actual fault in the design, and the designs must, therefore, be examined with a view to the removal of these obstacles to reliable operation. To do this requires that the engineer should be in close touch with what is happening in the kitchen, approaching the various problems which are raised with an open mind and doing his best to find a solution. I have said above that the domestic servant cares little for engineering, and perhaps it is equally true that the engineer cares as little for kitchen work; but this must be changed, and the bringing together of these two opponents is only another way in which co-ordination can be beneficial.

The Preliminary to a Selling Campaign.

A further difficulty to be overcome before the station engineer or manager will be interested is the actual provision of apparatus. There has been a real difficulty in getting the equipment. It is obviously no good starting a selling campaign when there is nothing to sell. Take the domestic clothes washing machine; there is an enormous demand for them at the present time, but they simply cannot be got. It is therefore obvious that the supply of goods must precede the demand, and it is there where the necessity for co-ordination which The Electrician has rightly made the keynote of this special issue comes in. The stuff must be there to sell before any attempts are made to sell it; and it therefore follows that the manufacturers must turn out goods in anticipation of the demand, and this brings us back again to being perfectly satisfied by study or experiment that the real requirements are first known.

It may be thought that these observations are somewhat pessimistic, but they are not so intended. But I contend it is useless to shut our eyes to facts and blunder along. To my mind, too much is being made of efficiencies and relative costs of gas, &c., &c. A servant to-day costs £100 a year at the very least, and most people would pay £150 a year to be rid of the servant, so if you can get the right appliances a householder can afford to spend about £3,000 in capital, or somewhat less to allow for repairs and replacements, in order to be rid of one domestic servant. Manufacturers and central station engineers do not yet realise what money there is in the business. When they do get thinking they will be astonished.

The Development of the Heating and Cooking Load.

Is a Showroom Necessary? Glasgow Says "Yes."

By R. HARDIE.
(Showroom Manager, Glasgow Corporation Electricity Department.)

> "There is no question that at this juncture the setting up of properly equipped showrooms in every city in the United Kingdom would do more to popularise electrical apparatus and labour-saving devices, for which the need is so clamant, than any other form of enterprise."

HAVING in Glasgow just completed the fifth year of our existence with a showroom, the results of the quinquennial stocktaking may be of interest to the executives of electricity undertakings throughout the country. It may be recalled that, after lengthy conversations with the Scottish Electical Contractors' Association, Mr. W. W. Lackie, then chief engineer of the Glasgow undertaking, decided to set up central showrooms for the purpose of providing facilities for the display and proper demonstration of the various designs of electrical apparatus. Although the development has been hindered, due to war restrictions, the venture has proved a decided success, as the following figures will show. Annual sales have increased from £4,000 to £25,000, and the enterprise is now practically self-supporting. During the five years, apparatus to the equivalent of over 16,000 kw. has been connected to our mains, made up of over 5,000 electric fires, 6,000 irons, 1,000 vacuum cleaners, 100 cookers, in addition to numerous large cooking equipments in works' canteens. Flash lamps, dry batteries and kindred lines are not handled by us, as we do not consider this fair business. For the same reason, we do not adopt energetic measures to meet the lamp renewal demand, this is already done quite successfully by the trade. Our mission we conceive is to develop business which prior to our starting was left undone, and which, in our opinion, can only be done properly by the supply authority. We have no desire to compete with the trade, having recognised that our legitimate business is to encourage electrical sales by every electrical firm in Glasgow.

Chief Electrical Booster.

In a recent issue of "Electrical Merchandising" it was laid down that the central station commercial manager will best further his interests by acting as 'chief electrical booster' in his community, and pointing out to each and all new opportunities to sell goods. By this means he will produce the greatest results in appliances and load added to his lines, and in making friends among local electrical men, who are in constant contact with the central station's customers." A policy of this kind may not reflect itself in a large surplus at the end of the year from the showroom standpoint; but, if the demand for electrical apparatus is broadened, the main object of the establishment of the showroom is achieved. It may be asked, Has our progress been made at the cost, or to the detriment, of the local contractors, and what is their attitude towards the showroom? The reply is that the contractors are our best friends, and a large proportion of our turnover is with them. In Glasgow—and probably this holds good all over the country—there is no firm, whether manufacturer, factor, wholesaler or contractor, in a position to display a comprehensive range of electric apparatus. The manufacturer is restricted to his own particular lines, the factor or wholesaler's profit is too small to permit of displaying and demonstrating apparatus; and, in any case, his premises are not, as a rule, suitably located for the visitation of the public. The contractor who executes the wiring and advises the consumer in the selection of fittings, &c., is not usually in a position to stock. In these days of high costs his capital is more than locked up in his wiring business.

The Uses of a Showroom.

By the provision of a properly-equipped showroom, situated in the best shopping thoroughfare, the supply authority can, and should, provide the necessary demonstration facilities, for demonstration is the sure forerunner of sales. The contractor can either send or accompany his client to the showroom, select fires, cookers, vacuum cleaner, washing machines, irons, kettles, &c. The supply authority, with its local prestige, is regarded as above suspicion, and the customer is assured that only satisfactory and tried apparatus will be supplied, and that the guarantees issued will be supplemented. As a rule he is content to be guided by our experience, and we do our best to merit this confidence. As for the contractor, he is now satisfied that we do our best for his clients, and are in no way tempted to filch a customer from him. It is pleasing to record that, as a result of five years trading, our relations with the trade are of the friendliest description, the initial tendency to jealousies and misunderstandings having been entirely cleared away. Emphasis is laid on this point, because in Glasgow and district there are 40 or 50 contractor firms, who, in the execution of their ordinary business, act as first-class *unpaid* canvassers for the electricity department, and generous co-operation on our part is essential.

Growth of the Heating Business.

The growth of heating business has been steady in Glasgow, with the exception of the winter of 1917-18, when our activities were hampered by the restrictions on the sale of electrical apparatus, rendered necessary by the shortage of generating plant. Fortunately, up till now, although often sailing near the wind, we have not been compelled to restrict the supply of current. With prospects of the early starting up of several 18,750 kw. sets at our new Dalmarnock power station, we anticipate being in a position to go "full steam ahead," unaffected by fear of November fog, peak loads or other contingencies.

The progressive growth of the heating and cooking consumption in Glasgow is indicated by the following figures :—

1915	1,733,259	units
1916	3,348,035	,,
1917	4,438,042	,,
1918	5,198,611	,,
1919	6,995,599	,,
Total for five years	21,713,546	,,

A gratifying feature of this load is that most of it was obtained by connecting up apparatus to existing services and distributors originally laid for lighting purposes, and little or no capital expenditure was incurred in obtaining the considerable revenue which the figures represent. With the rapid growth of this business we shall probably have to face the problem of overloaded distributors, more especially in the business centre of the city, where a continuance of the demand for electric heating in large office blocks will overtax our present mains. In the residential districts the load is not so concentrated, and does not yet threaten difficulty.

The Future of the Electric Fire.

Undoubtedly, with our peculiar climate, the electric fire has a vast future, provided we can find it profitable to make the charge for current reasonably low. It is ideal for situations where intermittent heat is required. Where heat is required for over-long periods at a stretch, the cost is apt to work out high ; but, as electrical men, we may rest content if we can argue with truth that what gas as a heating agent can do electricity can do much better and equally cheaply, always provided the cost per unit is right.

In Glasgow we offer a special rate to domestic consumers—that is, for current used for cooking, heating or other domestic uses over 800 hours use per annum of the maximum demand for lighting, where energy for lighting and heating purposes is taken through the same meter and charge—1d. per unit.

Electric Cooking.

With regard to electric cookers for domestic premises, we cannot, for obvious reasons, lay claim to such marked progress The price of an electric cooker runs from £20 to £40, whereas gas cookers are installed absolutely free of charge. Small wonder, therefore, that electric cooking is limited in its appeal to the owners of better-class houses. When you seek to introduce electric cookers into the new housing schemes, it is difficult to argue against gas on the score of initial expenditure. In these days of abnormal building costs, when the price of every constituent part of the structure is soaring, the additional capital expenditure involved in the installation of electrical cooking equipment tends to put it out of court. Apart from the actual equipment, the cost of wiring has gone up by leaps and bounds. We are arranging at present to erect a complete electrical equipment in a five-apartment house, which is being built by the Local Director of Housing, to get actual costs data, as compared with an all-gas house, to be erected alongside. No coal or other solid fuel will be used in either of the houses, and in the electric house neither fireplaces or chimneys will be provided, in order to ascertain the actual saving in building by the omission of these. In the absence of water-power, I look upon complete electric service as a counsel of perfection. While anxious to do the whole job, I recognise that hot water can most economically be obtained either by means of a separate coke boiler or by a coal fire, with boiler behind, in the living room, and possibly with a combined oven. This will at once heat the living room, provide ample hot water for sinks and bath, and do certain oven work and ordinary boiling ; and this coal fire will be a coal saver as compared with the kitchen range, which all competent judges agree is obsolete. In winter, any cooking which cannot be done by this coal fire, also summertime cooking, when the fire will be out of use for most of the day, can be done quite economically with an electric cooker, just as it is now done with the gas equipment.

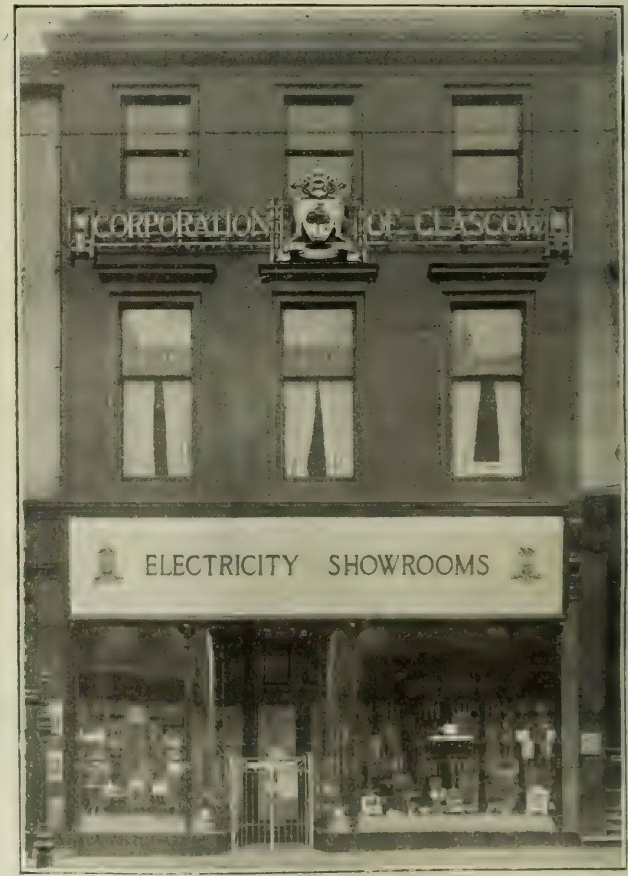

Fig. 1. Exterior View of the Glasgow Electricity Department Showroom.

Electric Fires Economical.

Electric fires will be installed in all other rooms, and can be recommended as economical. Until we get nearer Utopia, which I presume will be an absolutely smokeless suburb, I am afraid something on the lines indicated will have to serve. We will, I am convinced, only weaken our case if we attempt too much. A year ago the Glasgow Corporation electricity department carried out an experiment with an all-electric equipment in two three-apartment houses. While it established the fact that electricity is entirely practicable for all domestic purposes, the bills for current, even at the low rate of $\frac{3}{4}$d. per unit, worked out high. The total consumption in 12 months was 10,052 units (£32) in one case, and 10,981 (£35) in the other. At to-day's price of 1d. per unit the figures would be £42 and £46. These figures obviously are not attractive to the ordinary artisan, and, so long as we are dependent on coal at the generating station, there does not seem to be any means of materially reducing them. Electricity cannot be sold, even by municipalities, at less than cost. At a B.C.G.A. meeting held in Glasgow recently one speaker suggested that the Corporation should be asked to subsidise handsomely the gas department in its efforts to remove the smoke nuisance and raise the standard of health. Assuredly, without subsidies, electricity will not be sold in the near future at ½d. per unit, the maximum figure if electric service is to be complete, and subsidies are rather out of favour at the moment. The common sense of the question seems to be to concentrate on the partial service, which I have indicated we can perform economically to the consumer and profitably to ourselves. Let us leave them one coal fire in the living room for them to poke at, if they must.

Provision is being made in all new local housing schemes for an electric iron, at once the oldest and best example of electrical heating. Nothing can be said against it, either on the score of high running cost or unsatisfactory service.

FIG. 2. "CANNY SCOTS" INTERESTED IN THE SHOWROOM.

LIGHTING BECOMING NEGLIGIBLE.

Although the general adoption of the metal-filament and gas-filled lamps of low wattage has done away with the necessity of laborious arguments in favour of electric lighting, lighting is becoming a more and more negligible percentage of the station load, and lighting only consumers are apt to become non-remunerative. Only by the use of current-consuming devices other than lamps can many of these be made profitable customers. Gone are the days, let us hope, when one refered to the "Proceedings" of the I.E.E. to find a complete condemnation of electric cooking and heating; although, even yet, it is possible to read an article in "The Times" Engineering Supplement, by an alleged "Electrical Correspondent," on the rivalry of gas and electricity, arguing that electrical engineers must content themselves with lighting and power, because, forsooth, in the nature of things it is impossible to compete with gas as a heating agent. Fortunately, this type of engineer is rapidly becoming extinct. All who count in the industry are out for the encouragement of the domestic load.

SOME FIGURES.

As for the benefits to the undertaking, Mr. Grogan's figures from his own house (quoted at East Midland Sub-centre, I.E.E.) are instructive :—

Lighting consumption	200	units per annum
Heating and cooking consumption ...	4,200	,, ,,

Even with a less enthusiastic adoption of electric appliances in the home, it is a simple matter to multiply the lighting consumption by 10. Mr. Grogan's claim that, assuming only a moderate proportion of lighting consumers were persuaded to adopt electric heating and cooking, the annual output of many stations would be doubled, is mild.

UNWIRED HOUSES.

With regard to the future, much remains to be done in Glasgow district; only about 10 per cent. of the houses are wired, the remainder being gas lit. As the E.D.A. aptly puts it: "Everybody wants electricity"; but in these days, when property owners are obtaining little or no return on capital sunk in dwelling houses, it is hopeless to expect them to spend fresh money in modernising the thousands of gas lit tenements (a design of building confined practically to Scotland) in our area. Whether we, as a supply authority, may consider it advisable, in order to obtain this business, to wire these older houses is a question which will have to lie over at least until the present spate of actual applications are dealt with. This also may be said to apply to the cooking business, as we cannot hope to capture this load in adequate bulk until we are prepared either to copy the gas authorities by installing cookers free, or at a nominal annual rental, relying upon the increased revenue to recoup us for this capital expenditure. The gas people seem to find this business quite lucrative, and we ought to be able to wage a more equal fight than at present. The Glasgow gas department has over 300,000 cooking and heating appliances in use; the corresponding electrical figure is in the region of 30,000–40,000, so that we have still a considerable leeway to make up.

What has been said in this connection applies equally to some of the larger appliances operated by fractional horse-power motors—negligible individually, but valuable in bulk. The washing-machine, a new comer but admittedly one of the most efficient labour savers, at its present price (£50 to £60) cannot find as ready a sale as we could wish. The average man cannot afford it, no matter how desirable. He is left cold by the argument that the general adoption of electric service will save a servant's board and wages (equivalent to £60 or £80 per annum). He never did, nor does he expect to, indulge in the luxury of a maid. This impecunious class constitute the majority in most towns, and will I am afraid, of necessity, have to continue to ask their women folks to carry on with the O-cedar mop or carpet sweeper, and perform this washing by the old back-breaking methods of the wash tub.

DESIGN OF APPARATUS.

Our experience goes to show that, generally speaking, there is not much to complain of in the design of apparatus. Fires are in the main satisfactory. Elements have a good life, and designs give promise of being varied enough to suit the most exacting tastes. Cookers are still far too heavy, the foundries who manufacture the castings evidently stipulating that there must be a certain weight (2 to 4 cwt. generally) in each cooker. We could with profit emulate the design and weight of the American product. The boiling plates, as heretofore, remain the weak spot, but many capable brains are at present on the work of development in this direction, and we may confidently anticipate in the near future the production of a satisfactory radiant-type of boiling plate.

The British iron has improved out of all knowledge within the past two years. The same remark applies to electric kettles, toasters and similar appliances.

Vacuum cleaners are a first-class selling line, but we are still almost dependent on America for these, as with all appliances operated by fractional horse-power motors. Why?

Owing to heavy freights and adverse rate of exchange, the present price of a washing machine (£60) is high. Is there not an opening here for some enterprising British firm to commence manufacture?

In conclusion, I share the generally accepted belief that we have barely scratched the surface of this domestic business. Let any electrical engineer ascertain the figures for gas appliances in use in his area, and he will realise the vast possibilities; and let him take heart of grace, because each year will see him in a better position to deliver the goods.

The Making of Goodwill.

By T. C. ELDER.

As it appears in the balance-sheet, that mysterious term goodwill oftens covers a multitude of commercial sins, as any keen accountant will testify. Yet essentially it stands for the very soul of business. Its relationship to the factory or office, the collection of plant and machinery—what Dr. Johnson called the "parcel of vats and boilers"—the furniture and apparatus, files, card indexes, and the rest of it, is that of the spirit to the body. No analogy would seem juster. But a variation is at once perceptible on first analysis.

For wherein does this spirit of goodwill have its real habitation as a living force? Not in the body that I have roughly described, but in the market places of the world, or more precisely, in the mind of the customer. Your goodwill is of real assessable value in so far as it represents a favourable conviction or persuasion in the intelligence of so many hundreds or thousands of buyers, in one or many parts of the world, with whom you hope to do business.

The Destination of the Goods.

Market power—the systematised selling of industrial products—depends on several main elements of successful business management. There must be a reasonable degree of efficiency in the actual production itself, which means that through every process of manufacture the destination of the goods is kept in sight, and adjustment made accordingly in quantities, designs and costs. There must be intelligent continuous study of methods of reaching the market, in the physical sense of transport by land and sea, and convenient packing and consignment. And finally there must be given to what may be termed, by contrast to this physical process, the psychology of distribution, that skilful direction which is calculated to make the market not merely receptive but eager.

Publicity and Organisation.

It is astonishing how frequently in the engineering industry, which supplies machinery for every other industry, these elements are badly combined. At the two extremes there are, on the one hand, still firms which boast that they do not advertise, with many others whose advertisements are so feebly ineffective as to be almost dangerous, and on the other hand, it must be admitted that some of the cleverest publicity has been done on behalf of firms not equally well organised in their works.

Both parties are wrong who argue respectively, on the one hand, that if the goods are well manufactured they need no advertising, or, on the other hand, that brilliant publicity will make a market for goods that are more or less below standard. Here it is understood that I am thinking of abiding success, for great general demand will penetrate to the most modest and secretive factory, while bluffing advertisement may create a temporary rush of business. What is under discussion in this article is the creation of lasting goodwill, and that calls for ability, both in market management and in works management. For simplicity's sake, I must here assume efficiency in the factory. If the factory could be taken on tour it might be that other publicity would not be needed; but the works are a fixture, and the market must be told by means of pamphlets and catalogues, the recitals of the salesmen, the display of advertisements, and the news paragraphs and articles that will be devoted to any original effort on the part of the firm. You cannot maintain goodwill unless the market memory is continually refreshed. The amusing mutual contradiction of the two common arguments against advertising, that in good times no more orders can be accepted, and that in bad times there are no orders to be got, will not bear to be tested by this principle. You never know when you will need that customer in whose mind your goodwill is planted, nor can you calculate that the plant will live if your competitors are allowed to choke it with their weeds. The only safe thing and the obviously enterprising thing is to keep him always reminded favourably of your existence, and your willingness to serve him.

Prejudice of Value.

The lawyers say that if prejudice is on your side when you go into court it is very difficult for reasoning or evidence to defeat you. Trade goodwill is prejudice in your favour, and goodwill gets far more orders every day than carefully examined merits. The millions of pounds worth of branded goods that are sold in the shops every day have each their little cellular corner in the brain of the buyer. It is very hard to sell him anything "just as good." Does that theory apply, it may be questioned, to the trade in machinery? That is supposed to be a deal, or a duel, between experts, both having technical knowledge and ability to appreciate the fine points and minute differences of detail. I have no hesitation in giving my opinion, based on personal experience, that there is at least as much human nature in engineers as in other people, and that, except when there is only one machine that will serve a special purpose, they are certainly influenced, and rightly influenced, by their knowledge of the reputation and character of the firm that they prefer: that means that the firm's goodwill is working in their minds. As multiplied in many minds this influence is of incalculable value, and it is mainly created and upheld by intelligent and persistent publicity.

All this is but the preamble to a general dissertation on quality and quantity of advertising and publicity, which would fill a book; but it is important that the preamble should be approved before an examination of the clauses is made.

The Path of Prosperity.

By H. E. GOODY.

There is, perhaps, no other business in which the supply is so utterly unsympathetic to the demand as the electrical industry. Practically everybody wants electricity for heating and cooking, but very few are able to get it. The demand is insistent and persistent, but, owing to the apathy of those responsible for the supply, it has, so far, proved ineffective. People want electrical service, but they do not want it regardless of expense and trouble; and if electricity is to develop as the nation and every section of the industry desires (excepting the supply authorities) the business must be placed on a financial basis which corresponds to some extent with the paying ability of the average consumer. The present charges are fantastically absurd.

Central Stations and the Future.

Central stations as a rule seem to be incapable of taking the long view. They lack the sense of perspective, and, instead of looking to the future, are apparently content to get as much money as possible out of their existing consumers. If the supply authorities throughout the country would reduce their rates for domestic heating and cooking to a figure which brought the cost of electricity to within a reasonable distance of gas charges; if they would employ the same methods of encouragement as the gas companies in connection with the hire and installation of cooking and heating apparatus; and, finally, if they would only import the same degree of enthusiasm and enterprise into their efforts to obtain new consumers as the latter; there is no doubt that, within a few years, the domestic gas business would be in a parlous condition.

Every station engineer knows that his present generating costs and capital charges per unit could be enormously reduced if all existing users of electric light were also users of electric heating and cooking. In a purely residential neighbourhood it is probable that the cost per unit could be halved by the achievement of a good, steady day load.

The central stations must, however, take the initiative. They must cut their rates and trust to obtaining the load necessary to justify the cut. They cannot expect the consumer to instal and use electrical apparatus at a cost beyond his means, in the hope that the charge will be reduced in the next decade or generation. One may build houses, plant trees, or even pay taxes for posterity, but the householder will certainly not consider the welfare of his remote descendants in the selection of a cooker.

SERVICE CHARGES MUST GO.

Another thing which discourages the prospective consumer is the charge which many companies impose for running their mains into the house. In the old days service was free if the length of the run was under 60 ft. Now a charge is made in some districts, if not in all, even in cases where the mains are within a few feet of the house. To make the consumer pay the cost, or a part of the cost, of the mains is obviously unfair, since they remain the property of the central station.

EXTRAORDINARY STUPIDITY.

I have been in the electrical business all my life, and am an enthusiast for all things electrical. So keen is my desire to use electricity for every domestic purpose that I would not object to paying considerably more for electrical service than for gas. But even *I* have been discouraged and driven into the odorous arms of the gas company by the extraordinary stupidity of electricity supply authorities.

I had intended buying a house in one of the new garden suburbs now in course of erection. In building a house, and deciding upon such things as room and water heating and the necessity or otherwise of flues and chimneys, it is obviously desirable to have some information about the cost of electricity. The only information I could get was that the electricity would probably be available before the gas; but no one would or could tell me what the price per unit was going to be. Although some of the houses were nearly complete, the supply authority, or whoever was responsible for retailing the current, had not made up its mind on this fundamental point. Clearly, I could not, however enthusiastic I might be on the subject of electrical service, indulge in the gamble of installing electric cooking and heating without knowing the price of current. Also, of course, the question affected the cost of the house, since, if electricity were to be economically feasible, I should be able to dispense with fireplaces, chimneys, mantels and a kitchen range. One would have supposed that the organisers of a garden suburb would obtain precise and detailed information on such a point before starting to build houses.

My keenness would have made me content to pay *twice* as much for electricity as for gas, but the thought of my bank manager's eagle eye for a dwindling balance prevented me from running the risk of having to pay five or ten times as much.

A HOLLOW MOCKERY.

The particular houses referred to were advertised as labour-saving houses. The phrase "labour-saving" is a hollow mockery under non-electrical conditions. With electric heating, cooking and cleaning they would have deserved the description; without, their only title to distinction lay in the provision of a kitchen cupboard with revolving shelves, and a serving hatch between the kitchen and dining room.

It throws an interesting sidelight on the question of electrical development to know that, when it was found that gas would not be immediately available in the new houses, the commitee of management, instead of taking the heaven-sent opportunity of installing electric cookers, &c., turned instinctively to an anthracite abomination which should combine the functions of cooking and water heating. Of course, it would have been too much to expect the central station people to take advantage of such an unusual contingency as the absence of a gas supply. With a little energy and foresight they might have installed electric cookers and heaters straight away in several hundreds of houses.

Thus, in actual practice, electricity is not even the *second* choice of the ordinary man, simply because he knows that the cost is prohibitively high and that, even if he is willing to pay the price, there will be numberless other obstacles to surmount before he can enjoy the benefits of complete electrification.

THE COST ENORMOUS.

The cost of having a complete set of electric cooking and heating appliances for even a small house is, of course, enormous, and this fact would alone deter a great many people from using electricity, even if it were a good deal cheaper than it actually is. It may be that cookers and radiators are hired by a few supply companies, but generally speaking it is necessary to purchase outright. The large Metropolitan gas companies not only supply gas, but also sell and hire (and sometimes make) all the necessary apparatus of utilisation. The advantage is obvious, since the profits of one department may be used to offset the losses of another. For example, before the war some of the gas companies used, I believe, to lend gas cookers free of charge, and look for all their profit to the increased consumption of gas. If the electric supply companies would only pursue the same course, there might be some hope for the future of the industry.

Something must be done, and that quickly, if electricity is to take its proper place in the scheme of things. This is no time for tinkering with the existing supply rates. They must be cut drastically and relentlessly. That is the only way to save the situation. If necessary, the manufacturers should combine with the central stations (the non-municipal ones, at any rate) and pool profits, so that the advantage to the former from the increased demand for apparatus would be shared with the latter, in the event of the low current charges proving unremunerative, which, in fact, they would not do.

AN ADDITION TO PROPAGANDA.

A great deal of electrical propaganda has been issued during the last few months, and propaganda is always useful and welcome; but it would be infinitely more effective if the written word were backed up by the determination of the central stations to make their proposition financially attractive. It is of little value to work a householder up to a high pitch of enthusiasm by means of skilfully-worded advertisements and attractive pictures, knowing full well that, as soon as he gets an idea of the initial and operating cost of electrical service, his enthusiasm will turn to disgust and annoyance.

The gas companies are right to increase their rates as the cost of coal and labour rises. They are right, because they have almost reached their limit of saturation, and cannot hope to reduce the proportionate cost of production by increasing output. The position of electricity is entirely different. The saturation point is not within sight or estimate; in fact, the solution is so pitifully weak that the electricity is hardly noticeable. Obviously, the proper course for the supply companies to adopt is to attempt to compensate for rising costs by obtaining more and bigger consumers, rather than by putting up the price per unit.

In common with the majority of the population of these favoured isles I hate gas and like electricity, but unfortunately the amount of money I can afford to spend on heating and cooking is limited; and this limitation compels me to cleave to the gaseous by-product of the coke factory and to forego the help of its clean and costly rival.

May the days of my bondage be numbered, for my present position as an electrical enthusiast in a gas-equipped home is anomalous and heart-rending.

Where British Electrical Show Windows Fail.

By ERNEST A. DENCH.

A number of the electrical window displays that I saw while in England were overcrowded. Even the neat and well-balanced arrangements had their shortcomings. For instance, some otherwise excellent electrical displays lacked the propaganda element that is so necessary to the sale of electrical household appliances, whether in England or America. This element is most important in Great Britain, because there the prejudice and unenlightenment concerning modern electrical appliances is a thousand times greater than that in America.

Most Americans are open to conviction, and once you have convinced them as to the utility of an article the rest is smooth sailing; but in England, even to-day, things go largely by tradition. Because her mother laboured over the wash tub, or cleaned the house with a broom, is sufficient reason for her daughter to follow the same methods. This also applies to the farmer or to the manufacturer who has been accustomed to having certain machinery operated by hand or treadle power because those methods were good enough for his father.

The Minor Progressive Faction.

But in spite of all these obstacles, no matter what country one may visit, there is always the minor progressive faction fighting the major conservative element. This is what is going on in England to-day, despite what the war has done to revolutionise things. In practically every case where the minor progressive faction is concerned, the chief thing that checks their activities is fear. The manufacturer hesitates to run certain of his machinery by electricity instead of by hand because he will have a large sized strike on his hands through the foolish prejudice on the part of his workers. Instead of looking at the broader side of increased production, and realising the cheaper it is the more the product can be sold, the British mechanic fears that the speeding up process will throw people out of work.

The Spoiled Husband.

In the English home it is the progressive English wife who fears that her husband, spoiled because he was waited upon hand and foot by his sisters and mother while at home, will consider her both lazy and extravagant for seemingly wishing to shirk her work. Many English women, even in this progressive age and generation, are martyrs to hard work because it is expected of them by their husbands, relatives and neighbours. They get no credit for performing their household duties more quickly and efficiently because they use their household electrical appliances. To the prejudiced and unenlightened, such progressive housewives are work shirkers, for the English as a nation thrive on work. This is an excellent national spirit when it is not carried to excess, but the happy medium, unfortunately, is not always present.

Considering these obstacles to progress, one would expect to find English electrical windows full of propaganda material in the form of showcard arguments, and exhibits that show the old at a disadvantage against the new. This is actually the case, and I give below a few of the commendable efforts of English electrical firms that I came across during my six months' visit.

Advertising the Electric Hot Plate.

The **Bromley Electric Light Company**, Bromley, Kent, are handicapped by small, narrow windows, far above the sidewalk. One must climb a flight of stairs in order to gain admittance to the inside of their showrooms, yet this does not prevent them making full use of the limited facilities at their disposal. In their first window an electric hot plate was displayed on a pedestal at each end, with a sign hung from a chair in the middle. The sign stated that

> "The Electric Hot Plate will boil a kettle of water, Toast, Fry and perform all the duties of a gas ring. No flame, no danger."

The second show window was devoted to an electric kettle, while a suspended sign pointed out

> "Electric Kettle.—Two pints of water can be boiled in an electric kettle in 10 minutes at a cost of one-sixth of a penny. Notice the absence of fumes and smell and the perfect cleanliness."

The Iron Argument via Poster.

The **Borough of Stepney, London**, put out a very attractive poster while the weather was warm. I cannot recall now whether there was a lithographed sketch of a witch mounted on an electric iron instead of the conventional broom or not. I can, however, quote the wording of the poster correctly.

> "Electric Ironing means cool work.
> A 'witchon' an iron."

Increasing Current Consumers.

To obtain more electric light consumers, the **Croydon Corporation**, Surrey, made extensive use of the local newspapers, as well as the tramcars. One of their newspaper announcements inquired

> "Do You Require a House That Will Give You the Minimum Amount of Work and Always Keep Clean and Healthy?
> Then
> Use the Electric Supply for Heating Lighting and Cooking."

Their tramcar sign patted the prospective consumer on the back, and who is there who does not fall to compliments such as the one below

> "Of course, you use electric light.
> It's so cheap in Croydon."

"Atmosphere" that Counted.

Messrs. **Hazelton & Blythe**, Paddington, London, floored their show window with black and white checked linoleum to suggest the kitchen "atmosphere." The display contained a few electrical cooking appliances, each article being laid over a dainty embroidered gold mat.

Messrs. **Oborn**, Paddington, London, had a display of electrical household appliances last autumn, seasonable surroundings for this display being provided by sprays of golden and red autumn leaves hung down in the rear of the exhibit. Loose autumn leaves were also scattered over the floor among the articles displayed.

Two Good Investments.

Messrs. **John Russell & Company**, Charing Cross Road, London, announced by the card route in their electrical show window that

> "Victory Bonds and our Electrical Appliances are two Sound Investments."

Messrs. **W. Banham**, Paddington, exhibited several vases that had been converted into electric lamps for the table. A card suggested

> "Make Use of Your Vases—convert them into lamps."

The **Ajax Company**, Ilford, permitted their illuminated windows to act as their silent salesmen, for in one of them appeared the following card:—

> "The Shop is Lit by Half-watt Lamps.
> Note the Effect."

Only by the employment of such aggressive salesmanship and advertising methods that take into account British psychology, can the English electrical contractor-dealer hope to make converts to the good cause—electricity.

Criticisms of Electric Fittings.

By A WEST-END FURNISHER AND DECORATOR.

THE wealthy customer who sets out to purchase electrical fittings for a town or country house can have no possible ground for complaint against the manufacturers of these things. If his purse is deep enough to pay the really long prices asked, there are on the market fittings which are a pure joy to the most fastidious. But it is not so easy for the man of taste who must limit his expenditure to choose fittings which he finds satisfactory from the æsthetic point of view. The reason for this appears to be that designers of the moderate priced fittings seem reluctant to accept the limitations imposed by price, and do their utmost so to dress up the cheaper thing that it shall look as though it had cost a good deal more than is really the case. The maker of inexpensive electrical fittings is by no means alone in this. Household furnishings generally are all too frequently "fussy" and, therefore, unsatisfactory. It is so easy to manufacture ornament by machinery that a great deal too much of it is put on the market in one form or another.

Let the manufacturer and designer of electric fittings consider the interior of an ordinary living room. The carpet will be patterned—probably a good imitation of some Persian or Turkish original; the walls will be covered with a patterned paper; the furniture will be carved, inlaid, mounted with chased or stamped metal work; the curtains, tablecloth and upholstery will be of figured material—in all probability three different kinds; there will be a number of pictures in the room with carved and gilded frames; ornamented tiles; elaborately designed fireirons and fender; and in addition a considerable quantity of bric-à-brac, bronzes, pottery, elaborately bound books, and a hundred and one trifles all clamouring for the attention of the occupant of the room. In such a room it is difficult to find any manufactured article which can be described as *a good plain thing*, honestly proclaiming on the face of it the material of which it is made. We find cotton masquerading as silk, celluloid trying to look like ivory, and in many cases electric fittings trying to look like good honest brass, when, as a matter of fact, they are nothing of the kind.

In a recent number of "Ways and Means" I find the following description of a suburban woman and the suburban home in which she lives.

> "Clothed in a dress of artificial silk with an imitation fur on her shoulders, an imitation aigrette in her hat, imitation silver buckles on her imitation leather shoes, she approaches her villa (the modern name for an imitation house), and opens the cast-iron gate, designed in imitation of hand wrought-iron. The front of the house is of imitation half-timber work, and the front door is grained in imitation of oak. The floor of the hall is of linoleum manufactured to imitate tiles, and the walls are covered with embossed paper in imitation of leather. Entering her drawing-room she adjusts the machine-made curtains, an imitation of hand-made lace, turns down the gas fire, an imitation of an oak log which is never consumed, seats herself at a bureau which is an imitation of an eighteenth century antique, picks up a penholder of imitation ivory and takes from a writing case of imitation crocodile leather a sheet of notepaper with an imitation linen surface. Having written an invitation to dinner to another imitation woman, noted among her friends for her imitation hair, teeth and complexion, she rings for her cook and arranges that the meal shall consist of imitation turtle soup, and other imitations of expensive delicacies, with the inevitable imitation butter and imitation sugar—products of cocoanuts and coal tar respectively. Thus she leads her imitation life in the hope of an imitation heaven, and when in due time she dies she is buried in an imitation oak coffin, with a plate of imitation brass inscribed with an imitation sentiment, bearing testimony to the honesty and sincerity of her life."

Suburbia, full as it is of many excellent qualities, is always fair game for the cynic because it is trying to appear that which it is not. I am pretty sure that it contains many hundreds of thousands of electric fittings which, their owners fondly believe, look worth a good deal more than they gave for them. Cannot the designer of electric fittings, as a modern man dealing with modern methods of illumination, cut adrift from all this make-believe and use materials and forms essentially simple and dignified and with the minimum rather than the maximum of decoration?

Reference has been made above to materials which are not what they seem. Unfortunately, the brass which is used for the manufacture of many electric fittings is a flagrant example of this, and in London especially its use is to be deplored. The action of sulphur and carbonic acid gas in the London atmosphere renders the use of the alloy of which many so-called brass fittings are made in many cases dangerous, and in all cases undesirable. I shall not be surprised if within the next few months one or two devout worshippers in a London church are seriously hurt by the fall of an electric fitting on which the atmosphere is acting in such a way as to render it a source of danger. Apart altogether from the action of the atmosphere, electrolytic action cannot be ruled out in connection with fittings made of alloys of the kind I have in mind. There is, of course, no reason at all why metal should be used. Just as metal gas fittings are sometimes even now designed with a central urn, a survival of a feature which was necessary as an oil container in the days of hanging lamps, so designers of electric fittings have used metal as their main material when wood or cane would have answered the purpose equally well.

In summing up the views which experience has led me to adopt I thing that moderate-priced electric fittings usually err on the side of elaboration rather than simplicity. The tendency in the modern treatment of interiors is to avoid complexity and to rather insist on the quality and texture of materials, and to eschew meretricious ornament of any kind.

On the constructional side I am hardly competent to offer detailed criticism, but one or two actual experiences may be interesting. I have had to fix recently for a customer a wall bracket of the well-known Dutch pattern. The casting did not leave anything like enough room at the back for the three wires, and it was necessary to make a vertical groove in some expensive panelling before it was possible to fix the bracket in position on the wall. The other case that came to my notice was that of a very well-designed electric table lamp made of mahogany. This was properly weighted at the bottom and the shaft carefully bored for wiring, but it was surmounted by a decorative bronze cup to take the light. The makers of this had taken no trouble whatever to ensure that there was sufficient room for the wire to pass through. The hole left by the casting was much too small and had jagged edges likely to cause trouble by damaging the casing of the wire. It was necessary before the lamp could be wired at all to enlarge the hole in question by boring and filing. These are trivial details, but very annoying to the man who has to give estimates and work to them in these days of high wages.

Domestic Electricity from Another Point of View.

By H. TEELING SMITH.

The systems used for generating heat for cooking purposes differ materially in almost every country in the world, and their peculiarities are invariably the outcome of local conditions and customs. In many countries custom counts for much; even in England you will find in the country districts where the young girls who get married and have to set up home are desirous of cooking on the ranges or stoves that they have been familiar with in their mothers' homes. In the more thickly populated districts, where the children are taught cooking at school, it is not unnatural that the minds of the pupils should be influenced by the systems in use in such institutions. Therefore, if gas stoves are used for demonstrating cooking operations, it is almost to be expected that the student will become so familiar with the gas cooking stove, that she will, if the gas company hire out such articles, wish to introduce them into her own new home.

On the other hand, in India one is surprised to discover that the cooking utensils are of a most expensive type, yet on probing the matter to the bottom it is discovered that religion has a good deal to do with the shape of the utensils and the material from which it is manufactured, hence it becomes difficult to develop modern ideas in that country where this involves the use of strange receptacles shaped contrary to the rules that so drastically govern the preparation of food for human consumption.

To go a step further, in highly civilised countries electrical engineers are endeavouring to convince those, whose houses are situated in districts supplied with electricity, that there is no finer system of cooking than by employing electric cooking devices, and fortunately for those gentlemen there are quite a large number of people who are carried away with the idea of promoting cleanliness in the kitchen, and who allow these latest engineering triumphs to be installed for the benefit of their culinary staff.

There will always be a certain percentage of the population to whom the spending of a few hundred pounds on latest ideas is of no consideration, nor do these millionaires have any regard for the cost of maintenance. They are carried away at the outset with the idea that they have something which has cost more than their poorer relatives can afford. The mere fact that the cost of cooking a dinner is ten times more than by means of a coal range is in itself a point worth boasting about, and they have not realised that the heat obtained from electric current is the outcome of a vast consumption of coal at the depot where the current has been generated. In this country we are faced with the problem of how to make a scarce supply of coal go round. From a lighting point of view there is much to be said in favour of electricity, but unless that electric current is produced by some power other than by consumption of coal, it is, in my humble judgment, unwise to advocate its adoption for cooking and heating purposes.

If mankind is to live and thrive in the centuries to come, then it is essential that to-day we should economise in the consumption of coal; let it be used in its raw state in every household in such contrivances that will create a minimum of soot and smoke, or, if it be converted into gas, let that gas or electricity be used for lighting and for auxiliary heating purposes, such as the boiling of small quantities of water by a luxuriant bachelor for shaving purposes in the morning, or the preparation of a glass of toddy before retiring at night; but if it is to be advocated that gas and electricity should be used in every city to the exclusion of bituminous coal, coke or anthracite, then the miners will have to produce a great deal more than double what they are producing to-day, and make sure that there is adequate supply for the generations to come.

From a heating point of view, for instance, it takes at least 5,000 units to give the same amount of heat that one ton of coal would generate. I leave readers of The Electrician to calculate how many tons of coal are required to create 5,000 units of electricity. As regards cost, we will take it that the unit is supplied at 2½d.; this represents a total of £52 1s. 8d., as compared with the price of coal, which is to-day about £3. The question is, is it worth while? I am aware that in this issue other points of view will be put forward, but I wish to express my opinion as one who does not view electric cooking in rays of a rose coloured illuminant, but in the cold light of day.

The Ethics of Internal Wiring.

By ALAN KIRK, A.M.I.E.E.

The internal wiring of buildings is a subject that merits far more attention, consideration, time and skill than it generally receives. No matter whether the building be a cottage factory or palace, the first consideration must be to ensure safety to life from shock or fire—in fact, too much stress cannot be laid on this point, "Safety first and last at all costs." The second consideration should be efficiency, including utility, and the third reduction of initial cost.

The Necessity for Compromise.

In many installations the relative merits of efficiency, utility and cost are so interlocked that it becomes necessary to modify or even to sacrifice to a greater or less extent one or other of these factors, but in no instance should the factor of safety be departed from. The great fascination of this branch of the electrical profession is that every building presents its own problems to be solved, and very few are absolutely identical in all details.

Unfortunately in this present-day existence where the purely commercial view takes precedence of the professional desire, the careful study of each problem is often *non-existent*. Why should this be?

A Retrogression.

In many details there has been a retrogression in the planning of internal wiring during the last quarter of a century. To a certain extent this can be traced to the mad desire for initial cheapness at the expense of safety and efficiency. This so-called cheapness has in many ways been very costly.

To those of us who carry our memories back into the past, and compare the work that was planned and executed say 30 years ago with *some* of the work that is being installed at the present day, it becomes apparent that the progress towards a higher standard has been painfully slow, and we may surely be excused if we view the future with apprehension. How can we account for this? Is not the answer that in the earlier days we placed our professional honour first, we loved our work, its interest was our all, but now the "call of the blood" is unheard amongst the clamour of sordid gain.

The Consulting Engineer.

There are two recognised classes of professional men, consulting engineers and architects, who endeavour, according to their lights, to prepare specifications for internal wiring work. Taking the consulting engineer first, as it is his legitimate work, how does he carry out his duty? Does he set his standard "Safety at all costs"? Happily in some cases, Yes; but alas in very many cases, No! It is an astounding fact that there are very few consulting engineers who deem it essential, or part of their duty, to go into detail in connection with internal wiring work until after the contract is let, and this largely accounts for the custom of architects trespassing upon the preserves of the consulting engineer, because they (the architects) have found by experience that if they engage the services of *some* of the so-called consulting engineers, they are no better off than when they have themselves prepared a sort of skeleton specification and trusted to the honesty of the contractor. This is very much to be deplored, but until some strong action is taken by the I.E.E. this state of affairs will continue.

If the position of internal wiring in relation to the building work is considered from an impartial point of view, it will at once be evident that it is an insoluble problem, if the present-day methods of attempting to dissociate one from the other are adhered to. The only solution that we can expect to meet with success is absolute co-operation between the consulting engineer and the architect, but the whole question is teeming with difficulties under the best of conditions.

The Architect *v.* The Engineer.

The architect naturally places his architectural considerations first, the engineer rightly places the safety and efficiency of his installation in the first place, and the two points of view are certain sooner or later to clash, and it is then that all the consideration and skill of each side is required to discover a solution that will be acceptable to both. There should not be any difficulty arising that could not be overcome if both parties had the ultimate success of the work *as a whole* as their sole aim.

The question of illumination is a point that affects both parties, but the degree of illumination should be decided by the lighting expert, whilst the external appearance of the fitting or decorative effect is a matter for the architect.

It is often a matter for regret how the architect's best efforts inside a building have been utterly spoilt or nullified by the electrical fittings installed, over the selection of which he had no say or control. The whole of the internal work of a building should form one decorative scheme, designed at the same time as the planning, the necessary degree of illumination at the various points decided by the lighting expert, the outward appearance of the fittings submitted to and agreed by the architect, the best method of carrying such into practice agreed upon and embodied in detail in the specification and bills of quantities for the builder and electrical contractor.

THE BAD SPECIFICATION.

How many specifications are issued that do not attempt to put the onus of responsibility upon the contractor, not only making him responsible for the correct execution of the work, which is right and proper, but making him responsible for settling all details, and leaving matters of principle to his discretion! It is quite time that this vicious practice stopped! A specification for internal wiring work, to be worth its name, should be a specification of the particular works it has to cover, it should be all embracing, down to the minuest detail, leaving nothing in doubt, clearly stating what materials are to be used and how the work is to be executed, *not* what *may* be used or how it *may* be executed. This can only be put into effect by the person responsible being thoroughly qualified and able to visualise the completed work as a whole, and also by a very close co-operation between the parties responsible for the building and internal wiring.

There are one or two terms extensively and improperly used in many specifications. One is the use of the word "Simplex," when a specification states that "all wires are to be carried in Simplex." What on earth does it mean? Another term is the word "point"; this is quite correct in itself, but in many specifications the contractor is requested to state what his cost will be "per point." This is absolutely bad, and is grossly unfair to both the client and contractor. The costs of internal wiring work are made up from the amount of material to be used and the amount of labour required to fix it. How then can anyone accurately or fairly estimate the cost per point when the governing factors are an unknown quantity? To take an "average price per point" based on the total amount of work to be executed is not fair to either party, as the average length of run might be, say, 20 ft., and the point afterwards required to be added or deducted might be a 10 ft. or a 30 ft. length of run.

THE FUTILITY OF THE PRICE PER POINT.

As an example of the futility of pricing "per point" the following instance may be instructive:—A firm of contractors were given an order to wire for seven extra points, work to be measured on completion and priced in accordance with the schedule rates—the result being that the cost of the conduit, wire and labour for six of the points came to less than £5, and the cost of the conduit wire and labour for the seventh point came to over £6. It is strange that this anomaly has remained for so long, when there is a fair and easy way of adjusting any additions or deductions required, namely by measuring the actual work affected, and pricing it at per foot or yard run. It would be of great benefit if the measurement system was carried still further, and proper electrical bills of quantities were issued with the specification for the tenderers to price. There is nothing new in the idea, it is used nearly exclusively in all building contracts, with entire satisfaction to all parties.

The writer prepared a complete bill of quantities for the internal wiring of a large military hospital about 20 years ago for the contractors to price, but the whole effort was spoilt by the insertion of a clause in the specification that "the contractors tendering must satisfy themselves that the quantities given are sufficient for the due completion of the works, &c." In other words, the unfortunate contractors tendering were to be responsible for any errors made by the Government official!

ELECTRICAL BILLS OF QUANTITIES.

It is obvious that bills of quantities are the right lines for all wiring work to be based upon, but it will necessitate the employing of qualified electrical quantity surveyors to prepare them, and they must have properly prepared plans and details laid before them in the same way that a quantity surveyor now has for building work. There is no difficulty to be faced in the matter, and it would undoubtedly save time and expense in the long run, it would free the contractors from a lot of vexatious labour that they should not be called upon to do, and it would give the client an accurately itemed account of how his money was to be spent. But, if this is attempted, it must be done properly, and not in the slipshod manner that at present governs nearly all internal wiring contracts.

Every contractor tendering for wiring work has to prepare his own bill of quantities for estimating purposes, and he has perforce to do so under the most difficult conditions imaginable, because, more often than not, all he has to guide him is a skeleton outline of the work contemplated, flatteringly called a specification, and floor plans with crosses or dots on it to indicate the approximate positions of where the lights may be fixed.

What is wanted is a lucid and sound specification, and complete set of plans and drawings showing in detail the proposed construction of the building in question, and a bill of quantities of all materials required for the contractor to price; such bill of quantities will form his schedule rates, and the total sum will show the amount of his tender.

If work was carried out on this basis it should help towards attaining a higher standard, and would result in a considerable saving of time and money, thereby decreasing the initial cost of the work.

SUPPLY AUTHORITIES AND WIRING.

Most of the public supply companies have endeavoured to help towards raising the standard of internal wiring work, and many of their engineers take a real interest in this branch, and have done much to uphold the traditions of their profession; but there are, unfortunately, a few who have hindered rather than helped, and it appears to be chiefly those that attempt to carry out wiring installations themselves as a side line to their proper vocation.

One explanation of the cause of bad work being executed by the wiring departments of supply companies is that, in their endeavour to undercut the wiring contractor, they try to reduce the initial cost as low as possible, and in doing so entirely lose sight of the factor of safety.

SAFETY QUESTIONS.

"Safety" may be subdivided under the heads of "shock" and "fire." To eliminate the risk of shock necessitates *all* metal not carrying current being efficiently earthed. To eliminate risk from fire necessitates all inflammable material being covered or protected by non-inflammable or fire-resisting materials.

In all internal wiring installations it is safe to assert that one of the weakest spots in the installation is the flexible wire. Accepting this statement as a fact, and bearing in mind our desire to increase our factor of safety, let us consider the use of an ordinary circular flexible wire braided overall with copper or other suitable metal wire. Such a flexible wire used in conjunction with properly designed brass cones, caps and nipples, for connecting up, the holders of all pendants, hand lamps, standards and other fittings having a flexible wire connection, will be automatically and efficiently earthed, and all danger from fire or shock, so far as the flexible wire is concerned, will be eliminated. The increased cost over the ordinary method is trifling when compared to the additional safety ensured; but it is not intended that the system of armoured flexible wire shall take the place of wires run in conduits.

The increased practice of using flexible wire for circuit wiring is a thoroughly bad one, and, although largely in use on the Continent, every endeavour should be made to discourage its use in this country. Its low initial cost may be alluring to some, but its probable ultimate cost should be enough to condemn it.

That the electrical industry in England is handicapped cannot be disputed when one realises that there are no less than 137 different varieties of electric current supply from the public supply companies, 30 of these being direct current, 57 are single-phase alternating current, 11 are two-phase alternating current, and 39 are three-phase alternating current. In London there are 37 different varieties of supply, 15 being direct current, 18 are single-phase alternating current, 2 are two-phase alternating current, and 2 are three-phase alternating current.

THE FLAT RATE TARIFF.

There is one direction in which the engineers of the supply companies could greatly assist in lowering the cost of internal wiring installations without in any way lowering the standard of work, and that is by giving a flat rate for all current supplied, whether it be for lighting, heating or power.

At the present day in many installations it is necessary to run duplicate wiring throughout a building, one installation for lighting and one for power, the consequence being that the initial cost is considerably higher than is justified, viewed from the point of safety and efficiency. That there may be difficulties to be overcome by the supply companies is admitted, but they should not be insuperable to the supply companies' engineers if they devoted their energies to such an end, and left the internal wiring to the legitimate wiring contractor. It is not often possible for station engineers to find sufficient time from their duties to enable them to qualify themselves for dealing with all the complications of the internal wiring branch of the industry, and yet they not only attempt to carry out business as wiring contractors, but often aspire to act as consultants for internal wiring installations.

QUALIFICATIONS OF CONSULTANTS.

It would be a decided gain if it were made compulsory that before any person could act as a consultant or in a consultative capacity for internal wiring work he must have served satisfactorily for a certain time with a reliable firm of wiring contractors. When one pauses and passes in review the whole field of internal wiring and those engaged in it, the most striking fact is that the wiring contractors, whom one might reasonably expect to be the class to lower the professional standard for monetary gain, are in fact the greatest upholders of good work of the highest standard. The reason for this is not hard to find. To be a success in the internal wiring industry as a reputable firm it is an absolute necessity that your work shall last. To ensure the work standing the test of time it must be planned and executed in the best manner, and the reputable wiring contractor, with his practical experience of the details that help to make or mar a job, is more often than not in possession of greater knowledge upon these points than the consultant. The foregoing remarks apply to many esteemed and respected firms of electrical contractors. That there are an ever-growing number of so-called electrical contractors who are a disgrace to the name cannot be denied; but any consultant who gets bitten by one of them deserves all he receives, because if he was competent he should have been able to discriminate efficiently.

As a general rule, the firms who do not realise what good work really means obtain most of their orders by entirely sacrificing safety and efficiency for low initial cost, or by corruption. Are they solely to blame? Surely the blame must be equally borne by those who knowingly employ them, or encourage them by their own lack of proper knowledge.

REDUCTION OF COST.

Is there any royal road to a general reduction of the initial cost for internal wiring? Many suggestions have recently been put forward, but they all have the fatal tendency to sacrifice the factor of safety in favour of a small and highly problematical saving in initial outlay. One help towards decreasing the initial cost, and at the same time increasing the efficiency of the installation, is to keep always in mind when designing the installation the fact that the less material and labour used the lower the cost and the higher the efficiency. We have been asked on several occasions recently "What is the best system of wiring?" The answer is that there is no one system that can be taken as the best system for all types and classes of buildings. The internal wiring for every building or type of building must be decided on its merits, after the local conditions have been studied and the use to which the building is to be put.

Assuming that a good screwed conduit system is the soundest for internal wiring, can we advocate that this shall be used in a highly decorated church or cathedral, where it may not be practicable to place it out of sight? Then we may have a factory where *all* wires can be placed entirely out of reach, and where the runs between the points are abnormally long, what possible advantage has screwed conduit over open cleated wiring (V.I.R. or cab-tyre sheathed) except to run up the cost? No, every proposed wiring installation must be decided on its merits, always keeping in sight the governing factor of "safety." If this were done, what vast strides we should make; no longer should we hear of lead-covered wires and "Stannos" being buried under plaster; we should no longer be horrified by the enormous waste of money caused by using steel conduit for wiring that is placed in such a position that it cannot be touched or disturbed.

There have been many arguments upon the relative costs of the many different systems of internal wiring, and it is a difficult matter to prove fairly, because, although you can assume certain conditions or take a certain type of building as a basis, in all probability it may be a foregone conclusion that one particular system is the only system that is permissible for that work; therefore the comparison of costs is not a fair or proper argument for or against the other systems contemplated, because the cost of installing is not, and must not, be taken as the governing factor, which must be in all cases "safety." Should the factor of safety be equal for two or more different systems in a particular type of building, then by all means let the question of cost be a determining factor for that particular job.

Then the only fair way to get a comparison of costs is to take out the quantities required for the actual work in question, not taking an average run, but pricing the job as a whole, and this can only be done accurately after the building to be wired, or the plans and details of same, have been seen and studied.

To illustrate how important it is to study each proposed internal wiring installation on its own merits, let us take the nett cost of fixing ¾ in. screwed conduit. We find that even when confining our inquiry to ordinary residential property the cost per foot run may vary from 8d. to 1s. 4d., according to the local conditions to be surmounted.

THE ESSENTIALS OF THE SYSTEMS.

In conclusion, it may not be out of place to set down how and when each different system should or should not be employed. In all cases where the work has to be buried under plaster the screwed conduit system should be used exclusively. For surface work, any system that complies with our foregoing conditions regarding safety may be used. "Stannos" wiring should only be used for surface work, and even then is restricted to installations having their own private supply, or to alternating current supplies from public companies if a double-wound transformer be inserted at the junction of the company's and consumers' mains. Lead-covered wiring should only be used for surface work, and great care must be taken to place it where it is not liable to mechanical damage. Cleated wiring should only be used when it can be placed in such positions that it is out of reach and not liable to be touched or disturbed. Wood casing should only be used on the surface, and never in positions subject to dampness. Flexible wire should never be used for circuit wiring under any condition.

Developments in the Supply World.

Progressive Station Engineers Tell Us What They Are Doing.

A GOOD idea of the development which is now taking place in the use of electricity for domestic purposes may be gathered from an examination of the increase in the number of consumers and in the number of units generated in any particular area. The person who is most concerned with both these figures is the station engineer. And for this reason, and because he is more closely in touch with the consumer than the manufacturer, the factor or even the contractor, what he has to say on present-day conditions is well worth hearing. We publish a number of such opinions below. They are unanimous about one thing—that electricity for domestic purposes has a great future before it. There is almost unanimity about something else—that to ensure that future in reasonable time there must be a co-ordination of effort by all concerned. We have no doubt about the essential truth of both these matters. As some of the statements given below show many undertakings are still suffering from war-time conditions, but all show their determination to push forward with the greatest speed which of they are capable.

Bolton's Domestic Developments.

By W. J. H. WOOD, M.I.E.E.

(Borough Electrical Engineer, Bolton.)

As Bolton is essentially a manufacturing town, the possible domestic load is insignificant, compared with the demand for power. At the same time considerable progress is being made, and a large number of applications have been received for lighting, cooking and heating. During the year ended March 31, 1920, 487 new domestic lighting consumers were connected to the mains, and their connected demand amounts to 407 kw. The domestic heating and cooking load connected to the mains during the year amounts to 201 kw., an increase of 100 per cent. over the year ended March 31, 1919. This is highly satisfactory, especially as from the number of applications and inquiries that are being received, there seems every prospect of this rate of increase being maintained for some time. At the same time no special efforts are being made to foster this load, and its rapid growth is no doubt due to the advantages the consumer derives from the use of electricity for domestic purposes. The price charged in Bolton to-day for domestic lighting is 5·1d. per unit, and 2d. per unit for domestic power, both subject to discount of 5 per cent. on accounts paid within 21 days. No meter rents are charged. These prices compare favourably with those in many other areas.

It is questionable whether the ordinary domestic lighting consumer actually pays at the price charged owing to the cost of providing the service at present-day prices, and the increased standing charges on the undertaking. But it is really necessary to encourage a domestic power load in addition to lighting, in order to produce the increased revenue required per service. Apart from this, it is the duty of the Electricity Supply Department as a public utility to encourage the more general use of electricity for all domestic purposes, even if the actual profit obtained from this particular class of supply is small, because it affects the general welfare of the community as a whole.

One of the difficulties met with, in the more general use of heating and cooking, is that the service originally installed for lighting only, is found to be too small when the consumer wishes to use a radiator or a cooker. This involves the cost of replacing the service by one of larger capacity. The same applies to the distributing mains in a residential district. These, in many cases, are rapidly becoming loaded up, especially on systems that have been in operation some time. But it is up to the Electricity Supply Authority to provide a cable network of adequate size to supply the needs of its consumers, whatever these may be.

A well situated and equipped showroom is, in my opinion, of the greatest advantage to the supply department as a means of encouraging the more general use of electricity for all purposes. But to be really useful it must be well stocked with a variety of the latest fittings and appliances. A number of these should be ready wired and connected up for demonstration purposes. The personnel in charge must realise that the articles on show are for sale, also that in dealing with domestic appliances, the customers, as a rule, will be ladies, to whom the artistic effect of the article as well as its utility will appeal. Window dressing for an electrical show room is just as necessary as for a milliner's shop, therefore, don't let us get into the habit of making a show of radiators in the summer and fans in the winter.

It is also necessary to co-operate with the wiring contractors in the district, and as a matter of fact, it will be found that wiring contractors, especially those in a small way of business, will make use of the electricity show room, even if it is run by the Corporation In many cases it is an advantage to the contractor not to have to carry an extensive stock, and by arrangement it is possible for him to obtain at reasonable prices any fittings and equipment he may require from the Corporation show room.

But when all is said and done, the main object of the electricity undertaking is to sell electrical energy, therefore, it really does not matter who sells the apparatus required for its use, whether it is the contractor or the Corporation, and if by establishing a show room, the use of electricity can be extended, the contractor is bound to have his fair share of any business going.

We have established extensive show rooms in Bolton, well situated in one of the main streets, and the venture has proved to be very successful and remunerative. Several of the wiring contractors have also established show rooms, and the fact that whereas, in 1913, there were about a dozen recognised wiring contractors operating in Bolton and to-day there are at least thirty proves that there must be money in the business, and that the efforts made by the Corporation do not crowd out the private trader.

A Showroom as a Development Agent.

By THOMAS ROLES.

(City Electrical Engineer and Manager, Bradford.)

I am glad to learn that it is intended to publish a special issue of The Electrician dealing with the development of domestic electrical appliances, and have no doubt that this will prove as interesting and beneficial to the industry as these special issues generally are. In Bradford we are adopting no special methods for developing lighting, heating and cooking loads, as it is taking us all our time to cope with the large number of applications that we are receiving for the supply of electricity generally.

We have recently enlarged our showroom where demonstrations of all kinds of electrical appliances are carried out, together with sales both to the trade and also retail; and we have no hesitation in saying that this method has been very successful, and in the near future we anticipate still further enlarging this department to the extent of having a 60 yds. frontage in one of the principal streets; also the whole of one floor, together with half the lower floor of our new office premises, will be devoted entirely to demonstration and sale purposes. From the above it will be gathered that we are of the distinct opinion that a showroom is of considerable advantage in extending the use of domestic electrical appliances, and the annual turnover that has been realised by this side of the department has been many times in excess of what was anticipated.

Regarding the question of co-operation with contractors, we are strongly in favour of this, and our experience has gone to show that a considerable amount of tact and appreciation of human nature must be the permanent characteristics of the person in the immediate charge of the sales department, otherwise the traders, rather than give support, will use every endeavour to cause obstruction with the ultimate object of closing such department entirely. The relationship between this department and the contractors, not only in this locality, but also in the surrounding districts, leaves nothing to be desired, and this is borne out by the large amount of business that is carried on between us.

Respecting the question as to the effect of increased domestic loads on our network, due to the use of additional domestic appliances, this matter has not caused us any anxiety up to the present time owing to the fact that our services and network are somewhat heavier than is found on the average distributing network. We certainly anticipate that the domestic loads in this district will develop, but the extent of the increase will, in our opinion, be largely governed by the success of electrical cooking apparatus, and the initial cost of the same, and also what charges for current can be profitably maintained to make their use advantageous in comparison with competitive devices. While this is a matter that the future will decide we, ourselves, believe that the outlook is more [illegible] hopeful.

The Domestic Load and Tariffs.

By C. G. MORLEY NEW.

(City Electrical Engineer, Cardiff.)

Probably like many other undertakings, we, at Cardiff, have been particularly busy since the war connecting up new consumers—in fact, during the past 12 months, we have connected practically double our previous maximum, and have, therefore, not done very much to increase our business propaganda.

In pre-war days, owing to the progressive policy of the Corporation in regard to extensions of cables to new properties and the continual following up of builders, we reached the position that practically without exception all new properties were fitted up electrically. In order to further heating and other domestic supplies, we reduced our rates to 1d. per unit and made no charge for meters. The result was that, whereas in 1912, we had 354 kw. connected, at March, 1920, we had no less than 3,077 kw., this latter being an increase over the previous year of 855 kw.

We have done very little with cooking loads as it seems impossible to push this business unless one is able to hire out the apparatus, and so far we have not availed ourselves of the facilities which the Electricity (Supply) Act, 1919, gives us. When we take advantage of these I have no doubt a showroom would be not only useful but necessary. We abandoned this some years ago because of the fact that anyone interested in any apparatus shown, had to be passed on to someone else instead of being able to close the matter whilst they were interested.

The whole question of increasing domestic supplies is wrapt up with that of a suitable tariff, and as an expedient we are considering the single-meter system, with an allowance at the ordinary lighting flat rate of a definite number of units, based on average consumption of similar properties, all above this number being at a rate which will induce consumers to adopt the many devices which are available. In this connection I consider that there is a very large field if one could increase the apparatus that can be run from an ordinary lighting circuit. Such apparatus would find considerable use in the summer months and could be dealt with, on account of the high diversity factor, by mains and services as they exist. When, however, it comes to the somewhat heavy heating and cooking appliances, no doubt this will be severely felt and cable extensions necessary.

In our case where the bulk of our residential consumers are taken from a single-phase network—now being changed over so as to be dealt with from the three-phase system—we could in many cases, with the existing system (transformer tanks) increase their number, and, in obtaining new feeding points, increase the capacity of many distributors without having to lay new ones.

We co-operated with contractors in the past in so far that we had available for their use a list of extensions contemplated, and we found a certain number availed themselves of this information, to canvass the particular routes covered. We now find that a number of new contractors have made their appearance, and must freely admit that they are adopting very energetic methods, but there are times when one feels that it would be better from a departmental point of view if their energies were directed a little more to districts in which distributing cables are already laid. Some co-operation is considered necessary with manufacturers in regard to the different appliances which one would like to see in more general use and which, under the powers now given us, we could hire out. Co-operation on the part of supply undertakings, in placing bulk orders for, say, flat irons, would undoubtedly reduce the price, and if in connection with such a scheme an arrangement could be arrived at whereby repairs and renewals could be carried out without each undertaking having to make arrangements themselves, it would help considerably in getting a large number of appliances into service, and a uniform hiring scheme and rates evolved.

Domestic Electricity at Newcastle.

By W. F. T. PINKNEY

(Lighting and Heating Engineer, Newcastle-upon-Tyne Electric Supply Co.)

The demand for new services for lighting purposes on the mains of the company has been so great during the last 18 months, together with a long waiting list compiled during the war, that it has been difficult to keep pace with new applications. Electric heating has been adopted in both residential and business areas to an extent which was scarcely anticipated a year or two ago. There is an increasing demand in Northumberland and Durham for electric cooking, particularly with the class of resident who normally employs one servant.

Current is supplied to domestic consumers who use lighting and two or more kilowatts of heating, at a fixed charge tariff based upon the lampholders installed, plus $\frac{3}{4}$d. per unit—the tariff being subject to an increase of 25 per cent. The tariff is popular and undoubtedly encourages good lighting and improved lighting load factor and is incidently a protection to the supply authority against future loss of revenue due to the introduction of high-efficiency lamps. The objections which might be advanced to basing the fixed charge on lampholders are not met with in practice.

The company has always adopted a vigorous policy in getting new business, and a number of trained engineer salesmen are employed who take every opportunity of keeping in personal touch with consumers and prospective consumers. Continuous advertising is carried out in picture theatres, &c., and a good deal of special advertising is done from time to time by posters, and by mailing consumers, generally with the object of obtaining increased revenue from existing consumers. Electric cookers, fires, kettles, irons, &c., are hired to consumers, but it has been found latterly that with the exception of cookers, the consumers prefer to purchase outright. Cooker consumers are periodically visited—usually by appointment—by a lady demonstrator, who gives any instructions, assistance, or advice, in the use of the cooker, if any is required.

With regard to the probable effect of the coming great demand for heating and cooking on existing networks little reliable information is yet obtainable. Generally speaking, we have found that in the outlying districts where the networks are small, the heating business has undoubtedly tended to load up the cables, but in the larger residential areas, this effect has not been felt. Those housing schemes which are to be electrically equipped throughout will supply very valuable information on the loading of cables and on the diversity of this class of load, and one such scheme which is to be supplied by this company will be completed at an early date, and one of the houses will be furnished and open to inspection by housing authorities for some weeks.

Due to the war, and subsequently owing to fuel and lighting restrictions, it has not been possible to observe the normal loading of the networks since 1914. This company considers it desirable to in some measure limit the amount of heating and cooking load in each district until after the coming winter, when the full effect of the existing lighting, heating and cooking connections under normal conditions will be known for the first time since pre-war days. In such districts where there is reason to believe that the networks may be fully loaded arrangements are already in hand for increasing their capacity.

The company has a showroom in the busiest shopping street of Newcastle, where up-to-date fittings and heating, cooking and other apparatus are sold. Only apparatus which has been tested and found reliable is stocked. The importance of this policy both to the company and to the consumer is that the inconvenience and cost of repairs is reduced to a minimum. This showroom, which is equipped with a kitchen for demonstration purposes, has been the means of introducing electric domestic apparatus of all kinds to consumers, and thus increasing the revenue from the sale of current. All wiring work is sub-let to electrical contractors in the district who, in addition, are allowed trade discount for fittings and apparatus purchased by clients introduced by them, and this is being taken advantage of to an increasing extent. Co-operation with the contractors is, of course, very desirable, and it is to the advantage of the electrical trades generally that there is a tendency among the contractors to equip and run showrooms of their own on much more up-to-date lines than has been done in the past.

Apart from the uses of electricity for heating and cooking in residential districts, there have been great developments locally in its use for commercial purposes, such as large heating installations in offices, and a number of electrically equipped kitchens for restaurants, cafes, works-canteens, &c.

A Power Company's Efforts.

By J. T. H. LEGGE

(Chief Engineer, Shropshire, Worcestershire and Staffordshire Electric Power Co.)

The development of the lighting, heating and cooking side of the electric supply business, and more particularly the two latter-mentioned, is having special attention by the Shropshire Company. There is little doubt that, with the high cost of services and extensions of distributor network for connecting small premises, the consumption of current for purposes other than lighting must be developed. More efficient lamps are now appearing in great quantities and the supply of electricity for lighting only, of small premises at the maximum rate permitted at the present time on commercial grounds is difficult to justify.

This company has, during the last six months, instituted a strenuous campaign with our already existing private residence and small business premises consumers, featuring the advantages of electric domestic appliances of various types, specialising, however, at first on flat irons and small cooker, which would take the place of the well-known gas ring. Two lady canvassers are engaged in this work. These lady canvassers were sub-station attendants during the war when male operators were unobtainable. Coupled with the campaign for private residences we are putting forward a "domestic supply" tariff, which consists of a fixed charge per quarter per room plus a charge per unit at the same rate as small power consumers for a certain percentage of the consumption, the remainder being charged at a low rate.

A show room is undoubtedly an advantage. The old type of show room, however, in which a multitude of fittings are displayed with very little room for demonstration purposes, is to my mind of small utility. In the show room of this undertaking we feature one article at a time, whether a vacuum cleaner, cooking appliances, flat irons, &c., and invite the co-operation of the contractors in our area, every facility being accorded for making use of our show room to the fullest extent. We make a speciality also of affording manufacturers of any particular apparatus every opportunity to give a demonstration in our show room, and assistance is given at such demonstrations by the commercial staff of this undertaking.

Progressive Methods at Wolverhampton.

By S. T. ALLEN.

(Chief Engineer and General Manager, Wolverhampton).

We have employed some definite methods of bringing about this healthy result First of all we instituted annual exhibitions in Wolverhampton on quite a progressive scale, and spent several hundred pounds a year in this connection. We built a model house, and we brought together perhaps 50,000 people annually and demonstrated to them in many ways the advantages of domestic electrical apparatus. At the same time I instituted systems of charging for electricity which were attractive, such as the differential system, which allows the consumer to pay a fixed amount per quarter as a standing charge and pay a lower price per unit for electricity. This tariff applied to the ordinary domestic consumer has generally resulted in the amount of energy taken being increased forthwith. The fixed amount is determined as a proportion of the rateable value in connection with ordinary domestic houses, and it is determined by the connections, having due regard to diversity factor, &c., in connection with the other types of premises.

In connection with small houses, especially those built under the housing schemes, when only lighting is required, we charge on the fixed price system, the consumer paying with the rent an amount per week for all lighting. This amount varies from about 1s. to 1s. 3d per week per house, depending upon the number of lamps, &c. The whole of the lighting in connection with the housing schemes of this County Borough have been arranged on this system, and since they have been in operation we have had no trouble. Further, it was realised that it was no good at all having exhibitions, pushing electricity supply for domestic purposes, without some ability to give the consumers an equitable and cheap scale of charges for utilising the electrical energy.

We have exercised full powers in connection with sales, hire and hire purchase. We have by this means been able to quote a consumer a fixed price per quarter for a complete installation, including wiring, heaters, standing charge, cookers, &c., together with, of course, a small running charge for the electricity used.

I quite realise that in future we shall have to look carefully into the matter of the distributing mains in the various districts, but the domestic load is in my opinion very remunerative, and we should not hesitate to extend the mains where necessary for the pump. One cannot help noticing that some engineers, although they may willingly wish to expend money on cables in their power areas, hesitate very much about putting a lot of money into distributors for residential districts. It is a good sound load, and if the electrical engineers have the courage of their convictions, they can develop it at quite a rapid rate.

Showrooms, I think, are very necessary. We have perhaps one of the finest, if not the finest, set of showrooms in the Midlands, in a main street. We are able at these premises to give demonstrations in connection with cooking, &c.

With regard to co-operation with contractors in the town, I have always endeavoured right through to assist the contractors as far as possible. The Corporation have full powers to carry out their own wiring work, and they exercise these powers to some extent, but in order to give the local contractors every encouragement and a large share in the installation work, we sub-let a very large amount of wiring work to them. For instance, last month we sub-let to the local wiring contractors something like £3,000 worth of wiring work. Consumers generally prefer the Corporation to advise them and to prepare complete specifications for wiring installations. When it is arranged that the work shall be handed over to a wiring contractor the Corporation does not attempt to compete, and we issue specification and tender forms to the various contractors in the town. The lowest tender, provided it is satisfactory, is accepted. A small percentage, the same in each case, is added to the lowest tender to cover the expenses of the Corporation in preparing the scheme and specification, obtaining the tenders, supervising the work and guaranteeing the work to the consumer for a period after completion. This proves a very satisfactory method of dealing with the matter for all parties. It gives the consumer a feeling of satisfaction in knowing that his accepted tender is the result of really fair competition, all the contractors having had to tender to exactly the same specification, and the contractors also realise that the conditions are fair. Evidence of the satisfactory arrangement is shown in the fact that whereas before the war there were only about four electrical wiring contractors in this town, we have now at least 20 who have their offices in the town.

I think the essentials for good results with a domestic load are :—(1) A sensible tariff by which consumers can receive comparatively cheap supplies of electricity on some simple basis which they can understand ; (2) exercising in the easiest possible way all the necessary powers for hire, hire purchase, &c. ; (3) the elimination, as far as possible, of all complicated agreements for hire, hire purchase, &c. ; (4) a properly organised sales and installation department, the heads of which are enthusiastic in their work. The people, as a whole, in my opinion, are keen enough. They, however, do want more information in detail about costs, &c., than they generally get. The Electrical Development Association pamphlets, &c., assist to a great extent, and I am hoping that we shall get greater benefits in this direction in the future, especially when all the authorities in the country agree to fall into line with those pioneers who have helped to raise the necessary money towards that Association and pay up their share of very necessary costs.

Where Showrooms have been Found Useful.

We have published above representative opinions from station engineers upon the various problems with which they are at present faced in connection with the development of the domestic load. In addition, a number of other engineers have kindly supplied us with information relating to their undertakings, and this information is summarised in what follows :—

At Aberdeen progress is satisfactory. Heating connections have increased from 2,400 kw. to 3,100 kw. during eleven months to June 30, 1920. There is a showroom in the centre of the city whence heating and cooking appliances are hired, but though no special measures have been taken to push the use of domestic appliances. The idea has caught on. There is, however, a large field to be tapped, and the problems of main sizes and voltages will require careful consideration. There is also a need for a satisfactory hot-plate, which will boil water in a time comparable with that taken by a gas ring. Plates of the red-hot type which have been tried in Aberdeen burn out too frequently, and the cost of repairs makes the use of these plates a luxury rather than a commercial proposition. An interesting point as regards the lighting load is the frequency with which the 100 watt gas-filled lamp has replaced the 60-watt vacuum lamps, especially for shop lighting. This has caused quite an unexpected peak.

At Brighton a publicity department and small showroom are used for pushing the use of heating and cooking. The former was readily taken up during the war, but the increase in charges which have lately been necessary are now hampering its development. The power load is increasing enormously, but the lighting load is still feeling the effect of summer time and early closing. Mr. Christie states that he has always co-operated with contractors, and looks upon them as his best canvassers.

Owing to the shortage of plant, the Charing Cross, West End & City Electricity Supply Company find that the normal increase of business is as much as they can comfortably deal with, so no special campaign is being conducted. They have always had a showroom, and have found it of considerable value, though that value cannot be measured by the actual amount of profit on the sales. As soon as possible heating and cooking will be encouraged by having a lower rate than the 2½d. at present in force.

At Derby there has been for some years past an active commercial department, which in 1913 carried out a cooking campaign by means of weekly lectures and visits to consumers' houses. This useful work had to close down in 1915 owing to the increasing demand for supply for munition work, but the showroom is still in operation in the centre of the town, and large sales are reported every week. We are glad to learn that this showroom is very much used by local contractors, with whom satisfactory working arrangements have been established.

At HULL, all surplus energy and initiative is being devoted to the power load. The showroom is an absolute *sine qua non*, but co-operation with contractors has not been a success.

The KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING COMPANY have no doubt that a showroom is a useful and necessary feature, as it enables inquirers to obtain unbiased information on any point relating to lighting, heating and cooking apparatus. Hiring has been in force in the district of this company for some years, but no attempt is made to compete with local contractors. There is a steady demand for heating and cooking apparatus, though this would be greatly increased were it not for the uncertainty of supplies and high prices. The gradual conversion of large residential premises into flats which is taking place in this district, and the domestic servant difficulty, are likely to cause the continuance of this demand.

At POPLAR the interesting step has been taken of giving substantial assistance to the Council's housing scheme out of the electricity department's funds. About 140 houses are to be erected. Limiters will be fixed in each house, and a minimum charge for supply and maintenance of 1s. 3d. per week for 90 watts will be made. This will not preclude a higher limit being fixed or the supply being given through a meter when desired. In many cases coal fire ranges are being satisfactorily converted to electrical working without making them unsuitable for their original uses. This is a distinct advantage in the winter months.

The WESTMINSTER ELECTRIC SUPPLY CORPORATION have a well-organised development department which keeps the company in close touch with all the electrical men in their area. Apparatus is hired out and kept in order by a maintenance department. There is a fine showroom at the offices in Eccleston-place, and the heaters of Belling, Quead and Westminster types have been standardised owing to their solid construction. The number of calls at the showroom and the business resulting therefrom are considerably greater at present than they were in 1918.

Undertakings with No Showrooms.

At BIRMINGHAM Mr. Chattock reports that the domestic developments of electricity have not been satisfactory recently, owing to the restrictions imposed on the undertaking during the war, and the fact that the power load in the district is now 12,000 kw. more than it was during the war. The generating plant is fully loaded, and no further connections can be made until the delivery of the new plant is accomplished. The showroom has not been re-opened since the war.

At DUNDEE there is at present no showroom, but Major Richardson thinks that to open one will not only be an advantage, but essential in connection with a general scheme of hiring apparatus. Unfortunately Dundee is at present faced with a shortage of plant, and no development can therefore be undertaken until the undertaking is in a fit position to give supplies. Major Richardson is so firm a supporter of co-operation between the contractor and the supply authority that he is not prepared to go on with the scheme outlined above unless he receives their hearty support. At present, however, they are lukewarm.

The shortage of plant is also preventing development at GRIMSBY, and Col. Vignoles has therefore not yet started any post-war campaign of development. Nevertheless the demand for electricity for lighting small houses and for heating and ironing and electric washing machines is very brisk. Col. Vignoles makes an interesting point that no difficulty need be anticipated on the network owing to the increase in the domestic load, as if the heating load grows the price should be so fixed that it is remunerative and will pay for any additional services required, while the distributors are greatly helped by the cross-connecting resulting from mains being laid in side streets. The real difficulty, however, is to ensure that in small houses now being connected electricity is used for purposes other than lighting, otherwise the supply will be unremunerative.

At LEEDS the demands for lighting are increasing more rapidly than they can be dealt with, while heating is also increasing satisfactorily without pushing. In this case the very wise policy is adopted of advising consumers against doing such foolish things as installing too small radiators. Cooking is handicapped by there being no hiring scheme. At present there is no showroom in Leeds, but Mr. Hefford is proposing to open one when the extension to the office is finished. He considers co-operation with contractors most desirable.

At LIVERPOOL Mr. Dickenson thinks that it is inadvisable to press the use of radiators, cookers and other domestic appliances, owing to the way the mains are overloaded, though there is a growing demand for these appliances. Every endeavour is made to co-operate with contractors, but there is no showroom.

Trouble is already being experienced at MAIDSTONE owing to the pressure drop due to the use of large cookers and mains laid nearly 20 years ago when the wildest dreams did not extend to a maximum load of 10 kw. in a moderate-sized house. Although there is no showroom at present at Maidstone, Mr. Hoadley is strongly of opinion that such means of development is a very paying proposition and that co-operation with contractors is to the advantage of the undertaking. His hiring scheme, which was put into operation at the end of June last, has been a very great success.

MANCHESTER is one of those fortunate places where there has been little necessity to push the sales, though prior to the war efforts were made to increase the load by use of advertisements and circular letters and personal canvassing. The corporation so far has not deemed it necessary to open a showroom, but has made use of those owned by a large number of electrical contractors. There has always been the closest co-operation between these contractors and the officials of the undertaking.

ROCHDALE is another of those districts where the power load is is almost all-absorbing. There is, however, a considerable demand for radiators, irons and vacuum cleaners, though cooking has not appealed to the public owing to the high price of utensils. Mr. Rudd is the happy possessor of an "all-electric" house, which he is always willing to show to interested inquirers, and although there is no showroom, a "Carrron" oven for demonstration purposes is fixed at the head office of the undertaking. Co-operation with contractors has always been very close. Mr. Rudd considers that the increasing efficiency of lamps will necessitate the consumers using electricity for other domestic purposes than lighting, if sufficient revenue to cover capital and running costs is to be provided. For this purpose an ideal tariff would be one covering the use of electricity for all purposes at a flat rate.

At SALFORD new connections have to be discouraged owing to delays in the delivery of plant. Mr. Robertson finds that lighting needs no special encouragement, and it is now being installed in all new houses and buildings, whilst it is also replacing district gas lighting very rapidly. Owing to the character of the neighbourhood the development of electric heating and cooking has not been very great, but should this occur serious attention would have to be paid to the network question.

At SHEFFIELD the demand for power has also been such as to preclude the possibility of organising any new campaign for the development of the domestic load. In such a campaign, Mr. Fedden thinks a showroom would undoubtedly be an advantage. He has had little experience of co-operation with contractors owing to the fact that the undertaking has its own installation department.

Mr. D. M. KINGHORN finds that in SOUTHWARK electricity development is very much retarded by delays in delivery of materials. Cooking, he thinks, except to a very limited extent, is not likely to develop unless the cost of apparatus can be reduced. On the other hand, heating will increase in spite of the fact that manufacturers do not seem anxious to tackle this particular line seriously. Co-operation with contractors is so close that in Southwark a showroom would be no advantage. Mr. Kinghorn emphasises the fact that the general uncertainty is very much a disadvantage in making any plans for development.

At STOKE-ON-TRENT delays in plant delivery are also retarding development. In this district as much as half a million in extensions and additional mains will have to be spent owing to the fact that the old pre-federation boroughs laid down distributors of 7/16 outers and 7/18 midwires for a three-wire low-tension system. Mr. Yeaman also has had the unusual experience of finding that a showroom was utterly ineffective, and it was closed some years ago. There is, however, close co-operation with contractors, with results that are more likely to be satisfactory, in Mr. Yeaman's opinion, than if a large showroom was opened and a large staff was established to compete disadvantageously with local firms.

At SUNDERLAND the applications for lighting connections are being received at a satisfactory rate, but there is a distinct lull for supplies in lighting and cooking, possibly on account of the price or lack of apparatus. A showroom which was opened for some years was closed during the war, and it is not proposed to reopen it for the present. It is been hoped that the close co- operation with the local contractors will provide what is needed in the way of publicity.

At WEST HARTLEPOOL there was also a showroom before the war, but this was closed, and it has not yet been reopened, though it is hoped to do so in the future. The department had always co-operated with contractors, and as heating and cooking is still available at 1½d. future developments should be very satisfactory.

New Heating and Cooking Apparatus.

A survey of the whole field at the present time shows that electric cooking continues to progress, particularly in connection with large installations for restaurants, canteens, &c. Some of these, as for instance that at Messrs. Debenhams, have already been described in THE ELECTRICIAN. We are pleased to notice also that electric heating and cooking is becoming increasingly popular for marine work, both cargo and passenger steamers and in the Navy

At the time of the "Ideal Home Exhibition" early this year at Olympia, many new pieces of apparatus were described in these columns.* This matter has not been re-inserted here, but the apparatus mentioned in the following pages in conjunction with that already described is representative of new designs and present tendencies. The outstanding novelties herein described are an electric still by SIMPLEX CONDUITS LTD.; a "Plexsim" oven by the same firm which has a removable oven interior for cleaning; the "Magnet" four-unit pedestal heater; and a "Magnet" electro hot water radiator installation in a cigar store. Many notable improvements in design are recorded in our notes concerning the Jackson Electric Stove Company, Ltd.

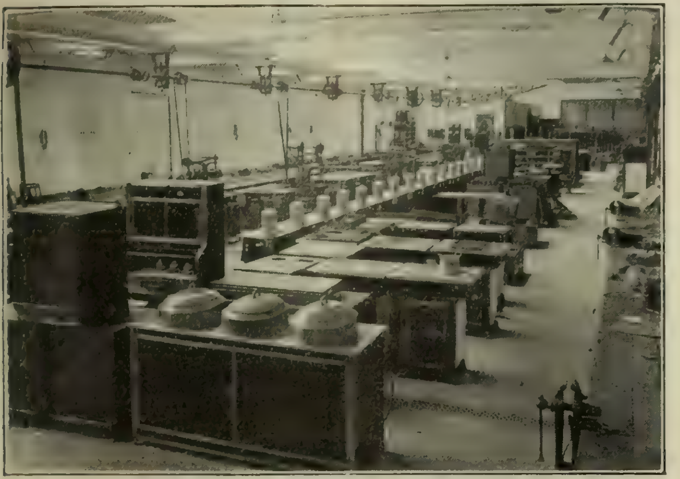

FIG. 1.—A PORTION OF THE NEW JACKSON WORKS AT WATFORD.

During the past 12 months a number of firms have made preparations for producing electric radiators, irons, kettles, &c., on a mass production basis, and during the coming season there should be no question of shortage of apparatus. In addition to Tricity House, there are now show-rooms open in London at the premises of the Jackson Electric Stove Company, Ltd., and Touchbutton House (Berry's Electric Ltd.), where demonstrations of electric cooking and labour-saving appliances are given. In some quarters it is stated that there is difficulty in making extensions to the mains for heating and cooking. Undoubtedly there is an element of truth in this, but so far as the smaller appliances are concerned, such as irons, kettles, &c., there is a wide diversity factor in the load they create. Further they form useful missionary work for the installation of larger appliances and for advertising the advantages of electricity to visitors to the houses in which they are used. It is to be hoped therefore that supply authorities in difficulty, due to overloaded mains and generating plant, will not cramp the progress in demand which has largely come as the result of earlier propaganda. It must be remembered that changes in habits and modes of living are slow in coming about, and it would be a mistaken policy to damp down demand because of temporary restrictions and difficulties. Such action means that a much greater effort will be required to re-awaken the demand which has been previously disencouraged. Propaganda takes time to produce an effect, and now is the time to support those who are endeavouring to arouse public interest, so that the demand may be ready when generating conditions have returned to normal and an increasing load will be welcome.

The considerable amount of space which is at present being devoted to electrical appliances for the home in the general Press is a most valuable aid to those sections of the industry interested in the sale of domestic electrical appliances. Another factor which will contribute to the development of this branch of the industry is the shortage of domestic labour, a condition which is not likely to change.

JACKSON'S PROGRESS.

After spending several years in what can be truthfully termed pioneer work, the JACKSON ELECTRIC STOVE COMPANY, LTD., have now planned and built a new factory at Watford for the manufacture of cooking and heating apparatus designed on lines which specialised experience indicates will be successful. A view in these works is shown in Fig. 1. With the provision of a modern factory, it was decided that to ensure success adequate selling effort would be required, and new show rooms have, therefore, been opened at 143, Sloane-street, S.W.1., and the services and experience of Mr. Gillett (of the Newcastle-on-Tyne Electric Supply Company, Ltd.) secured as sales manager. These are illustrated in Fig. 2. In addition, an advertising campaign will be commenced with a view to educating the public to the advantages of electric cooking.

During the war roasting and baking ovens were supplied to the Ministry of Munitions, some of which were capable of baking 300 lb. of meat at a time. The Royal Flying Corps, the War Office and Admiralty each claimed part of the Jackson output, and, in addition, a number of National kitchens were fitted with electrical cooking plant to the order of the Ministry of Food. In face of these war claims work, civil requirements naturally receded to second place, but, nevertheless, notable installations for staff cooking were made at Selfridge's, Swan & Edgar's and Cannick's of Newcastle-on-Tyne.

At the new show rooms staff meals will be cooked daily, and records kept for the information of customers. It is intended that these show rooms should be used by the trade to the fullest possible extent. The information and experience gained by the company will be placed freely at the disposal of contractors and supply authorities, and experienced representatives will be available to assist in planning installations and advising customers. A very wide view is being taken of the idea of rendering service to the trade and assisting trade customers to secure orders in connection with restaurants, staff kitchens, housing schemes, &c.

With regard to the cooking apparatus displayed in the show rooms, we were particularly impressed with the robust design. The oven interiors are of plain mild steel, close rivetted together, and when the door is shut the oven is practically a sealed chamber. The space between the oven interior and exterior casing is closely packed with lagging, and the interior portion is practically free from mechanical contact with the exterior frame, thus reducing heat conduction losses to a minimum. In the hot cupboards we noticed that the sides and back were lagged, a feature which is certainly to be commended, and which we have been surprised has not been made general practice in hot cupboard design. Another development in design occurs in connection with fish friers. These are made of mild steel plate with dull nickel-plated interiors, all seams and joints being welded. The studs holding the elements to the underside are welded, so that drilled holes are avoided, and if the apparatus boils dry no damage by leakage is likely to occur.

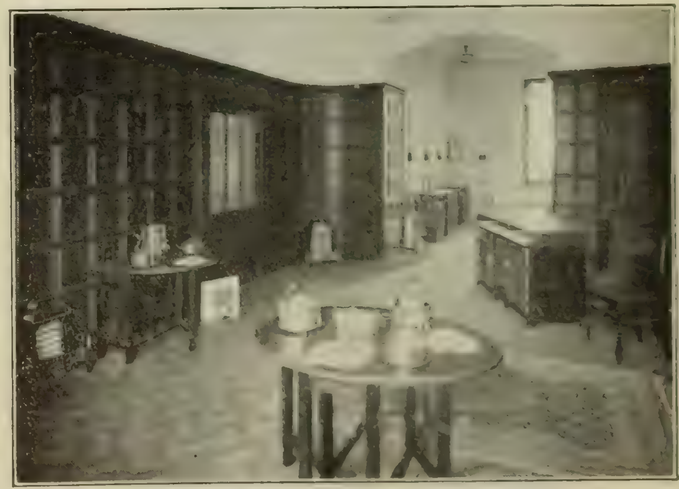

FIG. 2.—A GENERAL VIEW OF THE JACKSON SHOWROOMS.

The robust nature of the frame and mechanical design in general has been followed out in the electrical portion of the apparatus as well. The connections and leads from the terminal box to the actual heating element are made of solid rod or strip, thus all loose leads, &c., are replaced by rigid connections. The strip or rod connections are carried on porcelain insulators, and it should be noted that no wiring or connections are run through the lining of the oven. Mica insulation is dispensed with in the interior of the oven, porcelain being used instead. For convenience of splitting the load on alternating-current circuits, all double oven ranges are made with two separate terminal boxes for each hob and oven. The open type elements employed in the ovens operate at a radiant temperature, but are not heavily loaded, with a view to increasing their length of life. In connection with boiling apparatus and self-contained utensils, the same principle of strip or rod connections is carried out. The elements are connected together on the "ring main" principle, the end connection to the element being always under mechanical pressure. A nickel strip or "tag end" is employed to connect the element to the ring main. The boiling plates of the open type are rectangular in shape, and whilst permitting three-heat regulation, are designed to emit radiant heat even on low heat. The arrangement is shown in Figs. 3 and 4.

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* *See* THE ELECTRICIAN, Vol. lxxxiv p. 170, Feb. 13, 1920.

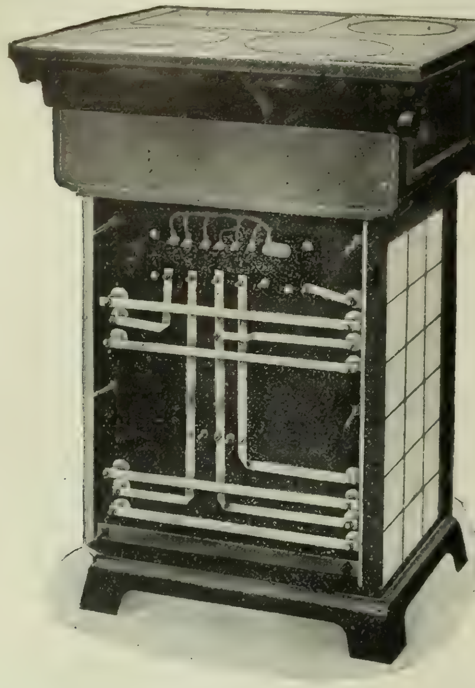

Fig. 3.—View of the Jackson Oven, showing Connections.

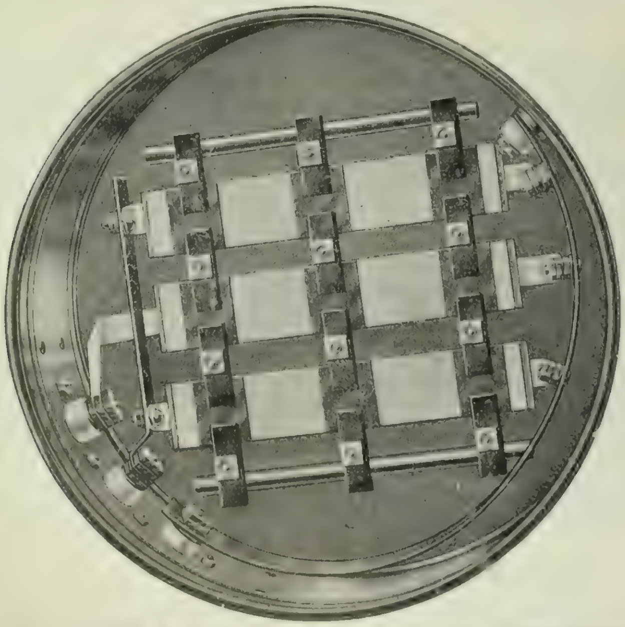

Fig. 4.—View of Jackson Hot Plate, showing Connections.

All Jackson radiators have cast-iron bodies, designed to be easily taken apart, and supplied in a number of designs and finishes. The standard fire bar consists of three pieces of grooved fireclay held in position by two iron strips fixed behind the bar, and which form the connection or terminal bars. Each end is slotted to fit studs on the radiator frame, which practice overcomes the necessity o twisting wires to form a connection. The front surface of the fireclay bar is curved to provide additional radiating surface, and the element consists of a spiral wire wound on the front surface of the bar only The soundness in design and construction of the various Jackson appliances indicate that this firm at least have realised that for electric cooking to become popular the apparatus must be thoroughly reliable.

Due regard has also been given to the requirements of the cook Small details of convenience, such as mounting rotary switches in a tilted position to permit easy reading of the indicator, have not been overlooked. Elements are of standard sizes, and can be removed or replaced singly without disturbing the connections of other elements. In the larger cookers a removable lagged shelf is provided which can be used to divide the oven into two equal portions, and the elements of each section are arranged for individual three-heat control, thus tending to economy in cooking when requirements vary considerably. Alternatively, this arrangement permits one-half the oven to be used for roasting and the bottom half for baking.

Fig. 5.—"Plexsim" Shaving Pot.

Fig. 6.—"Plexsim" Curling-Tong Heater.

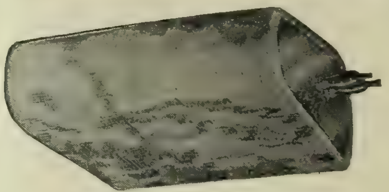

Fig. 7.—"Plexsim" Foot-Warmer.

"Plexsim" Appliances.

In a recent issue we referred to the commendable selling scheme which had been prepared by Messrs. Simplex Conduits, Ltd., in connection with their "Plexsim" electric iron. It is pleasing to hear that the results obtained since the commencement of this campaign have been very gratifying. Whilst the Press advertising and main efforts have been devoted to the sale of domestic irons, the specially designed cartons have also been used in connection with other household devices such as "Plexsim" kettles, firettes, toasters, curling-tong heaters, shaving pots, pipe lighters, one-bar fires, saucepans, foot-warmers and bed-warmers. Dealers and contractors can, therefore, make an effective window display of the "Plexsim" series, and any article in the series can be supplied to the customer packed in an attractive carton, ready to give away as a present. We illustrate here (Figs. 5 to 7) the "Plexsim" shaving

Fig. 8.—"Plexsim" Electric Still.

pot, curling-tong heater and foot and bed warmer. The shaving pot consumes 150 watts, the curling-tong heater 100 watts, foot warmer 50 watts, bed warmer 20 watts. Each of these articles is supplied complete with flex and adaptor and can be used off an ordinary lamp-holder. The finish and workmanship are quite equal in quality to the irons and other Simplex products, and in every case spare elements can be obtained and easily fitted.

Another interesting piece of "Plexsim" apparatus is the electric still, shown in Fig. 8 This is a strongly made piece of apparatus and special care has been taken in the design to make all parts readily accessible. Two sizes are made, having an hourly output of 4 pints and 4 gallons respectively, the loadings being 2,000 watts and 16,000 watts.

The "Plexsim" oven shown in Fig. 9 is constructed of sheet steel framework, the outer casing of the oven being heavily lagged. The interior or oven portion proper is in the form of a removable box, which, when taken out, gives easy access to elements and connections. Also the box when removed can be quickly and effectively cleaned. On the top of the oven is mounted a plate warming compartment. The oven casing is earthed by means of a spring under the connector which so connects to an earth lead. Three heat regulation is provided by means of a rotary snap switch mounted on the side of the oven together with an indicating lamp. The consumption on the highest heat is 1,200 watts.

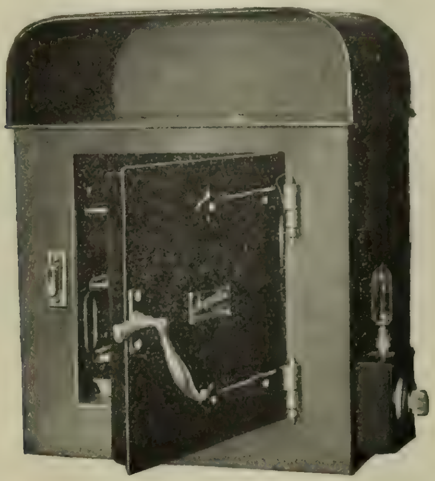

Fig. 9.—"Plexsim" Oven.

The "Plexsim" selling organisation are also handling the "Purser" oven, and "Creda" irons, kettles, fires, &c.

New "Falco" Apparatus.

During the past 12 months considerable extensions to both buildings and plant have been made by the Falkirk Iron Company, Ltd., in order to cope with the increasing demand for "Falco" heating and cooking appliances. In considering designs for new apparatus special attention has been paid to the requirements of the export market. A new catalogue is at present in the Press, and copies will be forwarded to all trade inquiries so soon as the issue is printed.

This company has installed a number of all electric plants and also some combination sets for use in conjunction with steam, gas, coal and oil fuel. Many of these large plants are of considerable size and have a loading of over 100 kw. During 1920 electrical cooking equipment has been supplied for use in the galleys of four large passenger vessels, as described in our Special Marine Issue a week or two ago, and several cargo boats, and other plants of similar character are in process of construction in the works. Cooking apparatus for marine work is constructed on much heavier lines than that required for land service, due to the additional strains caused by vibration, rolling, &c. In addition to marine installations several cooking plants have been installed in hotels, and institutions both in this country and abroad. The "Falco" 1920 domestic cooker as shown in Fig. 10.

Kettles and irons are also being made on a mass production basis and for small apparatus of this class a special type of connector has been devised after a prolonged series of tests. A new series of "Falco" sheet metal fires are in course of development and these we hope to describe in a future issue, so soon as they are ready for distribution to the trade. The latest "Falco" hot water heater can be supplied to any desired rating from 500 watts to 4 kw. with heat regulation by means of rotary snap switches. They can be obtained as heaters only for fitting to existing systems, or complete with cylinders constructed of galvanised iron or copper.

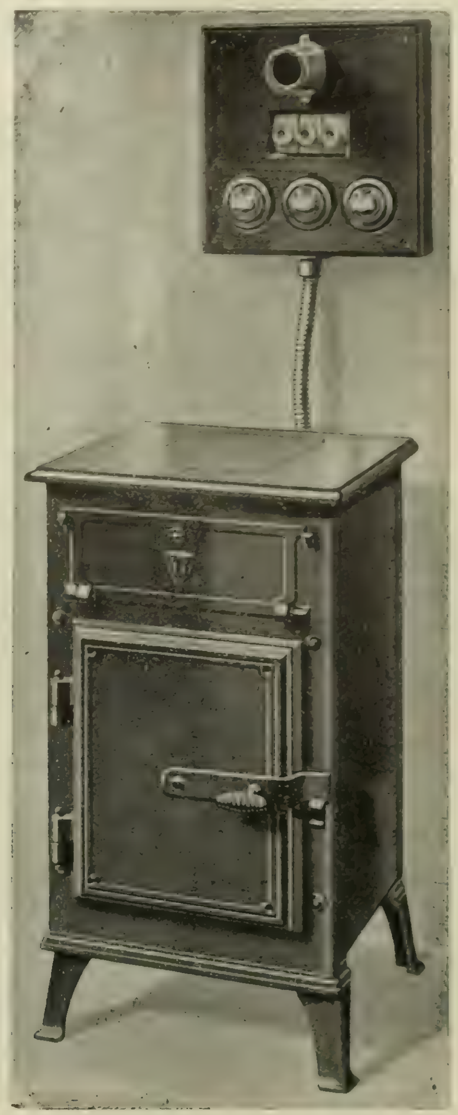

Fig. 10.—"Falco" 1920 Domestic Cooker.

"Magnet" Heating Appliances.

During the past season many new designs of "Magnet" appliances have been produced by the General Electric Company Ltd., and further new types are in process at the works for production during the coming season. Most readers will remember the small but effective pedestal heater first shown at the "Ideal Home" Exhibition at Olympia. This heater has been further developed by providing two, three or four 600-watt units on one base, each unit being mounted so that the heat rays may be focussed in any desired direction. Also each unit is controlled by a separate switch. Thus in the four-unit type each unit can be used independently for reflecting a beam of heat into any desired quarter of a room, or alternatively fixed horizontally and used for cooking or boiling purposes Fig 11 shows clearly some of the various purposes for which this type of heater can be employed.

The "Magnet" electrically heated hot water heaters are becoming increasingly popular for use where radiant heating is either not desired or unsuitable. Two types of this heater are made—the "Column" and the "Cabin"—both being similar in principle, and made of steel and brass throughout, cast iron with its cumbersome appearance and liability to breakage in transit being entirely dispensed with. As will be seen from Figs. 12 and 14, which show the cabin type in perspective and section, respectively, the appliance is a hot water radiator, with an electric immersion heater, and radiation is effectively obtained by means of a number of heat distributing gills. Three heat regulation is provided for by means of terminals which are intended for connection to wall mounted switches.

The "Cabin" type is made in five sizes from 500 to 1,500 watts capacity and can be used for either wall or floor mounting by the adjustment of detachable supports. The "Column" type is made in eight sizes from 1,000 to 3,000 watts and is designed for floor mounting. In Fig. 13 a number of "Cabin" type heaters are shown mounted in a cigar stock room, where thermostatic control is employed to maintain a constant temperature, day and night, with the aid of these heaters.

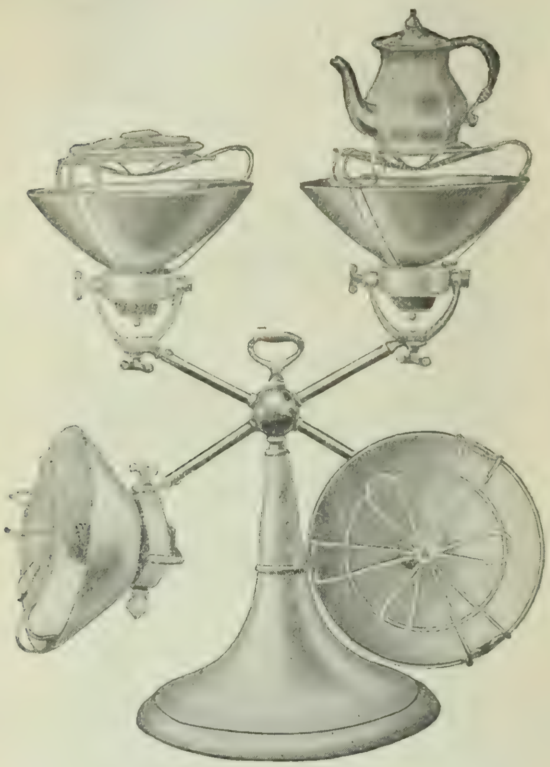

Fig. 11.—"Magnet" Four Unit Type of Pedestal Heater.

A development of the hot water radiator is the "Magnet" gown and towel rail, which is essentially an electrically heated system of hot water pipes made up into the form of a towel or gown rail. Electrically heated rails of this type offer many advantages over similar appliances heated by hot water drawn from a central tank. No piping for feed water purposes is necessary and the temperature can be regulated as required independently of hot water required for other domestic purposes. "Magnet" rails are rust proof and hold but a few pints of water, which circulate on the low temperature gravity principle. In addition to drying or warming towels, airing or warming clothes, &c., these rails can be employed for warming the air in a bathroom and reducing the condensing action of cold air on the steam from a hot bath.

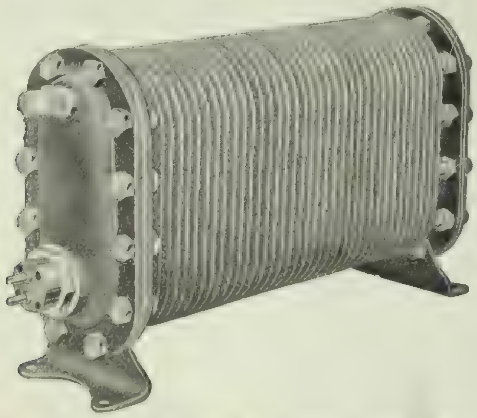

Fig. 12.—"Magnet" Cabin Type Electric Hot Water Radiator.

With the introduction of an electrically heated hot water system for domestic purposes in the form of the "Magnet" hot water calorifer the range of "Magnet" appliances for lighting, heating and cooking in the home becomes complete. The standard size "Magnet" hot water heater for domestic use has a 20-gallon tank and the water is heated by means of a dual immersion heater loaded to 3 kw. and provided with three heat regulation.

A few minutes after switching on a small quantity of hot water can be obtained and the full supply of 20 gallons becomes heated in about 2½ hours. If desired thermostatic control can be arranged so that the electrical supply is "cut off" or "switched on," as the temperature of the water falls above or below a predetermined temperature. The chart shown in Fig. 15 clearly indicates the performance of this apparatus.

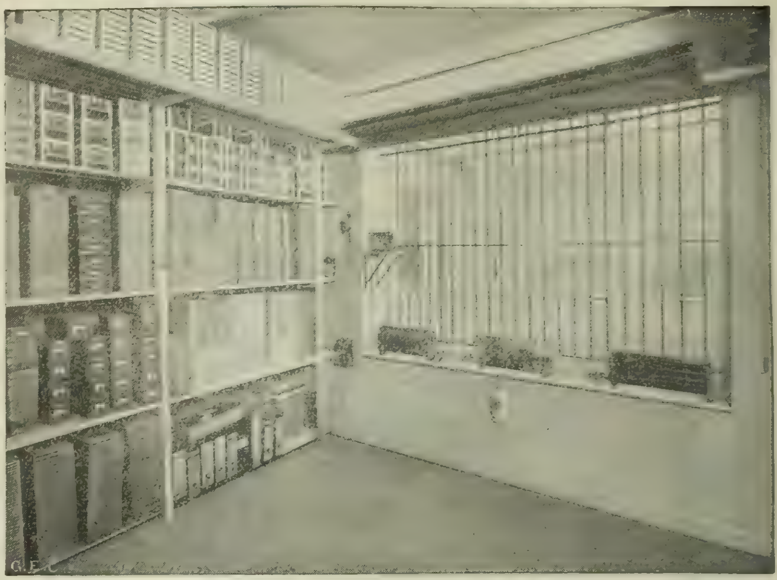

Fig. 13.—"Magnet" Hot Water Radiators Employed in Heating a Cigar Store.

Carron Progress.

Considerable progress has been made by the Carron Company during the past five years in the development of electric cooking on a large scale for canteens, restaurants, &c. Owing to many of these installations having been carried out in connection with war work it has not been possible to publish details or photographs of individual installations. In addition to equipment for land installations, a considerable number of equipments have been supplied for marine purposes and specially designed appliances produced to meet the special conditions entailed in marine service. A typical Carron canteen equipment is shown in Fig. 16, which is a photograph of the electric kitchen in a large steel works. The general service table occupies the front of the photo, and behind this is a combination set of six ovens and ranges. On the left end of this set are fixed warming and carving tables, whilst along the left-hand wall can be seen a pair of baking ovens and vegetable boilers.

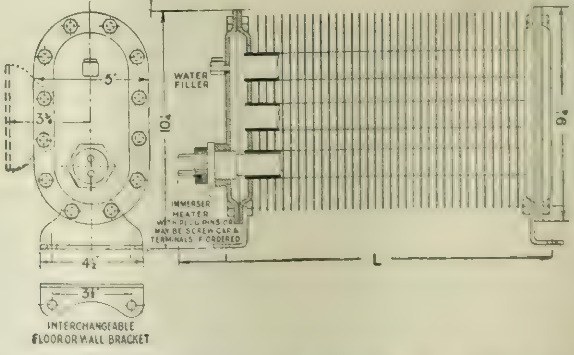
5"
3¼"
10¼
WATER FILLER
9"
IMMERSER HEATER WITH PLUG PINS OR MAY BE SCREW CAP & TERMINALS IF ORDERED
4½"
L
3½"
INTERCHANGEABLE FLOOR OR WALL BRACKET

Fig. 15.—"Magnet" Cabin Type Electric Hot Water Radiator. (Sectional view.)

In addition to what may be termed the heavy type of apparatus, this firm also manufacture a complete range of cooking and heating apparatus for domestic requirements from the humble iron or kettle to radiators, hot water boilers and cookers. The choice of finishes and styles in the new patterns of electric radiators is particularly wide, and this firm have succeeded in producing an armour bright finish for radiator frames, which is rust proof. The range of domestic electric cookers has been added to by the addition of a small cooker suitable for small houses and flats. It comprises a lagged oven 12 in. cube inside measurement and heated by a bottom element, and an open coil top element. The top element is also intended for use as a grill and toaster. Above the oven is mounted a small hot closet for warming plates, &c., and a hob plate above with central element completes the equipment, with the exception of the usual shelves, drip tin, &c., and a teak-wood switchboard comprising rotary switches, fuses, and an indicating lamp connected across the main terminals.

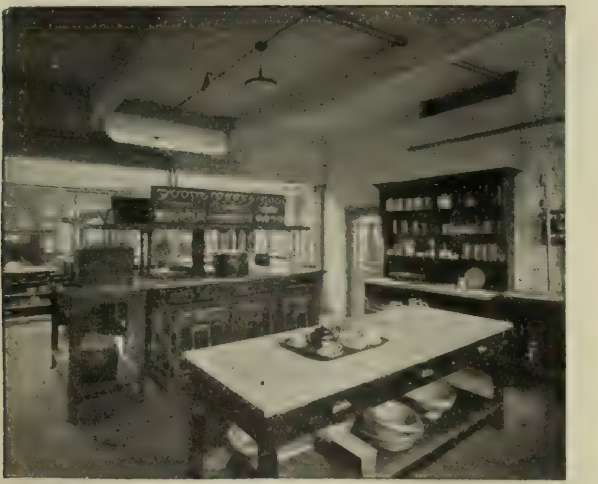

Fig. 16.—A Typical Carron Canteen Equipment in a Large Steel Works.

"B. & K." Apparatus.

The Brompton & Kensington Accessories Company, Ltd., were one of the early pioneers in connection with electric cooking, and it is therefore only to be expected that their range of apparatus offers a wide selection and provides for equipping installations of the largest size. Much of this firm's apparatus has been illustrated and described in our columns from time to time. In the domestic section their Model "C" cooking range is a self-contained unit suitable for a family of 8 to 12 persons, and there are in addition smaller ovens which can be used in conjunction with a small grill or a small hot-plate range, forming an equipment that can be used on the kitchen table and providing sufficient cooking facilities for a small family. For quick boiling purposes a kitchen kettle has been designed. It is made of heavy block tin and fitted with a replaceable immersion heater element, loaded to 1 kw. Four pints of water can be boiled in 14 minutes and two pints in eight minutes. A similar piece of apparatus is made in the form of quick boiling hot water jug, this being offered in plain block tin or nickel plated finish.

A "Tricity" Office Radiator.

In the larger offices some form of local heating is often desirable, because there are positions where a desk is some distance from a main radiator or heat source. Also floor draughts and windows are a frequent source of inconvenience in cold weather. The radiator illustrated in Fig. 17, manufactured by the British Electric Transformer Company, Ltd., offers a very suitable means of obtaining local heating. It essentially consists of a radiant heater bar, consuming 500 watts, mounted on sheet metal deflector plate, the apparatus being screwed to the wall or skirting by means of lugs. So used, it tends to warm the air entering in the form of a floor draught, or alternatively would serve a similar purpose when mounted under a window.

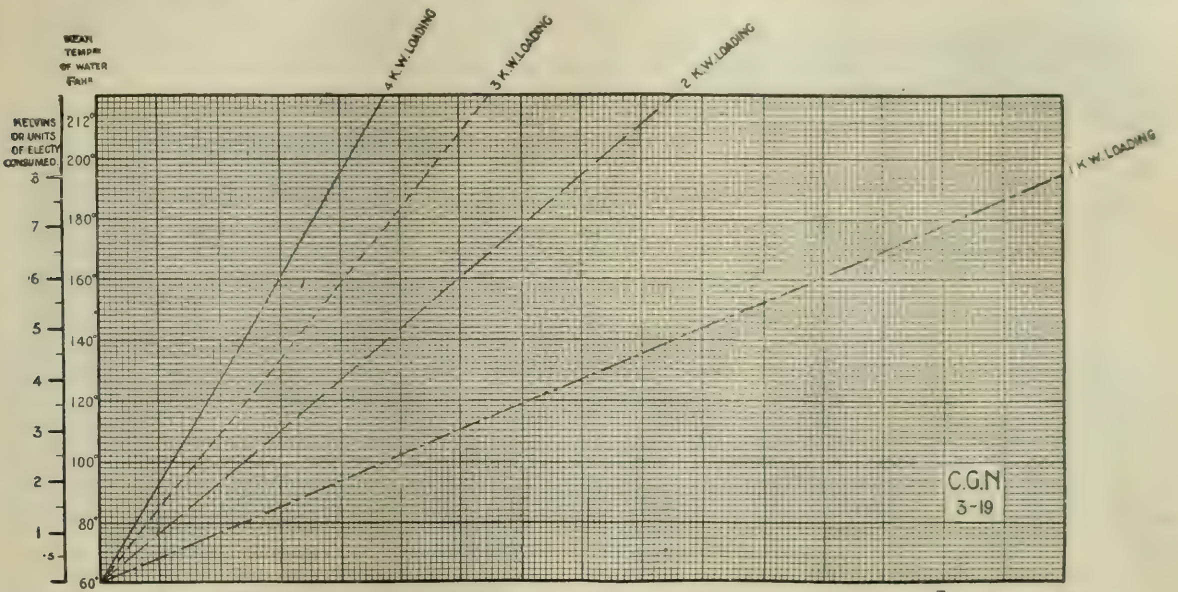

Fig. 15.—Performance Curves of the "Magnet" Hot Water Calorifer for Domestic Purposes.

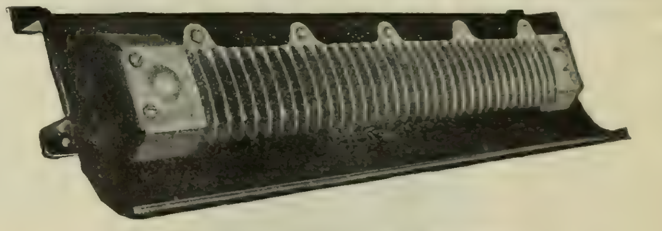

Fig. 17.—"Tricity" Office Radiator.

A Radiator Hot Plate.

In connection with their "Electro-vapour Radiator" which was recently described in these columns, Messrs. Benham & Sons, Ltd., have manufactured an ingenious device for attaching thereto in the form of a hot-plate suitable for use in keeping food or hot liquids warm. In Fig. 18 the hot-plate is shown fitted to a radiator and in use for maintaining the heat in a glass of hot cocoa. The glass dome is not supplied with the hot-plate attachment. This apparatus can be fitted to any radiator with water, steam or electro-vapour, and adds no additional cost to the running of the radiator. If desired these plates can be supplied fitted with an electric superheater, so that they can be used whether the radiator is on or off.

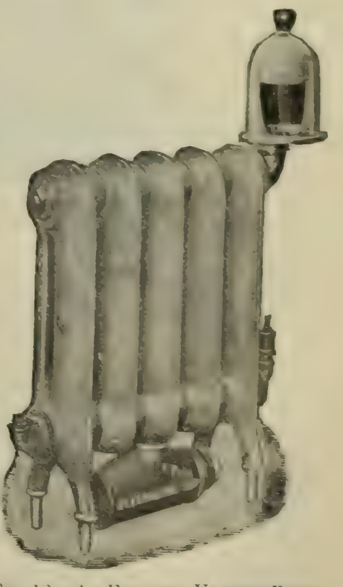

Fig. 18.—An Electro-Vapour Radiator Fitted with a Hot Plate.

Belling Conversion Immersion Heater.

On many occasions contractors and supply authorities have been asked by consumers to convert an existing spirit kettle or urn, &c., into an electrically heated appliance. To meet this demand Messrs. Belling & Company have prepared an immersion heater (Fig. 19). The heater consists of two tinned copper blades, each containing an element, and fitted into a brass terminal box. The apparatus is supplied tinned and with packing ring and screwed gland ready for sweating into the utensil.

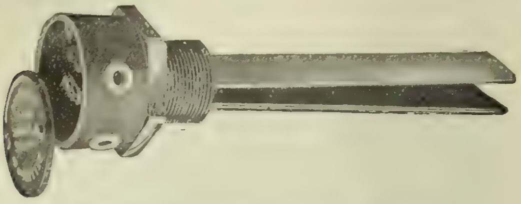

Fig. 19.—Belling Immersion Heater for use with Ordinary Utensils.

Filbar Improvements.

The Filbar Electric Heater, Ltd., have now removed to 46, Berwick-street, W.1, and we are informed that, whilst their Filbar boiler remains substantially the same as described in our issues of December 19, 1919, and February 13, 1920, it has been improved in one or two details. In the first place, the elements have been made interchangeable, thus facilitating the replacement of worn out sets. The design of the automatic circuit-breaker attached to this apparatus has also been altered. In the new breaker a pin is attached to a plunger arm on which are mounted movable contacts ; the plunger works in an inclined slot, so that when the circuit is made the plunger and contacts take a rotary movement upwards, and *vice versa* when the circuit is broken. This results in reducing the effect of the arc on breaking the circuit, thereby keeping the contacts cooler and increasing their life. Also a shorter coil can be used without reducing the effectiveness of the breaker.

Yule Apparatus.

The Yule Electric Company commenced to supply electric fires at the end of 1919, and during the ensuing months they have added a number of designs in the form of small grills, kettles, &c. Their open type of element, as used in all Yule cooking appliances and the smaller fires, is formed of a radiant spiral supported on a number of spiral insulators held in position by a framework of pressed steel. Allowance is made for expansion and contraction, and it is claimed that the porcelain supports are not strained or affected by changes of temperature. The "Troy" fire is illustrated in Fig. 20, and has open-type elements mounted in a sheet metal frame, supported on four feet. At the base and in front of the elements is mounted a polished reflector plate in the nature of a trivet, which gives a cheerful effect to the fire, and serves a useful purpose as well. The consumption is 1 kw. A small grill is illustrated in Fig. 21. It is of sheet metal construction finished stove black. One element of the radiant type is employed which acts both as a grill and hot-plate element, heat control being obtained by means of rotary switch. The consumption on full heat is 1 kw.

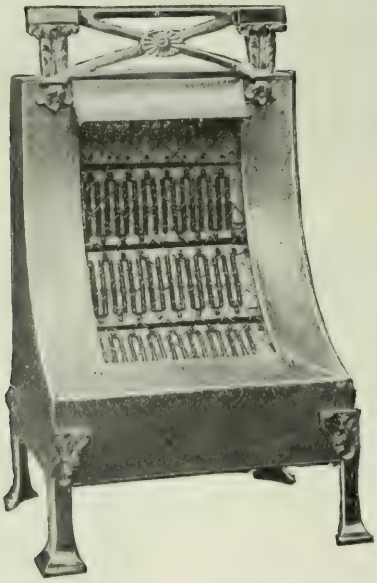

Fig. 20.—A Sheet Metal 1-k.w. Fire by the Yule Electric Company.

A particular feature of this firm's activities is the manufacture of small fires, kettles, hot plates, &c., for use in conjunction with the smaller country house lighting plants generating at a pressure of from 30 to 50 volts. With the growing demand for plant of this type there will undoubtedly be an increasing need for appliances suitable for use in connection therewith, and it is pleasing to see that this firm has realised the possibilities that lie in this direction.

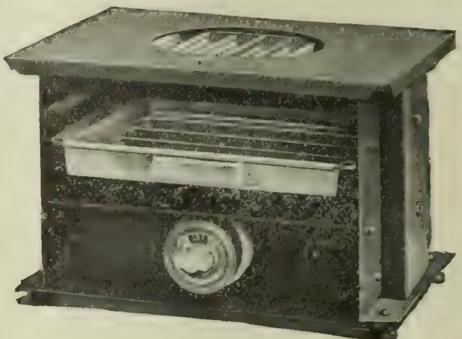

Fig. 21.—A Small Grill made by the Yule Electric Company.

Touch-button House.

The complete installation of heating, cooking and labour-saving devices to be seen in operation at Touch-button House, the headquarters of Berry's Electric, Ltd., were recently described in a special article. The Magical Fire made by this firm, and intended for use in connection with their "Colec" system of heating, has been installed in the houses of a large number of distinguished persons, and also in connection with heating the saloons of certain passenger liners.

"Destro" Aluminium Self-contained Utensils.

Messrs. Strode & Company have manufactured a series of self-contained kettles, sauce pans, frying pans, milk boilers, &c., which are constructed of aluminium and provided with black ebonised handles. In appearance these pieces of apparatus are particularly neat and pleasing, and the aluminium gives the pleasure of brightness without the trouble of polishing. The loading ranges from 500 to 750 watts, according to the article and size ; but sufficient loading has been provided in each case for quick operation. The 3½ pint kettle, for instance, is loaded to 700 watts, and boils 1 pint of water in six minutes, 3 pints in 15 minutes. In addition to utensils, the range includes a large rectangular and a small round warming plate.

An "Xcel" Fire.

In completion of the range of "Xcel" domestic appliances, a radiant heater has been added to the list of apparatus sold under this brand name by Messrs. Drake & Gorham. The radiator has a cast-iron frame, supplied finished in "art black" or "electro bronze." A noteworthy feature of the internal construction of the "Xcel" heater is that all connections are rigid and loose wires and beaded insulation are entirely eliminated. It is claimed that the elements are so designed that expansion due to heat is automatically taken up without any strain being placed on the spiral element, and that adjacent coils of the spiral are prevented from touching one another and from taking up a permanent sag. Further, the spirals are so supported that it is impossible for them to become detached from the supporting frame. A wire guard protects the elements from accidental contact, and one element is directly connected across the main in compliance with the I.E.E. rules. A trivet is supplied, and can be fitted either to the top or bottom of the front of the fire. The loading is 2 kw.

Remarkable Arora Progress.

That suitability and quality of the product considerably affect the demand for that product is adequately evidenced by the progress which has been made by the Arora Company in the comparatively short time of five years. The business was founded in May, 1915, by Mr. F. S. Grogan, in conjunction with the firm of Messenger & Company, Ltd., a firm with an established reputation as heating engineers and ironfounders. In the first 12 months additional temporary space had to be obtained, and in December, 1919, it became obvious that the only way to meet progressive demands was to build a new works. To-day this new factory is practically finished, and within a week or so the change over from the existing temporary factory will be made. The new building consists of three main bays of 40 ft. span, giving a total width of 120 ft., the length of each bay, being 85 ft. Ground has been obtained and the building so designed to permit a still further extension of these bays to be made when the demand warrants it. As since 1916 the sales have practically doubled in invoice value each year, and as the sales for 1920 to the end of August already equal the whole of 1919, it is quite probable that the further extensions may be required at an early date. The products of this concern comprise both heaters and cookers for domestic and marine purposes, and a very considerable proportion of the output goes abroad. A view of the outside of these new works is to be found in Fig. 22.

Fig. 22.—View of New Arora Factory

A New Departure in Cooker Design.

The latest addition to the Arora family of cooking appliances is an oven which possesses many new control features. To meet the quite natural demand of the housewife for an oven that will quickly attain a cooking temperature, the maximum loading of the oven has been made higher than usual, being 4 kw. when all elements are working on high heat. With this loading the oven can be brought to a coooking temperature in eight minutes. The position of the elements is designed to reflect heat from the sides of the oven and from the top of the oven down on to the food to be cooked. Four elements, evenly spaced, are mounted at the top, and two elements are mounted on each side of the oven. A rotary four-heat switch controls the elements at the top and a similar switch controls the elements at the side of the oven.

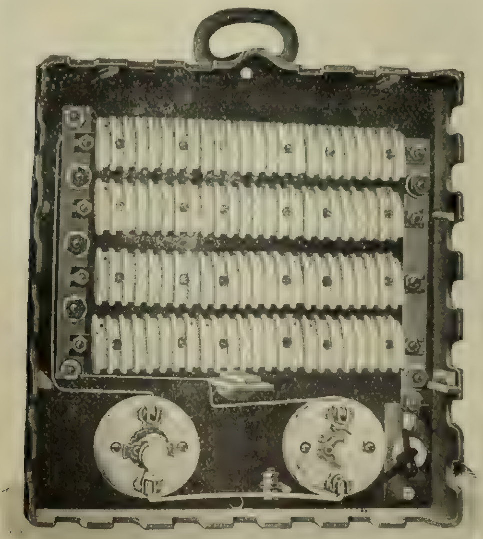

Fig. 23.—New "Arora" Fire. Sheet Metal Frame, Satin and Brass Finish, 2·25 k.w.

It is claimed that though the initial load of this oven is high, the average working load is less than with cookers which employ a lower rating at high heat. The position of the top elements facilitates browning operations, and the side elements are so mounted to ensure that an even temperature is provided in all parts of the oven. The exterior of the oven is of cast iron and the interior is enamelled, the door opening measuring 20 in. by 14½ in. Swing frames, which swing outwards to give access to the elements, carry shelves, on which slide grid shelves and a deflector shelf. The two control switches are mounted with a pair of fuses on a separate control panel, the connecting leads being carried in a flexible metallic tube.

In addition to the above, the "Arora" Company have also been installing a number of marine fires of the type illustrated in Fig. 24. The majority of these fires consume 500 watts with a single radiant element; but larger fires having two 500-watt elements are also made, control being provided by means of two tumbler switches. It will be noticed from the illustration that the fire has a substantial cast-iron frame designed for wall mounting, and that a heavy wire guard protects the elements. A special terminal box is provided, designed to facilitate speedy connection when employing armoured cables.

A new domestic fire of pleasing design is shown in Fig 23. The frame is of sheet metal finished in satin brass. The standard "Arora" fire bars are employed, each consuming 750 watts, giving a total loading of 2·25 kw We understand that in one district alone 50 of these fires were sold within 24 hours of the first sample being exhibited.

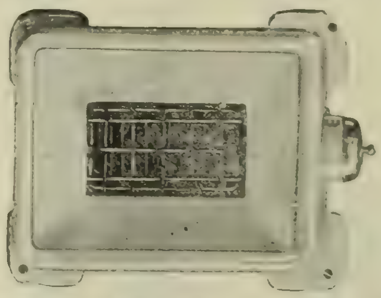

Fig. 24.—"Arora" Marine Type Fire.

"Sunco" Electric Fires.

A full description of "Sunco" fires appeared in our issue of November 28, 1919, and the sales during the last season bore adequate testimony to their popularity. For the coming season half a dozen new patterns have been developed by the Sun Electrical Company, and will be offered in a wide range of finishes as well as in vitreous enamel of various colours. In addition, an entirely new type has been designed in the form of an electric fire for building into a fireplace as a permanent fixture. The elements of "Sunco" fires are worked at a temperature which yields a large proportion of radiant heat. The bars are of a curved formation, which radiates the heat over a wider area than the ordinary flat bar.

Universal Radiant Heater.

We are advised by Messrs. L. G. Hawkins & Company, Ltd., that a small radiant heater has been added to the already comprehensive range of appliances sold under the brand name of "Universal." The heater consists of a radiant element consuming 625 watts, mounted in the centre of a cone shaped reflector, which is supported from a heavy triangular base. The position of the reflector can be adjusted to any desired position.

In the above we have confined ourselves as far as possible to the description of novelties There are, however, on the market well-tried designs of both heating and cooking apparatus which will do much to assist in the domestic electric development which is coming in the near future.

New Lighting Appliances and Accessories.

The general feature in lighting appliances during the past twelve months has been a continuance in popularity of the indirect and semi-direct systems. This is largely due no doubt to the pleasing effect produced by these methods and the economy obtained by using high candle-power gas-filled lamps. Low candle-power gas-filled lamps are now available, so that such lamps can be used for domestic lighting in conjunction with bowl type reflectors and silk shades. Concealed shop window lighting is another form of electrical illumination for which there is an increasing demand, and certainly shop windows so illuminated present a very pleasing appearance and aid the window dressers' task owing to the avoidance of shadows and the absence of interference caused by pendants. Below we describe a new form of pendant fitting for fitting for domestic use with gas-filled lamps, a new concealed shop window fitting and other new and interesting apparatus.

Period Style Lighting Fittings.

With the increasing demand for electric lighting sets in country houses and hotels there has naturally arisen a desire to maintain as far as possible the "old time" style of furnishing, which is characteristic of the country house. The use of C.T.S. or armoured wiring has obviated the necessity for cutting away or damaging valuable old oak pannelling, and by employing suitably designed lighting fittings an harmonious electric lighting installation can be installed which yields modern convenience and retains the right "old time" atmosphere. A very interesting display of old English lanterns and electroliers specially designed to be suitable for use in apartments of Tudor and Jacobean styles can now be seen in the showrooms of the General Electric Company, Ltd. Examples are shown in Figs. 1 and 2.

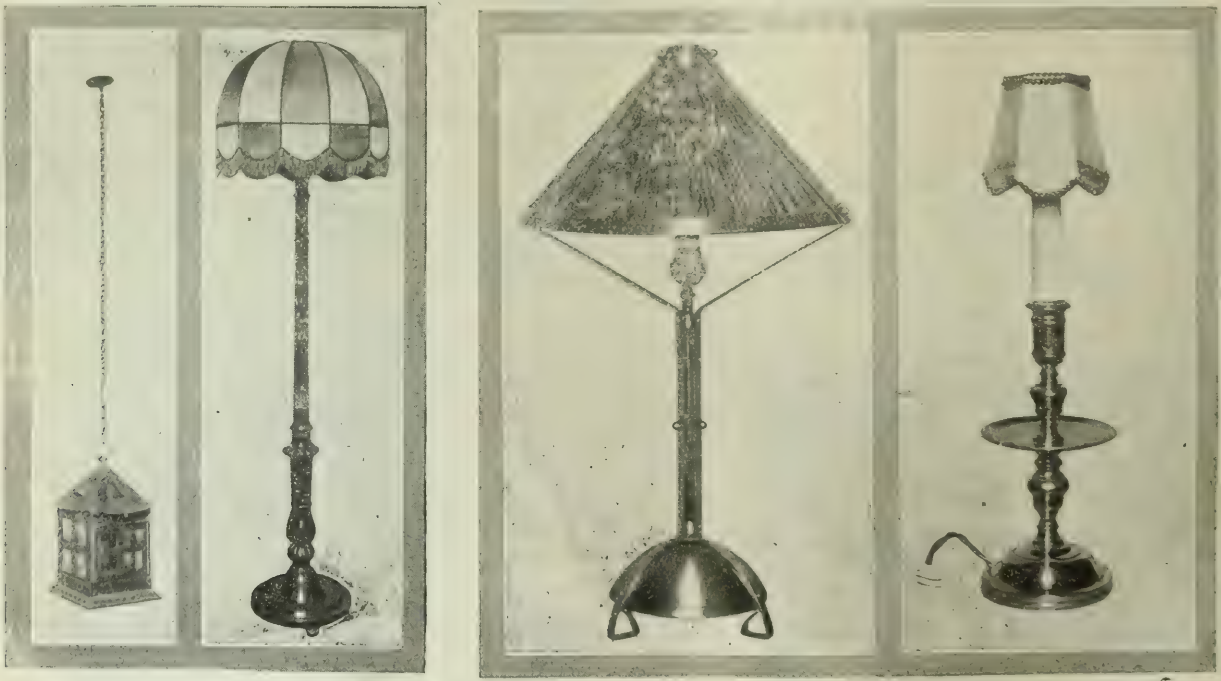

Fig. 1.—Examples of G.E.C. Artistic Fittings.

Reflector Pendant Shades.

To meet the undoubted need which exists for a shaded fitting for use with the smaller candle-power gas-filled lamps, Messrs. Strode & Company have designed a pendant silk shade fitting, which incorporates a specially shaped dome metal reflector fitted above the silk curtain. This allows for the light to be constantly reflected downwards, and the curtain provides the required shading to give depth to the surroundings. The resultant illumination is a combination of diffused and directly reflected light, which results in a soft lighting effect without any glare. A similar fitting has also been designed for use with 20 to 60 watt vacuum lamps, the only difference being an alteration in the shape of the dome reflector occasioned by the slightly different shape of the lamp.

The same firm have also designed a shop window reflector for use with gas-filled lamps.

In this appliance the reflector portion is of aluminium, and the fitting is intended for mounting at the top of the window along the front edge, so that the light is reflected from a concealed source, into the window and on to the goods displayed. The lampholders are fixed in a channel trough at the top of the fitting, special attention having been given to providing adequate ventilation within this trough.

A similar fitting, but with a larger reflector, has been designed for studio lighting and photographic purposes.

"Moonstone" Glassware.

"Moonstone" glassware is of Canadian origin, and has been developed with a view to providing an efficient and pleasing means of diffusing light in connection with gas-filled lamps. The shades are mostly made up in the form of bowl fittings for semi-direct lighting. The light after being reflected through this glassware is of a white hue, very nearly approaching daylight in character. It is claimed by the makers that the loss of light by absorption is very small. "Moonstone" glassware is handled in this country by Messrs. Underwood (Manchester), Ltd.

New Holophane Shades.

The Holophane Company, Ltd., has prepared a number of the special glass shades for use with the new small candle-power gas-filled lamps. Special shades have also been produced for use in connection with concealed lighting for shop windows. Although, thanks to higher efficiency lamps, lighting has become more economical in consumption of electricity, there is, if anything, a greater need for efficient and correct shading due to the higher intensity of modern light sources. With holophane shades available in many types for various lighting purposes there is really no excuse for inefficient shading, or for the pernicious practice of using unshaded high candle-power lamps.

Propaganda.

We have received from the Electric Lamp Manufacturers' Association a copy of a booklet, with a coloured cover, on which are printed the words "Come In." This booklet, we understand, is being sent to supply authorities and contractors for distribution to prospective users of electric light. The booklet is attractively printed and illustrated, and the story portion deals with a tour through a modern electrically lighted home, due advantage being taken of each opportunity to drive home the advantages of electricity as an illuminant.

Other electrical appliances, such as the iron, radiator, vacuum cleaner, &c., are mentioned. We may be permitted a criticism of one or two points in this production.

Whilst, undoubtedly, electric light is a convenience in the coal cellar, we think that the illustration of the coal cellar might have been left out or it could have been termed a wine or store cellar, and the idea of the all-electric home helped thereby. Also on the front cover a gentleman is shown opening the door of the house, the said gentleman being in evening dress. Is it necessary always to indicate an elaborate home and evening dress in connection with electric lighting? To-day electric lighting is within the reach of a large public who do not dress for dinner, and would not if they could, and who do not live midst marble halls and palms. Why not, therefore, describe and illustrate a home and people similar to the home in which the majority of the recipients of a booklet live? This aid to selling by manufacturers and manufacturers' associations is certainly welcome, but as the booklet describes no particular lamp—that is it is combined effort of the Lamp Makers' Association—could it not have been just as well produced under the auspices of the E.D.A., as this is the purpose for which that body was formed?

New Battery Chargers.

Many motor owners prefer to charge their own accumulators, but in many instances this desire has had to be denied because of the cost entailed in rectifying alternating current for this purpose. The "Tungar" Rectifier made by the **British Thomson-Houston Company, Ltd.**, considerably reduces the expense and trouble entailed in rectifying alternating current supply. It is a compact and self-contained apparatus which both rectifies the supply and transforms it down to the required voltage for charging purposes. The essential parts comprise a bulb which acts as the rectifier in a similar way to the thermionic valve, an auto transformer, a reactance, and an enclosing case for the whole set together with a pair of connecting leads. By connecting this portable set to any lampholder battery charging can be commenced. In addition to charging this apparatus can be used for the direct operation of various low voltage direct current appliances in places where only alternating current supply is available. It should be noted that the rectifier acts as a check valve, and therefore it is not possible, when the rectifier is used for battery charging, for the cells to discharge back through the rectifier. The normal alternating current voltages for which these charging sets are supplied to operate is 110 or 220 volts, and the rectifiers are made for various periodicities from 25 to 60 cycles.

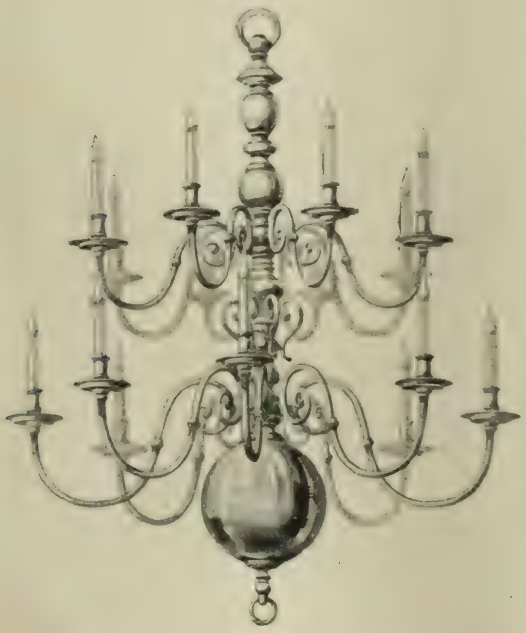

Fig. 2.—Another Example of G.E.C. Fitting

The "Dainty" Suction Cleaner.

The main point of difference between the "Dainty" cleaner supplied by Messrs. **Dalton, Downes & Company**, of Manchester, and the ordinary type of cleaner, is the position of the dust container. In this cleaner the container is fixed between the nozzle and the mechanism, the advantages claimed for this arrangement being the prevention of dust and hard articles like pins, &c., from getting into and damaging the moving mechanism. Further, there is no dustbag, which is liable to be torn or caught in articles of furniture. The motor is designed to run on either alternating current or direct current supply, unless the periodicity of the alternating current supply exceeds 50 cycles, when a special machine has to be ordered. The machine is easily carried from room to room as it weighs only 7 lb. It is supplied complete with ordinary nozzle for carpets, &c., upholstery nozzle, brush nozzle, flexible cord and adapter for connection to a lamp holder. The machine is guaranteed for 12 months.

An Adjustable Reading Lamp.

We may also mention an adjustable reading lamp supplied by Messrs. **Drake & Gorham, Ltd.** It essentially consists of a parabolic reflector mounted on a movable arm, and around the edge of this reflector moves a second focussing reflector for the purpose of deflecting the light to any desired position. The base of the lamp is heavily weighted to provide the required stability. Such a fitting serves a number of useful purposes, such as a reading lamp, piano light, desk lamp, &c.

Hart Snap Switches.

The Hart & Hegeman Mfg. Company, of Hartford, Conn., are well known in the United States as the makers of the "H & H" Hart switches, and the General Electric Company, Ltd. 167, Queen Victoria-street, E.C. 4, who are sole selling agents in this country, have recently issued a catalogue which gives illustrated particulars of the design and construction of these switches. Improved practice in electric light switching has led to the introduction of many types hitherto little known, and the rotary switch, which has proved satisfactory, is gaining in favour. The H. & H. Company has been manufacturing switches for 27 years, and their products have acquired a good reputation for sound construction and design. Though the catalogue gives details (including capacity, dimensions and prices) of a wide range of types, the list is not exhaustive, and particulars of switches for conditions other than those given will be supplied on application. Commencing with a general specification of standard switches, information is given concerning a variety of 250-volt and 600-volt surface switches, flush rotary, push button and door switches, &c., with diagrams of connections. Special attention is devoted to heater switches suitable for use on heating circuits owing to the rapidity of the "make" and "break" movement, and their reliable mechanism; there are also several forms of electrolier and Continental type of switches. The latter have been developed to meet the demand for inexpensive switches for use in countries previously employing German types. The first illustration shows a rotary double-pole standard switch, whose capacity at 250 volts is 20 amperes. Fig. 3 is a standard push button flush switch, with a capacity of 10 amperes at 125 volts and 5 amperes at 250 volts. These switches have a quiet easy action, and will bear constant use. The blades and contact jaws are made with care, and from the same material as the rotary switches. The working parts are case hardened and the insulation is ample. The movement is separated from the cross-bar, rendering the switch from "earth." A fibre cover protects the interior from dust; the operating buttons are of rubber composition, one being fitted with a pearl centre to indicate the "on" position. Fig. 2 is an illustration of a push button electrolier switch. With this type all switching "on" is done by the pearl button and the black button switches off, the buttons being operated alternately.

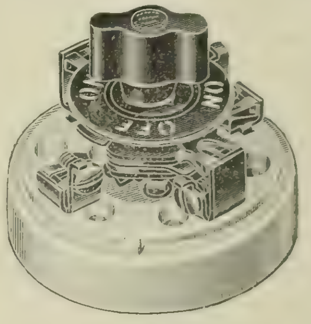

Fig. 1.

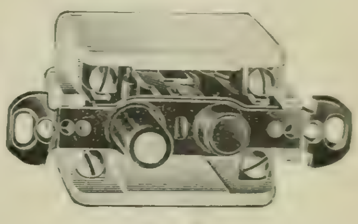

Fig. 2.

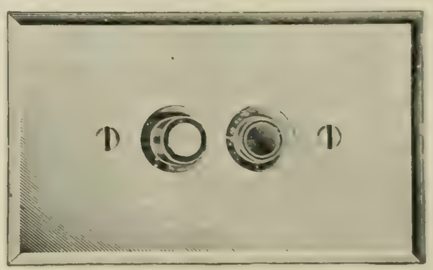

Fig. 3.

Municipal Tramways Association.

The nineteenth annual conference of the Municipal Tramways Conference was held in Cardiff on September 15, 16 and 17, under the presidency of Sir John Courtis, chairman of the Cardiff Corporation Tramways Committee.

An official welcome was given to the delegates and the ladies accompanying them, by the Lord Mayor of Cardiff (Councillor G, Fosdike), who referred to the recent strike of employees of the Tramways and other Cardiff Corporation Departments, but said he was full of optimism for the future, if both sides sat down with a single aim to arrive at an honest and fair decision.

The President, having thanked the Mayor for his welcome, then delivered his address, which we give below in abstract.

Presidential Address.

By SIR JOHN W. COURTIS.

(Chairman of the Cardiff Tramways Committee.)

Within the past half-century £79,000,000 have been expended in this country in tramways construction and development. Of that sum £54,000,000 have been incurred by local authorities. Since 1878 the length of the route open for public traffic in the United Kingdom has increased from 269 miles to 2,728 miles in 1918-19. Of the last named distance 1,713 miles were owned and worked by local authorities, and 146 miles owned by local authorities were worked by companies. The mileage worked by electric traction was 2,660 or 97·5 per cent. of the total. Compared with the last completed year prior to the war (1913-14) the total number of passengers carried has risen from 3,426,473,192 to 4,557,640,078 in 1918-19, an increase of 1,131,166,886, or 33 per cent. In the same period the number of car-miles run has decreased from 354,379,672 to 320,378,376, with the result that the average numbers of passengers per car-mile is now 14·2 as compared with 9·7 in the year 1913-14. The number of journeys per head of the estimated civil population works out at 108, as compared with 74 in the year 1913-14; whilst the number of passengers carried per mile of route open was 1,668,122, an increase of 400,387 or 31·6 per cent. on the pre-war figure. The number of local authorities who have obtained powers in connection with railless trolley undertakings is 26, and of these only seven actually carried passengers. Of the total five companies have also obtained powers, of which only one was operated during 1918.

The progressive conditions under which we live demand that we shall provide ample transport facilities for enabling the great industrial populations of our towns to spread themselves out over wider areas, and so relieve the density and overcrowding of populations within relatively small districts. Whatever form these facilities may take can be decided only by experience. In the meantime tramways hold the field where large numbers are concerned. Whatever form of road transport may exist, the paramount condition must be that the passenger must pay for his passage. The accounts of almost all our undertakings for 1919-20 have brought home to the community the sharp reminder that we have been selling rides at less than cost price during the past year, but there is an unreasoning opposition to any increase in fares. It is this opposition that has been the greatest stumbling block in the path of the National Council in dealing with the wages question, which has absorbed most of the time of that body since it was constituted in September, 1919. Limited by statute in our charging capacity, and opposed by public sentiment to increased fares, the finances of the industry have drifted into a state of difficulty, and of some danger to our stability. I am sure that you will agree with me that our first and foremost duty to-day is to endeavour to awaken the public mind to the absolute necessity for increased revenue, unless indeed we must abandon our steward-ship, drift helplessly along into jeopardy and chaos, and stand by indifferent to the arrested progress of the industry which is our special care. By all means let the employees have adequate wager for their services, but by all means likewise let the users of tramways recognise the resultant demands upon them.

The National Industrial Councils, with their constituent district councils, are a new and distinctive instrument in the commerical life of the nation. Their early career and progress will therefore be watched with great interest and concern. To these organisations both time and patience must be granted in their youth. We need not be surprised if they encounter some difficulty in the field of finance, where interests clash the most. They exist, not only for wages questions, but to promote the general well-being of the industry, and if a tribunal composed of representatives of the entire public on one side, and a section of the public engaged in operating this monopoly-service on the other, can hold an even balance, and find solutions of their difficulties by common agreement, as a result of an appeal to reason, and thereby put an end to the dislocation, by strikes and conflicts, of a necessary service, they will deserve well of the community.

The outstanding achievement of the National Council is the passing of the Tramways (Temporary Increase in Charges) Act, 1920, arising out of an investigation of the Tramways budgets for the current year. It is for us to use that Act to the extent of making tramways generally self-supporting.

The question of the rating of tramways that now make no profit upon pre-war earnings will, I hope, be considered at the conference. The burden of road maintenance, constantly added to by reason of heavy commercial vehicle transport, is ripe for adjustment. The appropriation of the proceeds from the taxation of mechanically-propelled vehicles is one that has occupied the attention of the Executive Council during the year. The claim of tramways authorities to share in the yield of such taxation is irresistible in these days of electric traction. It is our bounden duty to press that claim. Again, the question of rate-aid from tramways must be considered. No sanction to increase fares under the Act of 1920 will be granted for the purpose of producing profits to be applied in reduction of direct local taxation. The obvious corollary is that, under normal conditions, no money must be taken from the rates to subsidise tramways. Self-support should be the watchword.

Two Papers on "Tramway Fares" were then read by Councillor Higham (Blackburn) and Mr. P. Priestly (Liverpool), of which we give abstracts below. These were discussed together.

Tramways Fares.

By COUNCILLOR O. HIGHAM.

(Chairman of the Blackburn Corporation Tramways Committee).

Postulate that tramway undertakings have to pay their way, and not be a burden upon the rates, then a proper adjustment of fares to meet the enormous increases in expenditure is essential. Wages and cost of materials have increased out of all proportion to the fares we have been charging, and, unfortunately, we are not able to hand on to our patrons the increases in the cost of producing rides (which is the commodity we sell) with the same facility as other industries.

Riders should pay for their rides, and with that end in view, every Authority should adjust its fares to keep pace with the constantly increasing cost of labour, material, and money, and similarly when the process is reversed. In most towns the time has arrived for the abolition of the penny fare. The first mile of your tramways from the centre of the system is in general the distance you have to depend upon most to make the undertaking a success, and if the people who use this portion are to escape all the increases in cost, how then can you expect to get the necessary revenue out of those who travel the longer distances, especially in view of the fact that in rush times you are most liable to have your cars crowded with penny fares to the exclusion of longer distance passengers?

Then there are "workmen's" fares. In view of the present position should these be continued? It will be generally conceded that a "workman's" fare is not a sound economic fare, and part of the cost of carrying such "workmen" must therefore be borne by someone else. This is not a rational state of things. When we had large classes of workmen receiving miserably low wages, there may have been some reason for subsidising the carrying of those who had to use the cars to get to their work, but now, if the amount of wages is taken into consideration, then it is not the people who go to work before 8.0 a.m. who should have half-fares, but those who go to their daily toil at 8.30 or 9.0 a.m. I am firmly of opinion that there should be no subsidised fares for any class.

Tramways Fares.

By P. PRIESTLY.

(General Manager of Liverpool Corporation Tramways).

The general question of tram fares may be subdivided into:—(*a*) fares for ordinary passengers; (*b*) fares for workmen, children's fares, &c. Consideration should also be given to the question of issuing contracts, transfers, &c.

It is clear that for a system to be remunerative the fares to be charged must be such as will bring in sufficient revenue to cover the whole of the costs. The scale of fares charged will also depend upon the density of the population, and upon how often the residents can be induced to travel.

Having regard to the present high operating costs passengers cannot now be carried anything like the distance for the same fare as in 1914. The best method is to take a central point of the tramways undertaking as the town terminus, and from that point to divide the system into mile zones. It must then be ascertained at what cost a passenger can be carried for a mile. In some towns this amount has been found to be 1d. per mile, whilst other towns have had to make a minimum charge of 1½d. per mile. Consideration should, of course, be given to the best traffic point nearest to the mile distance, so that in some cases it might be a little more, or a little less than a mile. It might be found some advantage to charge a slightly lower fare to the long-distance passenger, in which case the first zone would be a mile, and the next stages could be slightly increased in distance, so that passengers from say a five mile radius would be able to travel to the central terminus for, say, a 4d. fare.

It might be asked why the longest distance passengers should be given the advantage of a cheaper ride. The area served by the tramways undertaking will, in future, have to be extended, as towns are bound to spread out over wider areas in the future, under the Government Housing Scheme of twelve houses to the acre, and the passenger who travels on a tramway system for the whole of the distance should be given some advantage, as the running costs per car mile are less as the car reaches the less thickly populated districts, when there are fewer stops, and the speed is increased, so that whilst the standing charges remain practically the same per passenger, the running costs decrease slightly, making the total charge per passenger slightly less, and therefore a lower fare can be charged. It will also be recognised that these outside areas serve as feeders to the main tramway system, and, in course of time, when the districts are fully developed, become amongst the best paying portions. I think that the time has gone by when consideration should be given to splitting stages, *i.e.*, 1½d., 2½d., &c., fares, as these give rise to considerable difficulties in the collection of fares I am not generally in favour of overlapping stages, except between the first and second 1d. stages, which do not extend outside the City area. These overlapping stages often encourage the business people to use the trams wherever they may be going within the business area.

I am entirely against the principle of granting special privileges, such as workmen's fares, children's fares, &c. Where cheap fares have been adopted, the passengers usually travel during the rush hours of traffic, and it is entirely wrong in principle that one class of passenger should have cheap fares at the expense of the other passengers.

Contract tickets are unworkable on a tramway system, and wherever these privileges have been introduced they have been in general abused. I am rather in favour of a system of higher fares being charged on special occasions, such as race meetings, football matches, &c., as I consider that a large number of the people attending such meetings are strangers to the town, and only come there for that special purpose. They should, therefore, be charged higher fares in consideration of special cars having to be provided for their convenience. I consider that, if it were practicable, non-residents should be charged a higher fare, as they are under no obligation to meet any deficit which may arise from the operation of the tramways undertaking. I am entirely against the adoption of the transfer system, which is difficult to work, and, even when put into operation, has proved to be untatisfactory.

DISCUSSION.

Ald. Fred. Smith (Liverpool) urged that the ratepayers were entitled to some relief of rates from the tramways in return for the credit they gave upon which the capital required for constructing the tramways was raised. If the tramways were leased to a private company a rent would be paid.

Mr. W. Murray (Walthamstow) was doubtful whether the abolition of the penny fare was wise. Hitherto the short-distance passenger had been penalised, and the long-distance passenger favoured, and the real hope was to increase long-distance fares, and charge the same per mile, no matter how many miles were travelled. He was not at all sure that it would not be best to provide trams free, like the library, education and recreation grounds.

Councillor Naylor (Liverpool) differed from Ald. Smith as regards contribution to rates, and thought that no favour should be shown to any class of passenger.

Mr. G. W. Holford, replying to a question with regard to charging higher fares for race meetings, football matches, &c., said that in the Bill which recently passed through Parliament, there was a clause giving powers to charge these higher fares, but such cars must not interfere with the ordinary service; they must be extra cars run for the particular purpose.

Mr. E. S. Rayner (Hull) thought that too little consideration was often given in fixing fares to the frequency of the service and the carrying capacity of the cars. When a 56-seater car carried 128 passengers that was a very profitable service at pre-war fares. The question was whether this sort of thing was to be continued, or were they going to endeavour to give a pre-war standard of service. He favoured keeping the stages as at present, and increasing the fares to meet the additional cost of running, and it was up to tramway managers to educate the public to this. The introduction of a 1½d. coin would be a good thing, because he believed there would be less objection to paying 1½d. in one coin than in two.

Mr. J. S. D. Moffet (Belfast) said the traffic in Belfast had increased in spite of the higher fares.

Mr. J. B. Hamilton (Leeds) said it was very difficult to say what a fare should be, because costs were continually rising, and they had to determine whether a position of stability had been reached in regard to costs which justified them in fixing a fare which would require little, if any, alteration. Changes in fares were most unsettling to the public. The subject called for a scientific examination of what the costs would be based upon the specific characteristics of the traffic in various places.

Ald. Squires (L.C.C.) said the public must expect to pay the cost of what it received. He did not agree with the cheap midday fare on the L.C.C. system.

Councillor Turner (Belfast) spoke strongly against giving cheap fares to workmen. No class should be subsidised. Workmen's fares meant cheap cars at the rush hours, when they could be least afforded by the undertaking.

At the conclusion of the meeting luncheon was taken in the City Hall, at the invitation of the chairman and members of the Cardiff Corporation Tramways Committee

The discussion on the two Papers on Tramways Fares was continued in the afternoon.

Mr. H. Mozley (Burnley) called attention to the loss occasioned by fares missed. This loss had been avoided at Burnley by the conductor collecting the tickets.

Mr. H. P. Stokes (Plymouth) reminded the Conference that there had been a great increase in traffic since the war, and more people were carried standing than was previously the case, therefore to that extent, the increased cost of operation had been offset.

Mr. J. Barnard (Bolton) believed Bolton was the only town that had not changed its pre-war fares, nor lengthened nor shortened the fare stages, and in spite of that they contributed £15,500 to the rates last year, and set aside 2½d. per car-mile fo- depreciation.

(*To be concluded.*)

The Machine Tool Exhibition.

(*Concluded from page* 333.)

Some "Navy" Equipments.

The Electrical Apparatus Company, Ltd., of Vauxhall Works, South Lambeth-road, London, have an interesting exhibit of direct-current control gear (automatic and hand operated), alternating-current control gear and alternating-current switchgear, suitable for use in conjunction with motor driven machine tools, the various gear being manufactured by themselves and their associated company, Messrs. Bray, Markham & Reiss. A slow motion device on a 15 h.p. 200 volt starter with no-volt and overload releases is worthy of special mention. It is obtained by a pawl carried on the starter lever, moving on a guide way, and provided with alternate camming and arresting shoulders. The starter allows of a quick forward movement, but provides a dead stop on the centre of each segment, so that it is impossible to start the motor up too quickly. The backward movement, however, is not impeded. A series relay starter is a new and ingenious form of automatic starter, so designed that the rate at which the resistance is cut out is dependent on the rate of acceleration of the motor. It consists of an electromagnetic master device, which controls the operation of a number of contactors in such a manner that they can only close in correct sequence, and cut out the starting resistance step by step. By the provision of a specially designed pendular movement on the master switch, however, it is impossible for any step of the new resistance to be cut out in less than a pre-determined period, which is sufficient to preclude any possibility of damage to the motor it controls. The "Navy" type control gear shown is a compromise between the face plate and the drum-type starters, the aim being to embody the good points of both types. The features of the face plate type, it is claimed, are cheapness, compactness and simplicity (no-volt release); and of the drum type—star wheel action, magnetic blow-out, mica construction, ease of repair or replacement of fingers and renewable tips. The contacts of this type of starter consist of hard drawn copper tubes mounted on pillars. The starting or resistance contacts are free to revolve on these pillars, and are prevented from coming off by means of split pins. The contact between the line segment and the resistance contacts is made by four controller-type fingers fitted with renewable semi-circular tips of hard drawn copper, two bearing on the segment, and two on the copper tubes, so that there is no danger at any time of breaking contact. The shape of the finger tips and contacts give a star wheel action, rendering a glass window unnecessary. There are two no-volt "hold-on" coils, one of which surrounds the hub of the switch, and the other is mounted on a pillar attached to the base casting, which also forms a stop on the "full on" position.

B.T.-H. control is to be seen on several of the machine tools in operation, and although the British Thomson-Houston Company does not exhibit officially—they have no stand—some reference may be made to their apparatus, which is the standard for starting and controlling stationary direct-current motors This motor-control panel carries a starting rheostat and a switch fuse, the whole apparatus on a sheet steel base being designed to comply with the Home Office rules for the use of electricity in factories. There are no exposed live parts, and neither the starter nor the switch can be left in partial contact. These standard panels are designed for capacities from 10 to 40 h.p., and for voltages from 100 to 550. In conjunction with these panels an automatic starting rheostat has been designed to operate as an accelerating unit, and is an automatic device capable of giving full protection to motors. A feature of the starter is its current limit system of acceleration, which automatically gauges the load, thus ensuring that the motor controlled is started in the shortest possible time compatible with safety. These starters are suitable for three methods of control—viz., line switch control, pilot switch control and push button control.

Thermometer Equipments.

Included in the comprehensive display which one would associate with the Cambridge & Paul Instrument Company, Ltd., of Grosvenor-place, London, S.W. 1, are several interesting instruments. These include the electrical CO_2 recorders, devised by Dr. G. A. Shakespear and described in our issue of January 16, 1920. Another interesting new instrument exhibited on this stand is a totally-enclosed indicator and switchboard for use with the firm's electrical distance thermometers. This indicator is made for 12, 24, 34, 70 or 105 points. It is enclosed in a dust and fume proof metal case, and was originally designed for use on board ship, but may be equally well employed in damp or dirty situations on land. The indicator and switchboard have now been combined in one compact instrument. All the connections are made inside the case, so that there are no external terminals. The switchboard, arranged for the number of thermometers mentioned above, is brought into connection with them by moving the switch into the corresponding position. " Off " and " Test " positions are provided.

" Labour-aiding Devices."

" Labour-aiding devices " is the slogan of Irwin & Jones, Ltd., London House, New London-street, E.C., and among them we find the Hunt storage battery industrial truck. The Hunt truck is made in three types, each capable of carrying two tons, and each providing a platform in front for the driver. In the " A " type of truck, which is the type mostly in use, the drive is through a differential made up of cut steel gearing, which, together with the motor pinion, is enclosed in an oil and dust-proof housing. Either Edison iron and nickel cells or Exide lead cells will be supplied. The equipment consists of 36 Edison cells, type A 4, 150 ampere-hour capacity, 43 volts, or 20 cells type M. VII. ironclad Exide, 158 ampere hours, 40 volts. The Edison cells require 30 amperes for seven hours to fully charge, and ironclad Exide, from 15 to 30 amperes for $6\frac{1}{2}$ hours. The motor takes 36 amperes at 36 volts running at a speed of 1,000 revs. per min., and it will take 120 amperes at 36 volts for ten minutes without heating. The controller is of the drum type, having three speeds forward and three reverse, with positive stops between. No resistance is used in the control, varying voltage being obtained by multiple series grouping of the battery cells. Thus it is claimed that all the energy delivered by the batteries is utilised through the motors, and none is wasted in useless heating up of resistances. The speed of the truck is $6\frac{1}{2}$ miles an hour. The platform is 23 inches above floor level.

An Interesting Drill and Sharpener.

Messrs. Alfred Herbert & Company, of Coventry, whose principal, Sir Alfred Herbert, is President of the Machine Tool Trades' Association, have no fewer than nine stands, a number of them being occupied by affiliated companies operating abroad. Among them are two pieces of electrical apparatus new to this country. One is the Van Dorn electric drill which is also adaptable as a grinder. The electric drill motor is built on the same lines as a traction motor, but in miniature form. Drills up to $\frac{7}{8}$ in. are fitted with a fuse, and all sizes are suitable for connecting by means of a two-pin plug into a wall socket. Over $\frac{7}{8}$ in. in size, a double-pole fuse can be fixed between the main switch and the connecting socket. The motor is series wound, the armature being of the slotted drum type. On the larger machine the armature is built on a hollow shaft to secure maximum lightness. One of the distinctive features of the drill is the ventilating system. This consists of a large aluminium fan screwed on the armature shaft. A mechanical feature of the drill is that the spindle is offset, so that the holes may be drilled close to a flange or similar projection (*see* Fig. 5). The other electrical implement is the " Quicksharp " knife grinder. This is an American attachment for sharpening planer blades *in situ* on planers, jointers, &c. The time-saving advantage of the tool is apparent for by its use knives put into a machine are not taken off until worn out.

Motors and Trucks.

Messrs. E. Brook, Ltd., of Empress Works, Huddersfield, have a range of their standard motors from $\frac{1}{8}$ h.p. to 100 h.p. This firm manufactures nothing but alternating-current motors and built a modern works in 1914 with this object in view. Among the motors on view is a 50 h.p. ventilated motor suitable for working in chemical and very dusty works. The motor has a fan internally connected with the rotor, which draws the air through the machine, and fresh air can be drawn from the outside through a pipe and blown straight into the place where the motor is working. A recent design of motor has a brush lifting and short circuiting gear.

Several special features are claimed by Messrs. Greenwood & Batley, Ltd., of Leeds, for the " Greenbat " all-British all-steel electric truck, which is fitted with Ironclad Exide batteries. In the first place it is cheaper than imported electric trucks, and in the second place it is more soundly constructed. There is a double system of springing, and the carrying capacity is 2 tons with a towing capacity of another 2 tons. The battery equipment consists of 14 Ironclad Exide cells, type P.M.V. 12, and the motor is of the totally-enclosed series-wound type arranged for series parallel control, the whole outfit, with the exception of the batteries, being made at Leeds.

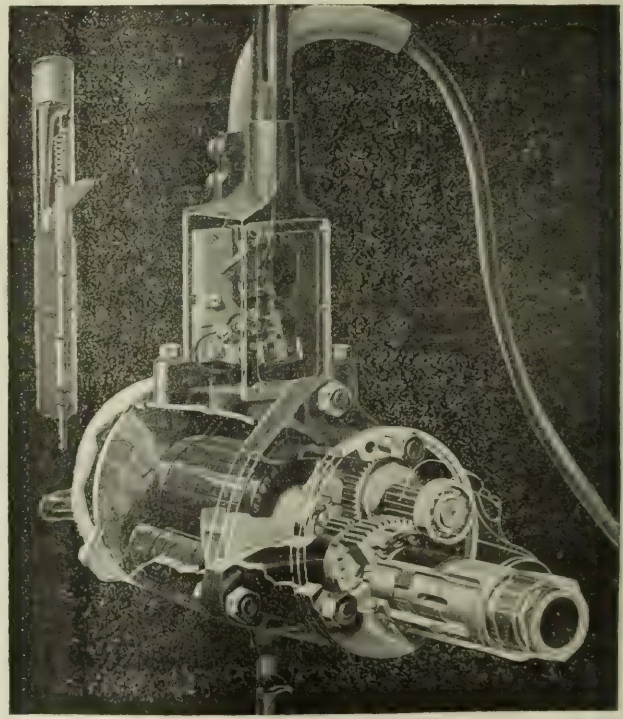

Fig. 5.—The Van Dorn Electric Drill.

The control of the truck is ingenious. There is a pedal cut-out which must be depressed before the circuit is made. The same action releases the brake and the truck is immovable until this is done, the pedal cut-out being interlocked with the controller, so that the controller must be brought into the neutral position to restart after once stopping. If the operator should stop the truck on top speed, it would be impossible for the truck to be restarted until the controller is brought to neutral, thus taking current through the resistance coils and starting on first speed again. This ensures smooth running and avoids overloading the motor. If for any reason the operator should collide with anything and fall off the truck, the brakes automatically come into operation and the pedal cut-out stops the truck. The controller handle is so designed that it flies back to neutral. There is also on this stand a 20 kw. de Laval steam turbine-dynamo set fitted with double helical gearing between the turbine and dynamo.

Messrs. Vickers, Ltd., of London, show the Williams-Janney variable-speed gear, described in our issue of Sept. 3, fitted to an electrically-driven winding engine. The winder consists of a small cylindrical drum of about 2 ft. diameter, running at 30 revs. per min., driven through double reduction gearing, and a Williams-Janney gear, directly coupled to a continuous running 20 h.p. electric motor at 500 revs. per min. The winding engine is provided with the usual driver's standard control lever and foot-operated brake. We understand, however, that the set as shown is more or less experimental

Some Foster Instruments.

The **Foster Instrument Company**, of Letchworth, have several new pyrometrical instruments on view, a feature of which is robustness combined with extreme sensitivity. The "Resilia" portable indicator of the high-resistance class is a case in point. Undoubted evidence of the robust qualities of this instrument were given by a mechanism designed to jerk the instrument in a manner not usually associated with delicate precision apparatus. This mechanical strength under rough handling is obtained mainly by the use of Hoskins' thermo-couple alloys and special spring jewel mountings. The commercial degree of sensitivity of these high resistance class instruments is 20 ohms per millivolt. These high resistance instruments are intended for conditions where it is desired to install thermocouples of great or varying length, and also where more than one instrument may be connected to one thermo-couple, and the instruments have an electrical resistance sufficient to secure high accuracy under these conditions. An inspector's outfit, also shown, is a variation from the simple portable outfit, and is a combination of radiation and thermocouple pyrometers in convenient form. It comprises a receiving tube, jointed for convenience in carrying, a connector and flexible cable, together with a portable indicator. A light portable tripod is provided for use when it is desired to take readings over a considerable period of time. A thermocouple stem about 24 in. long, protected in a metallic tubing, is provided, in connection with which there is a second scale on the indicator of a lower range than that for the radiation portion of the outfit. Convenient overlap of the two scales, however, provides self-checking. Again, robustness and sensitivity are combined, and an interesting test was carried out by attaching one of these instruments to the unsprung carrier of a Douglas motor cycle, riding it over many miles of notoriously bad roads without the slightest effect upon its accuracy. The moving coil of the instrument was not even sticky.

The Foster patent automatic recorder can be fitted with an alarm whereby a bell is rung when a given temperature is exceeded. The alarm contact may be set to any desired temperature, and when this temperature is exceeded the bell is rung intermittently about every 10 seconds until the temperature again falls below the predetermined figure. If necessary, the alarm contact arrangement may have two contacts, whereby a bell is rung when the temperature rises above or falls below certain narrow limits. Attempts have been made to apply alarm contacts to indicators, but if the deflecting force of the indicator only is relied upon to make the necessary contact, it is usually found to be insufficient, and therefore the arrangement is unreliable. If a clock or other mechanism is added to the indicator in order to supply the necessary force for making the contacts, then the apparatus involves practically all the component parts included in a recorder, except the actual pen and chart. For these reasons, the Foster Instrument Company has preferred to apply alarm mechanism to the recorder, and thus have the advantage of the automatic recorder.

The **Simoon Engineering Company, Ltd.**, of Bramber-road, West Kensington, show a range of direct-current motors of sound construction, which have been specially designed to work under the roughest conditions a direct-current motor is likely to experience. They are made in three types—the open protected, the semi-enclosed and the totally enclosed. A new foolproof switch has a cartridge fuse embodied in it in such a manner that the switch must be pulled out of contact before the fuse can be removed. These switches are of the instantaneous break type. Another foolproof ironclad switch, whilst operated by means of a handle projecting through the cover in normal working, is pulled out of contact by the action of taking the cover off. In conjunction with this exhibit is one by the **City Electrical Company**, of Emerald-street, Holborn, who show a compact portable lighting set of 5 kw. capacity. An average consumption of 5·227 pints of petrol per hour is claimed for it as against 6·8 pints per hour with most foreign sets. The whole outfit is made up of standard and well-tried parts.

The **Consolidated Pneumatic Tool Company, Ltd.**, of 170, Piccadilly, London, show samples of their well-known electrical tools. The Little Giant series of electric tools, such as drills, grinders, hammer drills, blowers, &c., are familiar at most engineering exhibitions. They are made for all voltages both in alternating current and direct current, and have firmly and successfully established their position in the engineering world.

Messrs. **W. Canning & Company**, of Great Hampton-street, Birmingham, exhibit machinery, chemicals and materials for general electro-plating, and polishing, including belt-driven low-voltage dynamos, motor-generators, polishing lathes, electric polishing motors, emery grinders, disc grinding machines &c. This firm has specialised in this class of plant for many years

Correspondence.

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AMPERE HOUR METERS FOR ELECTRIC VEHICLES.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In the notes appearing in your issue of September 10, certain alleged necessary criteria and desiderata in the construction of ampere meters for electric vehicles were set forth, forming ideals for which present-day makers were urged to work. It would be deplorable if the makers innocently accepted these as accurate or practical requirements. Picture the unfortunate designer unravelling the problem of devising an indicating needle which will "*return to 'zero' at the rate of 3 per cent. per day,*" or "*creep back to 'zero' at the rate of about 5 per cent. in 24 hours!*"

It was stated that the instrument should record accurately on discharge, and 30 per cent. slow on charge. Possibly this may be necessary for an alkali battery, but consistently to overcharge a lead battery by 30 per cent. would very much shorten its life.

It was also laid down that the instrument should be capable of recording temporary overloads, say, up to 300 per cent. for five minutes. What is the instrument to record—ampere hours, or a percentage of the battery output? 300 per cent. overload can be recorded as ampere hours, but it is quite misleading, as the available output of a lead battery varies with the rate of discharge. A fixed percentage retardation on charge is useless. Some retardation is convenient, but it should be possible to vary the amount, and it should also be possible to set the indicating needle at any desired position relative to "zero."

Ampere hour meters can only be regarded as very approximate recorders. They can serve a useful purpose in automatically cutting off the charge at a pre-determined point. They cannot be used as automatic controllers for any considerable length of time, but periodically—the intervals varying with the season of the year, and the conditions of working—arrangements must be made to charge up the battery independent of any pre-arranged indications of the meter dials.

Incidentally, another misconception must be cleared up. It was stated as a fact that batteries lose their charge at the rate of about 1 per cent. per day when standing! *If* this statement were accurate, it surely means that a battery would have lost the whole of its charge after standing on open circuit for 100 days, whereas actually over such a period the loss would not amount to 15 per cent. in lead batteries, and it is claimed that there are no open circuit losses in alkali batteries.

May I suggest that if instrument makers will, for the present, confine themselves to perfecting a simple and reliable meter, which will withstand all the vibration and vicissitudes of electric vehicle work, it will be much more to the point than to endeavour to introduce complications which have not even the merit of protecting the battery or assisting in the keeping of statistics?
I am, &c.,

Heaton Chapel, Sept. 16. Ernest C. McKinnon.

[Mr. McKinnon has not persuaded us of the undesirability of adding new features to ampere-hour meters for electric vehicles. These instruments need not have a very great degree of accuracy, nor are they intended to be used for highly scientific purposes. Being fitted to vehicles which are subjected to a considerable amount of vibration and rough handling, they are intended as an approximate guide to the users, and particularly to the drivers; and in the parlance of the latter are supposed to show whether the battery is "full or empty."

As regards the first paragraph of Mr. McKinnon's letter, if the battery is fully charged when it is necessary to carry out repairs, and at the end of that time an ordinary driver comes along to collect the vehicle, he looks at his ampere-hour meter and finds the battery is apparently "full." Without a moment's thought he may undertake perhaps to go a round journey of about 40 miles, but he will be lucky if he gets half-way. When he is stuck on the road, nothing will be said about the ampere hour meter, but the electric vehicle will be described as being no good. If, on the other hand, the meter was so made that it crept back to zero at the rate of, say, 5 per cent. of the battery capacity in 24 hours, it would, at the end of the fortnight, have indicated that about 70 per cent. of the battery capacity had disappeared, and although this would not be scientifically correct, it would give an indication to the driver that his battery needed some recharging before he could proceed on a long journey. As a matter of fact, the diminution of about 70 per cent. of the capacity after standing for a fortnight in cold weather is, with the Edison battery, about the right amount. We have more faith in the skill of our designers than Mr. McKinnon seems to have.

As regards the second paragraph of Mr. McKinnon's letter, there is no fallacy about the instrument reading 30 per cent. slow on charge. This refers to alkali batteries and it is admitted that this percentage should be adjustable to suit requirements of lead batteries.

As regards the recording of temporary overloads of 300 per cent. for five minutes, this is quite a moderate demand. Take, for instance, the Detroit Roadster, which is fitted with an ampere-meter reading to 40 amperes, the battery charge and discharge rate being 30 amperes. On climbing a certain hill in Birmingham, gradient 1 in 6, the actual battery discharge with one of these velocities was 150 amperes, this representing 400 per cent. overload on the battery and 275 per cent. overload on the ampere-hour meter. If an ampere meter of 10 amperes recording capacity had been fitted, the overload would be about 1,400 per cent., and might have permanently damaged the instrument..

With regard to the concluding remarks in para. 4, the writer seems to be considering only lead batteries, but a large number of the electric vehicles now running are equipped with Edison batteries, to which his remarks do not apply. The idea of using ampere-hour meters as automatic controls is fallacious, and the question of altering them to suit various seasons of the year is quite bright, but thoroughly pedantic and unpracticable.

As regards para. 5, there is no misconception about the fact that batteries do lose their charge when standing ; 1 per cent. is a round figure, which might be considerably more for the first few days, and considerably less on subsequent days. It is a well-known fact that when batteries are left standing and allowed to get cold the resistance of the electrolyte, especially in alkali batteries, increases quite considerably, and when very cold the cells become almost inert. They are, therefore, improved out of all proportion to the actual amount of energy put into them by the warming-up effect of a high-rate boost.

Mr. McKinnon seems to consider the question of protecting the battery of paramount importance ; but, if his ideas were followed, electric vehicles would be unsaleable. The batteries that are fitted to them must be capable of standing all the maltreatment and rough handling that they get, and ampere-hour meters have also to be found that will suit the conditions which practice indicates are necessary.

We agree with Mr. McKinnon that instrument makers should perfect a simple and reliable meter which will withstand all the vibration and vicissitudes of electric vehicle work ; but, on the other hand, it must also indicate to the unthinking and horny-handed driver the state of the electric vehicle battery.—Ed. *E.*]

THE METRIC SYSTEM.

TO THE EDITOR OF THE ELECTRICIAN.

Sir : In your current issue you describe the report on the Metric System by the Committee appointed by the Conjoint Board of Scientific Societies as " rather a colourless document." Is it not rather significant that the Committee failed to secure the endorsement of the Conjoint Board and that their own Chairman found himself unable to sign it ? Furthermore, according to their own apologetic prefatory note the Committee's chief source of inspiration was the Report on Commercial and Industrial Policy after the War, whose Chairman naively admitted after its publication that the subject of decimalisation had possibly not received the attention at their hands which it really deserved because of the large number of other important subjects which had been referred to that Committee.

In paragraph 82 of their Report the Committee make the useful suggestion that all machinery and apparatus of new types should be established " as a matter of course " on the metric system, and that this practice should be encouraged by " metric " specifications for Government and official work, but in their " Recommendation No. 3 " the Committee urge the continued use of British units by Departments of State ! Need one say more ? Our choice to-day clearly rests between :—

1. The continued use of a dual system (because we must employ the metric system in an increasing proportion of our business whether we like it or not).

2. The establishment of the metric system as the universal language of quantity (involving the gradual abandonment of the Imperial system which, by reason of its manifest defects, is so obviously unsuitable for universal adoption).

Is not the time ripe for the Government to progress beyond its present attitude of passive permission to a period of intensive encouragement in the British use of the Metric System so that later, when legislation of a compulsory character is introduced, it may be found to affect only the inefficient stragglers who had hitherto failed to modernise their methods under legal permission plus Governmental encouragement ?—I am, &c., Harry Allcock.

Manchester, September 21.

THE E.P.E.A. AND THE E.T.U.

TO THE EDITOR OF THE ELECTRICIAN.

Sir : It is unfortunate that the " Group of Senior Power Engineers," whose letter appears under the above title in your last issue, did not subscribe their names, as it would have enabled the Executive Council of the E.P.E.A. to provide them with a fuller explanation of their Policy, than is possible within the narrow limits of a letter. It is certainly safe to assume, however, that they cannot have been in the habit of attending the General Meetings of the Association, otherwise they would not have been guilty of such misleading statements as " the Executive Council of the E.P.E.A. holds the view that because we are a Trade Union we must throw in our lot with any other Trade Union in any strike that may develop, provided the grounds seem to us to be just." When and where did the Executive Council make such a declaration ? As a matter of fact no such assertion has ever been made, and their supposition is entirely erroneous. The support of the E.P.E.A. is not cast indiscriminatelyon to the side of a Trade Union, neither is it (as they apparently would desire) cast on the side of the employer, but is conditional upon either party consenting to make use of the regularly constituted machinery. If this is to " forfeit our independence " it is the inevitable consequence of our having to act as a Trade Union. We have been compelled by force of circumstances to use the strike weapon, and we have no right to act as an organisation of strike-breakers in every dispute. Those who are shocked at such heresy need to be reminded that nothing less drastic than a Trade Union could effect a cure for the intolerable conditions which existed before the E.P.E.A. entered the field.

The surprise exhibited by those Senior Engineers at the present conduct of the Association and the splendid attitude of aloofness which they adopt would be amusing were it not for the fact that it reveals their own shortcomings. If they had taken a more active interest in the development of the Association, if they had given their intelligent assistance whilst the policy was being formulated, they might have guided the Association more in accordance with their desires. Or, alternatively, they might have been educated up to the policy, and have ranged themselves in line with the bulk of the Association which supports the policy, for it is significant that the small minority of the members who to-day find themselves in disagreement, is largely made up of those members who have assisted least in the development of the Association and who have consistently absented themselves from the meetings.—I am, &c., W. Arthur Jones,

London, Sept. 21. General Secretary, E.P.E.A.

Commercial Topics.

Mica from South Africa.

We learn that Mica Shipments from South Africa have been resumed and a first parcel has just arrived per s.s. "Nevasa," while other shipments have been advised by cable. Considerable quantities are expected at regular intervals.

* * * *

The Chilean Market for Electrical Supplies.

The recent report of the Commercial Secretary to H.M. Legislation at Santiago (Mr. W. F. Vaughan Scott) on the demand for electrical goods in Chile is rather depressing reading from the British point of view. It is stated that Great Britain seems at present to have absolutely no part in this trade, which, taking the market as a whole, must be very considerable seeing that there are over 200 electric supply undertakings in the country. After Argentina and Brazil, Chile is the most progressive Republic in South America. Many engineering, railway and other public works were held up by the war, and the country should offer opportunities to British engineers and machinery exporters to extend their export trade.

Mr. Vaughan Scott states that, owing to the intermittent extreme cold periods experienced in most parts of Chile during the winter months, artificial heating is absolutely necessary, and, on account of their convenience, electric stoves are becoming more and more popular. Nearly all the stoves sold in Chile (over 4,000) are of American manufacture. A certain number of stoves are made in the country and fitted up with American lamps. The American stoves are generally quoted f.o.b., and in some few cases at port of shipment. No reliable information can be obtained regarding prices, as the figures are constantly changing. According to information obtained, the most current prices quoted to different local firms varied from \$5 to \$6 U.S. currency per stove of 600 watt power up to \$9 and \$10 for stoves of 2,000 watts (f.o.b. prices), and the terms on which they were sold were against acceptance of 90 days sight drafts, cash (with 2 per cent. discount), and in one case one of the firms is well supplied with electrical goods on consignment.

The two types of English stoves on the market are 1,400 and 3,600 watts, and their prices (f.o.b.) were 35s. and 75s. respectively, plus an increase of 50 per cent., and less 33 per cent. discount and 5 per cent. for cash payment. There would be an opportunity for British manufacturers to compete successfully with all other makes if they could offer a cheaper and as well presented a stove as the American that would not consume as much current as those mentioned. The Santiago Electric Light Company charges \$0.35 Chile gold (4½d.) per unit for electric current for lighting (which also is generally used for electric stoves), and \$0.24 Chile gold (3·6d.) for industrial power. The American stoves use a resistance wire made of nichrome.

In regard to electrical goods in general, it is stated that 60 per cent. of the electric lamps are of American manufacture, the quality of which, from information obtained, is not very good; 30 per cent. are Japanese, which in quality are inferior to the American article; and the balance of 10 per cent. correspond to those imported from other countries. Electric wire is principally imported from the United States of America, Japan and Spain; and of the electric lamps, fixtures, &c., 60 to 70 per cent. are imported from America, the balance coming from other countries. Battery cells are mostly imported from the United States and a certain amount from Spain. A certain quantity of brass insulating tubing is being manufactured locally.

Any United Kingdom manufacturer who may be interested in entering the market, and desires further information, should apply to the Department of Overseas Trade.

The Work of the National Joint Board.

At a meeting of the National Joint Board held on Sept. 18, the representatives of the Electrical Power Engineers Association explained that their attitude with regard to the recent dispute in the engineering industry and its threatened extension to the electricity supply industry was dictated by a desire to support regularly constituted machinery for the settlement of disputes. The declared intention of the E.P.E.A. to adhere to constitutional methods received the full approval of the employers' representatives on the National Joint Board.

The employers' representatives on the National Joint Board took the opportunity thus afforded of emphasising the value of the Board as a means of conciliation and of urging all electricity supply undertakings to support the Board's work by a prompt and loyal acceptance of the Board's recommendation.

The conference of employers and employed called together by the Industrial League and Council met on Tuesday at Olympia in connection with the Machine Tool Exhibition. Mr. G. N. Barnes, in opening a discussion on "Employment and Production" said that with steady employment local authorities might replenish stocks and get work done during periods of depression. New methods and improved machinery should be introduced with due regard to the maintenance and employment of workers displaced and labour and employers should act with more regard than they sometimes did to the necessity of labour as a whole. There could be no such thing as over production as a whole. An industrial revolution was the policy of despair. It simply fed the worker with phrases to his own undoing. A number of Mr. Barnes' remarks were evidently unpalatable to a section of the audience who expressed their dissatisfaction by songs and disturbances in the usual way.

Electricity Supply.

Barnsley Corporation have applied for a loan of £14,200 for electricity supply purposes.

The local electric lighting company is to provide 25 electric lamps for street lighting in Hatherleigh (Devon).

Lowestoft Council decided last week to apply for sanction to a loan of £7,104 for electricity meters, connections, &c.

The Lincoln Guardians have decided to adopt electric lighting in the nurses' new quarters. The cost is estimated at £200.

Mansfield Town Council proposes to borrow £10,000 from the Public Works Loan Commissioners for its electricity undertaking.

The Guildford Electricity Supply Company have signified their willingness to sell their undertaking to the Corporation for £55,000.

Public electric lighting has been decided upon by Leadgate Urban Council, and the Consett Iron Company has agreed to supply electric current.

Falmouth Corporation has accepted the offer of the Urban Electric Supply Corporation to install two electric lamps in the main street, as an experiment.

Tamworth Rural Council has consented to the Leicestershire & Warwickshire Electric Power Company laying a high tension 25,000-volt cable from Wilnecote to Kettlebrook.

Stratford-on-Avon Council have referred to the Electricity Committee an offer from the Electricity Company to dispose of the undertaking to the Corporation for £10,000.

In reply to a deputation recently, Donegal Urban Council announced their intention to continue lighting the town by means of gas until a company is formed for electric lighting.

Owing to the refusal of the Gas Company to lower the cost of public lighting, Elstree (Herts) Parish Council is making inquiries as to the possibility of obtaining a supply of electricity.

As extensions of the Faversham electricity works are necessary, before deciding to put in additional plant, the Council have asked Canterbury Corporation for their terms for a bulk supply.

Newcastle (Co. Down) District Council has renewed the contract with the Irish Town Lights & Power Company for public lighting for a year, at £340, an increase of £100 over the preceding year.

The North Metropolitan Electric Power Supply Company have informed Hatfield Council that they are about to lay cables between Hertford and St. Albans, and offer to supply Hatfield if local support warrants it.

Bingley Urban Council decided on Monday to give notice of their intention to refer to arbitration the question of the failures in the supply of electricity from Keighley, and it was suggested that Mr. Thos. Roles, of Bradford, should be the arbitrator.

Walsall Council have adopted a proposal to spend £119,500 on the completion of the generating station at Birchills. Ald. Ingram explained that by spending that money they were strengthening their position for linking up later on with places like Wolverhampton and Ocker Hill.

The net profit upon the electric supply undertaking for the last 12 months is £10,523. 1s. 1d.

Fulham (London) Borough Council has instructed the Electric Supply Committee to report upon the question of extending the electric lighting of the streets. Since the commencement of electricity supply in the borough the unclaimed balances of electric light deposits amount to £560 8s. 11d., and £500 of this sum has been transferred to the rent commutation investment account.

When the Trowbridge Electric Supply Company introduced electric supply into the town the local Council allowed the use of overhead cables, but, strange to say, after the company has been in operation for nine years it wants all extensions made by means of underground cables. If this unnecessary stipulation be insisted upon it will add considerably to the cost of future extensions.

In view of the prospect of obtaining electricity in bulk from the North Wales Power Company, Wrexham Electricity Committee have decided to hold up their scheme of improvements of their electricity undertaking estimated to cost £17,000. Mr. Thornton, the deputy borough electrical engineer, stated at the last meeting of the Committee that the Corporation was already committed to £6,000.

In our issue of July 23 we gave some particulars of the report of Mr. F. Nichols Moore, borough electrical engineer of Newport, Mon., on proposed extensions. We are now informed that the first portion of the scheme, estimated to cost £139,550, has been sanctioned by the Electricity Commissioners, and it is anticipated that the remainder of the scheme will also be approved after further information has been supplied to the Commissioners.

Darwen Corporation has protested against the proposal to include the borough in the Mid-Lancashire electricity district, and also, having regard to the financial responsibility involved, against the proposal to erect a super-station on the south bank of the River Ribble at Preston. Councillor J. B. Thornley, chairman of the Electricity Committee, thought Darwen would be involved in an unknown amount of cost in equipping the station at Preston. Darwen and Blackburn had entered into an agreement for the supply of current to Darwen which would be adequate for years to come. The proposed Mid-Lancashire district stretched from Fleetwood and Blackpool to Colne, and, in his opinion, the original proposal, under which Darwen, Accrington, Burnley, Colne and Nelson formed Group "D," was better.

Electric Traction.

It is reported from Berne that the first electrically-driven train has passed through the St. Gothard Tunnel.

Plymouth Watch Committee propose to impose a toll of 1½d. per 'bus-mile upon the motor omnibuses owned by the Corporation and run by the tramways department.

It is proposed to electrify the Highland Railway from Perth to Inverness, and to take power from the hydro-electric scheme, which is to utilise Lochs Ericht, Laidon, Rannock and Tummel, and was recently reported upon by the Water Power Resources Committee.

Over 1,000 Newcastle Tramwaymen came out on strike on Tuesday, causing a complete stoppage of the tramway service. The men's grievance is that certain employees, mostly inspectors and timekeepers, are not members of the Tramway and Vehicle Workers' Union.

At a meeting of the Walsall Council last week Ald. Cope, who proposed that application be made to the Ministry of Transport for power to raise the tramway fares, said that it was the only hope of their salvation . Unless the fares went up there was likely to be a loss on the year's working of £14,000 on the omnibus service. The proposal is to increase ordinary fares from 1d. to 2d., and workmen's fares from ½d. to 1d. per mile.

A suggestion having been made as to the advisability of adopting electric traction on the Manchester South Junction & Altrincham Railway, the Joint Committee controlling the line state that in view of the prohibitive costs which would be involved in a scheme of such magnitude, they regret they cannot entertain the suggestion at present. A conference of local authorities will be held in order to bring pressure to bear through the Ministry of Transport to have the line electrified.

At a meeting of Wolverhampton Town Council last week a letter was received stating the opinion of the Chamber of Commerce that the Council should consider the advisability of withdrawing their scheme for converting the tramways to the overhead system, and suggesting that self-contained motor-vehicles be substituted

Ald. Gibbons and Ald. Johnson said 'buses had been proved to be much dearer than tramways. The letter was referred to the Tramways Committee.

Imperial and Foreign Notes.

Kingsborough (Tasmania) Council is considering the question of electricity supply, and hopes to obtain current from the Government Hydro-Electric Department.

Lithgow (N.S.W.) Council has decided to provide electric supply in the town, and current in bulk will be taken from the steel works of G. & C. Hoskins Company at ½d. per unit.

The Adelaide (S. Australia) Electric Supply Company is erecting a new power house on land recently acquired at Osborne-street, and orders have been placed with the Metropolitan-Vickers Electrical Company for two turbo-generators (10,000 kw. and 5,000 kw.), in addition to the 5,000-kw. turbo-generator in transit. The latter will be kept at the Grenfell-street station until the Osborne-street building is ready.

At a recent meeting of the Hobart (Tasmania) Tramway Committee effect was given to the declared policy of the Council to give preference to machinery of British origin An order for tramway equipment lay between the British General Electric Company and the General Electric Company of America. The English Company's tender was recommended for acceptance, although the total amount was £720 above that of the American Company, less a possible amount of £200 on account of exchange rates.

From statistics published by the "Electrical World," we gather that the use of Industrial Power in California is extending rapidly, and from every branch of industry or manufacture there is an increasing demand for electric power. A questionnaire was sent out, and out of the replies received, the information from 299 companies, employing more than 50 hands each, was tabulated. These companies have a connected motor load of 214,980 h.p., and the consumption for 1919 was 193,800,000 units, only 9,500,000 being generated by private plants. Iron and steel works have motors of 81,616 h.p. ; food and kindred products, 32,958 h.p. stone, clay and glass, 16,713 h.p. ; shipbuilding, 46,100 h.p. ; and lumber works, 17,535 h.p. Electric power is extensively employed in chemical works, paper and textile mills, leather factories, mining, &c., and also for heating, cooking and other domestic purposes.

We learn from the "Bulletin" of the Federation of British Industries that, owing to the difficult industrial situation in Germany, efforts are being made to ease matters by the introduction of Mass Production and the Development of standardisation. Useful work appears to have already been accomplished by the "Standards Committee" especially in the engineering trades. Finished tables of standards to the number of 135 have already been drawn up, and about 400 similar tables are being prepared. The principal difficulty was experienced in selecting standards for such items as gearings and fittings. Two standard types respectively of worm drive and gear drive to meet all requirements have been substituted for the numerous types hitherto in use. Standards have also been applied to such details as hand wheels, cranks, springs, pins, &c. The work of the Committee also includes the standardisation of shaftings and of the many and varied types of electric, gas, water and steam-driven machines. Other bodies are engaged in drawing up standards applicable to the construction of agricultural machinery locomotive engines, merchant ships, &c.

Miscellaneous.

The Lizard Wireless Direction-Finding Station is to be reopened after the aerial system has been reconstructed.

A Cricket Match between the Osram G.E.C. Lamp Works and the Witton Engineering Works, on Saturday, the 11th inst., resulted in a win for the Lamp Works team, which will therefore hold the Championship Cup, competed for annually by teams from the head office and the various branches.

The Birmingham Chamber of Commerce, in collaboration with the Department of Overseas Trade, exhibited at the offices of the Chamber from Monday to Thursday of this week imported goods including domestic electrical articles of Swiss and United States manufacture, and tools made in the United States for the Indian market.

At last Friday's sitting of the Court of Inquiry into the Penistone Electrical Trades Dispute, Sir Allan Smith read the agreement (referred to in our last issue) under which the E.T.U. agreed to suspend the strike notices until the Court had reported and to withdraw the question of principle in the Penistone dispute. It was decided to report to the Minister of Labour and to adjourn the Court of Inquiry *sine die*.

Although the Penistone dispute is now happily settled the E.T.U. is again engaged in industrial strife, this time in connection with the South Wales steel workers over a man at the Port Talbot steel works who left the latter union for the former. The dispute is still unsettled and the notices expire to-morrow.

According to the "Gas World" the Gas Light & Coke Company has given notice to the Westminster City Council to terminate the contract for high-pressure gas lighting entered into in 1910, as a result of lack of response on the part of the Council's officers for reasonable consideration of the difficulties in which the Company has been placed. The works Committee of the Corporation has deputed representatives to confer with the Company with reference to the notice.

The fifth annual report of the Committee for Scientific and Industrial Research which has come to hand as we go to press, contains a review of the work which has been done by this body during the past five years. The programme of the department falls under four headings, the encouragement of the individual research worker, particularly in pure science, the organisation of national industries into co-operative research associations, the direction and co-ordination of research for national purposes and the aid of suitable researches undertaken by scientific and professional societies. The body of the report gives a detailed account of the activities during the past year.

Owing to the alterations in the law relating to patents, trade marks and designs introduced by the Patents and Designs Act of 1919 and to the various territorial and other changes made by the various Peace Treaties there has been an urgent need for an up-to-date digest of the patent laws of all countries. This is now provided by the new edition of the "Handbook of Patent Law of all Countries," of Mr. W. P. Thompson, a well-known patent agent. A very useful digest of British patent law and practice is given in the first 54 pages of the work, and over 100 pages are devoted to Colonial and foreign patent law and procedure. The position in the newly formed States, including Czecho-Slovakia, Finland, Jugo-Ŝlavia, Palestine and Poland is explained, and a good deal of useful information for engineers and patentees is included in this section. The present is the 18th edition of Mr. Thompson's Handbook, and as it appears to have undergone very careful revision it should prove extremely useful to all who are interested in patents, or to those who desire to secure British or foreign patent rights or to register designs or trade marks in any county in the world. It is published at 15s. net by Messrs. Stevens & Son.

Obituary.

We regret to record the death of the Right Hon. Sir William Mather, which occurred on Saturday last at Bramshaw, New Forest. The deceased was in his 83rd year, having been born in Manchester in 1838. He was well known in the electrical engineering industry as the chairman of Messrs. Mather & Platt, of Salford. He was Liberal member for South Division of Salford from 1885 to 1886, for the Gorton Division of Manchester from 1895 to 1895, and the Rossendale Division from 1900 to 1904. In early life he held what were then pronounced views on labour questions, and was a convinced believer in the eight hours system at a time when people generally were not so educated in their ideas on this subject as they are now. He was closely connected with the development of Owens College and the Manchester University, and for some time was chairman of the British Science Guild. Some years ago he visited the United States on an educational tour, and published a report whose recommendations have largely been adopted, though they were submitted to the usual uninformed criticism at the time.

Mr. J. E. Edmundson, the Urban Electric Supply Company's resident engineer at Hawick, met with a terrible death on Saturday, his body being found in a mutilated condition on the North British Railway near Hawick. The deceased was engineer and manager at the electricity works at Grantham for 14 years, and went to Hawick in February last year. He was recently discharged from hospital, where he had been under treatment for hernia. He was 42 years of age, and leaves a widow and two daughters.

We regret to record the death, at the age of 61, of Mr. John Henry Thornton, of Frank Thornton & Company, electricians, Burnley.

Personal and Appointments.

Dr. O. S. Sinnatt, M.C., D.Sc., M.Sc., lecturer in mechanical engineering at King's College. London, has been appointed professor of aeronautical science at the R.A.F. College, Cranwell.

On retiring from the position of general manager for the Pirelli General Cable Works, Southampton, Mr. G. Conforti has been presented by the staff with a gold watch, and by the employees with a gold albert.

The King of Italy has conferred the Italian War Cross upon Captain Wedgwood Benn, M.P., for services rendered during the war in connection with the Italian Flying Corps. This is the second Italian decoration awarded to Captain Benn, who, it will be remembered, was decorated with the Medal for Valour after his spy-dropping exploits on the Italian front, for which he also received the D.F.C.

Institution Notes.

The first smoking concert of the Electro-Harmonic Society will take place on Friday, Oct. 1, in the Great Hall, Cannon-street Hotel, Cannon-street, E.C. The concert commences at 8 p.m.

The address of the Institute of Cost and Works Accountants is now 38, Grosvenor-gardens, Victoria, London, S.W.1. (Telephone, Victoria 6776.) A library and a reading room is in course of formation.

The Birmingham District Electric Club have arranged a Snooker handicap for which a nominal entrance fee of two shillings and sixpence will be charged. Those wishing to take part should forward their names and the entrance fee not later than Monday next, to the Secretary, Mr. N. Deykin, 130, Station-road, Wylde Green, Birmingham.

The autumn meeting of the Iron and Steel Institute was held during the week at Cardiff. During its course a number of Papers of interest to electrical engineers were read, with which we shall hope to deal in subsequent issues.

In the course of an address on Tuesday afternoon Sir John Beynon deplored that the visit of the Institute should be made under the shadow of an impending coal strike, as mad as it was suicidal. He had a quarrel with the better class of workmen in South Wales, for if they examined the figures of the recent ballot they would find that only 66 per cent. of the men voted. The remainder, probably representing the sound common sense men, had allowed their prosperity to be gambled away by a pack of boys.

Business Items, &c.

Messrs. R. H. Barker & Company, Rutland Mills, Wakefield, have a 400 kw. British Westinghouse turbo-alternator for sale, with condenser and switchboard.

The partnership between Joseph Wm. Carrack, Wm. Hy. Cass and Harold B. Timm, electrical engineers and contractors, 6, Park-place, Leeds, has been dissolved. Debts by Mr. Carrack and Mr. Cass, who continue the business as Carrack & Cass.

Prof. E. P. Fetherstonhaugh, B.Sc., of the department of electrical engineering, University of Manitoba, Winnipeg, would be glad if United Kingdom manufacturers of electrical instruments and apparatus would place his department on their mailing lists for catalogues.

Messrs. Hyatt, Ltd., makers of the Hyatt roller bearings, will remove on Sept. 29 from their present offices at 24, Devonshire-street, W.C. 1, to Thurloe Place, South Kensington, London, S.W. 7. Telegrams: Hydrolim Southkens London. Telephone: Kensington 5143 (two lines).

The owners of British Patent No. 9,555/11, for a " Motor for transmitting to a distance continuous or intermittent angular movements," desire to dispose of the Patent or to enter into working arrangements under licence. Particulars from the Hertford Record Company, Ltd., 59, Lincoln's Inn Fields, London, W.C. 2.

Catalogues, Price Lists, &c.

Heat Treatment Bulletin No. 24, of the Automatic & Electric Furnaces, Ltd., is on volume changes in the heat treatment of steel by Dr. Leslie Aitchison.

A nicely-printed leaflet, entitled " Fresh Air by Electricity," has been issued by the General Electric Company, Ltd., and makes some very good points on ventilation and the use of electric fans. The Freezor " Koolah " ceiling fan is described and illustrated on page 3 of the leaflet.

A supplement to the Brush Ljungström Brochure issued by the Brush Electrical Engineering Company, Ltd., gives additional information as to the progress made with the installation of the plant and also some technical details of the 5,000-kw. blade system. Some good illustrations and shipping specifications of typical plants are given.

The directors of the Business Telephone Directories, Ltd., 25, Lawrence-lane, E.C., state that they have concluded an agreement with the Postmaster-General which gives them the sole right of publishing a Classified Trades Telephone Directory for London. This directory will be known as " The Buff Book," and will be published half-yearly in October and April. The classified trades list of subscribers at the end of the present P.O. Telephone Directory will be discontinued, but a copy of the new directory will be supplied to all London subscribers.

Bankruptcies and Liquidations.

The examination of Alfred Rowland Meggett, electrical engineer, 45, Thrumpton-lane, East Retford, took place last week. Liabilities are estimated at £675 and assets at £276.

A meeting will be held at 7, Greek-street, Leeds, on Oct. 19, to receive an account of the winding up of the Wensleydale Gas & Electricity Company, Ltd.

Tenders Invited and Accepted.

Dublin Guardians require tenders by 3 p.m. Sept. 29 for six months' supply of electric fittings, &c. Forms of tender from the Master of the Workhouse.

The Metropolitan Asylums Board require tenders by 2.30 p.m., Sept. 29, for extensions of telephone installation at Grove Hospital, Tooting Graveney, S.W.17.

Tenders are required by 11 a.m., Sept. 27, for six months supply of electric light fittings, &c., to Purdysburn Asylum, Saintfield-road, Belfast. Forms of tender from the Clerk.

The time limit for the receipts of applications invited by the Government of the Uganda Protectorate for a concession of a portion of the Ripon Falls of the Nile has been extended to Feb. 19, 1921.

Lincoln Corporation require tenders by 11 a.m. Oct. 8 for spray cooling plant. Specifications, &c., from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W.1.

St. Helens Corporation require tenders by Sept. 30 for a natural draught cooling tower for the electricity department. Specification from Mr. B. T. Hawkins, borough electrical engineer.

South Shields Guardians want tenders by 10 a.m., Oct. 1, for six months supply of electrical fittings, &c., to the Horton Institution and Cottage Homes, Cleadon. Forms of tender from the Clerk.

Bradford Corporation require tenders by 10 a.m. Oct. 28 for two natural-draught, chimney-type cooling towers, pipe-work, troughing, valves, &c. (Contract R. 160). Specifications, forms of tender, &c., from Mr. Thomas Roles, Electricity Offices, Town Hall, Bradford.

Sheffield Electric Supply Committee require tenders (by Oct. 12) for the supply of two 10,000 kw. steam turbines, condensing plant, pipe work, &c., alternators and exciters. Specifications from the general manager and engineer, Mr. S. E. Fedden, Commercial-street, Sheffield.

Tenders are invited for six months' supply of electrical fittings, &c., to the Midlothian and Peebles District Asylum, Rosslynlee. Forms from the Clerk, 19, Heriot-row, Edinburgh, to whom tenders by Oct. 2.

Invercargill (N.Z.) Corporation want tenders by Oct. 19 for cables and overhead tramway equipment. Specification can be seen at the Department of Overseas Trade (Room 48), 35, Old Queen-street, Westminster, S.W.1.

The Lancashire & Yorkshire Railway Company require tenders by 10 a.m. Sept. 30 for 12 months supply of signal, telegraph and electric light wires and fittings, metals, oils, &c. Forms of tender, &c., from Mr. Sharp, Stores Department, Osborne-street, Manchester.

Southampton Corporation invite tenders for the supply, erection, &c., of a 5,000-kw., three-phase, 50 ∿, 6,000-volt turbo-alternator, with condensing plant and accessories. Specifications, &c., from Mr. W. G. Turner, borough electrical engineer. Tenders to the Town Clerk by noon, Oct. 8.

The Municipal Board of Agra (India) require tenders for four Diesel engines and h.t. alternators, h.t. and l.t. switchgear, transformers and sub-station equipment; 15 miles of underground h.t. cables, 28 mills of overhead l.t. mains, &c. Specifications from Messrs. Handcock & Dykes, 11, Victoria-street, S.W. 1, to whom tenders by Oct. 22

Manchester Electricity Committee invite tenders (by Oct. 8) for the supply of five 8,500 k.v.a. three-phase transformers and fans, &c., and also three 6,000 k.v.a. three-phase transformers and fans, &c. Specifications from the secretary (Mr. F. E. Hughes), Town Hall, and further particulars may be obtained from the chief engineer and manager (Mr. S. L. Pearce), Dickinson-street, Manchester.

The Urban Council of Kinsale (Co. Cork) has accepted the tender of Messrs. O'Neill & Sons for the electric lighting of the town for three years, at £180 per annum.

Coxhoe (Durham) Parish Council has accepted the offer of Walter Scott, Ltd., for lighting East Helton by electricity from September 1 to April 1, at £5 per 50 c.p., lamp.

Stretford Urban Council has placed orders with the Metropolitan-Vickers Electrical Company for switchgear and transformers at £3,207, and for an automatic regulator and transformer at £510.

Glasgow Corporation have accepted tenders for electric lighting installations in houses at Kennyhill and Riddrie as follows: Mr. C. Kintock, areas 1 and 2, £10,812; and Mr. J. F. Hiddleston, areas 3 and 4, £7,771.

Portsmouth Electric Lighting Committee have recommended the Council to accept the tenders of the Metropolitan-Vickers Electrical Company for a 4,000 kw. turbo alternator at £38,070, and Babcock & Wilcox, Ltd., for water-tube boilers at £34,840.

Glasgow Corporation has accepted the following tenders: Metropolitan-Vickers Electrical Company, nine 1,875 k.v.a. step-down transformers, £29,241; British Electric Transformer Company, nine 1,875 k.v.a. step-down transformers, £29,385.

Manchester Electricity Committee has accepted the following tenders: Metropolitan-Vickers Electrical Company, h.t. switchgear; Callender's Cable & Construction Company, cable; Aiton & Company, l.p. water pipes; and Hamilton, Woods & Company, valves for Stuart-street station; Jos. Stubbs, Ltd., year's service boxes; Siemens Bros. & Co., tee service boxes; Hardy & Padmore, trough boxes, bends & troughing.

Companies' Reports, &c.

AUTOELECTRIC TRANSMISSION, LTD., was struck off the Register of Joint Stock Companies on Sept. 17.

The directors of STOTHERT & PITT, LTD., have declared a further dividend of 7½ per cent. (tax free), making 12½ per cent. for the year.

At an extraordinary meeting of the ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT on the 11th inst. the capital was increased to 550,000,000 marks.

The directors of the NAIROBI ELECTRIC POWER AND LIGHTING COMPANY, LTD., have declared a first interim dividend at the rate of 4 per cent. for 1920.

The BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY, LTD., has declared a dividend of 3½ per cent., free of tax, on the preferred and deferred ordinary stocks.

The directors of the BRITISH ALUMINIUM COMPANY, LTD., announce a dividend at the rate of 8 per cent. per annum (less tax) on the ordinary shares for the six months to June 30.

The PARA ELECTRIC RAILWAYS AND LIGHTING COMPANY, LTD., announces an interim dividend of 6 per cent. on the ordinary and preference shares for the past half-year.

The CANADIAN GENERAL ELECTRIC COMPANY, LTD., has declared a half-yearly dividend of 3½ per cent. on the preference and a quarterly dividend of 2 per cent. on the common stock.

An interim dividend for the half-year to June 30 at the rate of 8 per cent. per annum, less tax, has been declared on the ordinary shares of the MIDLAND ELECTRIC CORPORATION FOR POWER DISTRIBUTION.

The directors of the EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH COMPANY, LTD., have declared an interim dividend for the three months ended June 30, 1920, of 5s. per share, tax free.

The directors of the MADRAS ELECTRIC TRAMWAYS (1904), LTD., have declared an interim dividend for the year ended Dec. 31 on the ordinary shares of 8½ per cent. per annum, tax free. Last year the total dividend was 8 per cent.

The directors of STEWARTS & LLOYDS, LTD., have declared interim dividends for the half-year ended June 30, at rate of 6 per cent. per annum on the preference and 10 per cent. per annum on the preferred ordinary shares.

The report of J. STONE & COMPANY for 1919 states that there was a credit balance, after allowances for depreciation, &c., of £162,253, which with balance brought forward (£131,861) makes a total of £294,114. A dividend of 10 per cent. is to be paid and a bonus of 2s. per share on the ordinary shares, £199,074 carried forward.

The report of the directors of the DUMBARTON BURGH and COUNTY TRAMWAYS COMPANY, LTD., for the year ended July 31 last, states that the profit (including amount brought forward) after meeting debenture stock interest, was £9,224. After providing for sinking fund there was a balance of £5,651, and a dividend at the rate of 5 per cent. per annum on the ordinary shares is recommended, leaving £1,276 to be carried forward. Last year the same dividend was paid.

The gross revenue of the CALGARY POWER COMPANY for 1919 was $296,564, against $276,964 for 1918. Operating expenses, bond interest and other charges absorbed $206,835, leaving a net profit of $89,729 (against $82,490). After appropriating $50,000 for depreciation and bond discount, the balance carried forward to 1920 was $181,167. The net earnings for the past year were the largest in the history of the company, but they do not, in the opinion of the directors, warrant payment of a dividend.

The report of the directors of the HALIFAX & BERMUDAS CABLE COMPANY, LTD., for the year ended June 30, 1920, states that the net result of the year's working is a credit balance of £32,786 13s. 8d., compared with £26,627 11s. 1d. for the previous year The balance to credit of revenue account brought forward from last year is £30,062 18s. 4d., and with the above £32,786 13s. 8d. makes a total of £62,849 12s. Deducting £11,254 5s. 11d. expended on repairs and £1,500 interim dividend of 3 per cent. (tax free), paid in March last, there remains £50,095 6s. 1d. The directors propose to distribute a further dividend of 3 per cent. (tax free), making the total distribution for the year 6 per cent. This will leave £48,595 6s. 1d. to be carried forward, subject to Excess Profits Duty. The company's cable has worked efficiently during the year, except for two short periods when it was interrupted near Halifax and Bermuda respectively.

The report of the directors of the VICTORIA FALLS and TRANSVAAL POWER COMPANY, LTD., for the year ended Dec. 31, 1919, states that, after providing for interest and premium on debentures for year, amounting to £219,160, and depreciation and tax, &c., £394,488, there remained £175,626 net profit to which was added £93,693 brought forward from 1918. Two dividends, each of 3 per cent., less tax, on the preference shares absorbed £83,998, leaving a surplus of £185,320. On June 17, 1920, a dividend of 5 per cent., less tax, was declared on the ordinary shares for the year ended Dec. 31, 1919, and as preference are entitled to share pro rata with ordinary in surplus profits distributed until preference have received a total dividend of 10 per cent. for the year in respect of which distribution is made the directors also declared at same time a further and final dividend of 4 per cent., less tax, on the preference shares. These dividends absorbed £91,000, leaving credit balance £94,320, which is carried forward.

Forty Years Ago.

(THE ELECTRICIAN, SEPTEMBER 18, 1880.)

SWANSEA.—The British Association formally opened the telephone line between the Guildhall, Swansea and the waterworks (8½ miles). Whilst they were in Swansea the president congratulated the contractor on its success, and spoke very highly of the instruments used (Gower-Bell). It is expected that a Gower-Bell telephone exchange will be shortly established at Swansea.

ELECTRICAL ILLUMINATION OF MOUNT VESUVIUS.—The "Electrotechnische Zeitschrift" reports that the first experiments with the electric light on the Vesuvian railway took place recently under the direction of M. C. Moleschott and of the engineer, Girolamo Taddei, who represents in Italy the firm of Siemens & Halske. Only 14 differential lamps were used, being maintained in action by a dynamo machine of medium size giving alternating currents.

MUIRHEAD'S PATENTS.—No doubt many readers of the daily papers were surprised to read that one of the last Bills to receive the Royal assent in the late session was one to make valid certain letters patent granted to Messrs. Muirhead for improvements in the working of electric telegraphs. It seems that the patentees, having inadvertently omitted to pay the stamp duty of £50 at the end of the third year, nothing short of a special Act of Parliament could make good the omission. Messrs. Muirhead hold almost a unique position in obtaining such a special Act, but we doubt if their views are very favourable towards the present system of granting patents.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—"The Sopwith Affair"; "The Tests of Amphibians"; and "Training of Air Mechanics."

"The Cabinet Maker" (Special Autumn Issue). Coloured Plate:—"Bedroom with Tapestry Hangings"; "The Making of Humpty Floor Cushions"; and "Mahogany at the West India Docks" (illustrated).

"The Chemical Age":—"The Government Policy of Restricting Imports of Dyestuffs"; and Chemical Papers at the Institution of Mining Engineers.

"The Gas World":—"Detailed Analyses of Gas Companies' Accounts, showing how the Price of Gas is made up"; "Progress of 'Safety First' Methods in Industry"; and "Hire Rates of Meters."

"Hardware Trade Journal" (Special Autumn Number):—"Brass Foundry Practice"; "Making Pipe Joints"; "Electric Steels".

"Ways & Means":—"Gustave Ador and International Finance," by Anthony Clyne; "Decimal Coinage," by Harry Allcock; and "The Non-Ferrous Mining Industry," by James Wignall, M.P.

Prices of Metals, Chemicals, &c.

TUESDAY, Sept. 21.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£108 0 0	—	—
Electro Wirebars...	.	£118 0 0	—	—
H.C. wire basis......	per lb.	1s. 1$\frac{9}{16}$d.	—	—
Sheet	,,	1s. 6d.	⅛d.	—
Phosphor-bronze Wire (*Telephone*)				
Phosphor-bronze wire, basis	,,	1s. 9$\frac{9}{16}$d.	—	—
Brass 60/40—				
Rod, basis	,,	0s. 10¾d.	—	—
Sheet, basis	,,	1s. 4¾d.	—	—
Wire, basis	,,	1s. 4⅛d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£37 10 0	£0 10 0	—
Foreign or Colonial	,,	35 10 0	£0 5 0	—
Tin—Ingot	,,	275 10 0	£2 10 0	—
Wire, basis	per lb.	0 3 6½	—	—

Salammoniac.—Per cwt. 110s.–105s.
Sulphur (Flowers).—Ton £18 5s.
,, (Roll Brimstone).—Per ton £18 5s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £41.
Boric Acid (Crystals).—Per ton £74.
Sodium Bichromate.—Per lb. 1s. 5d.
Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 7¾d.: plantation 1st. latex, 1s. 6½d. per lb.

The metal prices are supplied by British Insulated & Helsby Cables; Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co., Ltd.

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Notes.

A New Mercury Vapour Lamp.

THE increasing use of the gas-filled lamp for lighting purposes has resulted in a partial eclipse of the arc lamp for this work; and it seems also to have drawn investigators away from what is a very fascinating subject. Nevertheless, as was pointed out in our columns a week or two ago, there is room for considerable enquiry into the properties of the metallic arc which is now receiving so large an employment for welding work. This applies particularly to the alternating current arc which, probably owing to the difficulties which surround it, has received less than its due share of attention. This question has, however, recently been investigated from another point of view by M. HENRI GEORGES, who in the "Comptes Rendus" a short time ago described a two electrode lamp, which starts with cold electrodes and operates at a pressure of over 500 volts. The tube is of quartz, and the vapour pressure is about 2 kg. per sq. cm. Reservoirs at the end of the tube contain a small quantity of mercury (about 1 c.c. for the 2 kw. lamp), while the lamp itself is filled with neon also under slight pressure. Connection is made to the secondary of a transformer with a self induction in the primary circuit and starting is effected merely by closing the primary circuit. The lamp takes about seven minutes to reach the steady state, when it appears as a thread of high brilliancy; the temperature of the walls of the tube being then about 700°C. In the first pattern of lamp the pressure on the terminals is about 2,250 volts, and the current consumed is about 1 ampere with a power factor of 0·7. It is hoped that lamps with a capacity of 10 kw. will soon be constructed and when this is done the most powerful source of ultra-violet light that has yet been available will be obtained. The investigation should also not be without its bearing on the design of the mercury vapour rectifier which is now finding an employment for industrial work.

The Economic Selection of Coal.

HAVING regard to the financial situation the days are gone by when coal could be used lavishly without any consideration as to its suitability for the work for which it was being employed. One result of this has been an increasing tendency to examine coal microscopically and physically and another to design boilers and other coal using apparatus with some reference to the class of fuel which is to be employed in them. The problems thereby raised are discussed by Mr. A. L. BOOTH in a Paper read at a recent meeting of the Iron and Steel Institute. He quite rightly points out that "true economy is in making the best of present day plant, and that the selection of the most suitable fuel is probably the most important factor in realising such economy." For this purpose microscopic examination has the advantage over chemical analysis that while with the latter fuels with quite different behaviours may give the same results, the former allows a very close distinction to be made and other useful information to be obtained. It is obvious, however, that such work cannot been undertaken by individual coal users with any great success, and that if there cannot be co-operative coal buying there should at least be co-operative coal analysis.

The University of London.

WE are not enamoured of the peremptory tone of the letter addressed by the MINISTER OF EDUCATION to the VICE-CHANCELLOR of the University of London, fixing a time limit to the Government offer of the Bloomsbury site as the new home for the University. Like some others, Mr. FISHER is convinced that the site is the most suitable one that can be secured, and he threatens that unless the Senate accept it no other site will be offered. This is a ridiculous attitude, even for a Minister, to assume towards a matter of the highest importance for London and the Empire. The best available place should be found for the housing of the University, and though Bloomsbury may be capable of being converted into a suitable home there are many who believe that much cheaper and more commodious accommodation can be easily found. In addition, experts say that King's College, which the University would have to vacate, is more valuable than the proposed Bloomsbury site and that the offer of the Government is lacking in generosity, and is merely an attempt to make a good bargain. Under these circumstances, the most thorough investigation should be made by independent authority into the whole of the facts, but this cannot be done if Mr. FISHER insists upon his ultimatum. This method of dealing with this important matter reflects little credit upon the Ministry of Education.

The British Association.

SINCE, a week or two ago, we called attention to certain ills which the flesh of the British Association is heir to diagnosis has been attempted by a number of distinguished physicians in the columns both of "Nature" and of "The Times." There is practical unanimity that something is wrong and almost equal regret that the proceedings of this Society fail to attract in the way they once used to. For ourselves, we feel that a broad policy is necessary if any certain cure is to be achieved, and we are not at all sure that Prof. H. E. ARMSTRONG does not hit the right nail on the head in saying that while "The neglect of science by the nation has long been the favourite text of the scientific preachers, it occurs to none to consider how complete is the neglect of the nation of which scientific workers have long been consistently guilty." It is all very well to deplore the greater interest that the nation takes in football and horse-racing than in science, but the aims of scientists should be to make science as interesting to the general public as these all-absorbing topics. The rest would then follow. Though it may not be possible to do this every day it might be possible to do it once a year. There are already sufficient societies whose aim is the dissemination of scientific learning among scientists. What is wanted is a society which will disseminate scientific learning among literary men, journalists, jockeys, actors and the public generally. If the British Association were to reorganise itself to do this it would not sully its traditions and would increase its usefulness.

Labour and Science.

IN this connection, it may be added, that while we hear much of the need for a better appreciation of the benefits of science by manufacturers, it is rarely that the equally great need for an understanding of science by Labour is emphasised. Scientific theories on maximum production have often been stultified by labour troubles, and it is equally true that delicate tests made with a view to obtaining the most efficient application of human effort will come to little if workers are privately determined that in no circumstances shall they succeed. It is obvious that the future demands the worker as well as the employer feeling a desire that science should be usefully applied to the industry with which he is associated. We are therefore interested to observe that the British Science Guild is arranging for a conference with the Labour Party during the current year. At this stage details are not available, but the Guild rightly regards this as an important precedent. If the time comes when Labour holds a larger measure of control over industry it is surely essential that its leaders should be well informed on scientific subjects. In this connection we may recall the saying of GOETHE, aptly quoted by the President at the recent Annual Meeting of the Guild, "There is no more dreadful sight than ignorance in action," but we have been very near having an example of it recently.

Electricity Supply Costs and Agreements.

As we mentioned recently, the Federation of British Industries has inaugurated a scheme for the interchange between its members of figures relating to electricity costs. At present some 50 members have supplied the required data, of which we hope proper use will be made, as it will not be an easy matter to fix upon an equitable basis of comparison, when so much depends upon the load factor, the local conditions, the hours worked per day, the character of the work for which electricity is employed, and the time of day at which it is used. We are glad to see that this has already been recognised to some extent at least by those responsible for the compilation of the information, and that manufacturers are now being asked to state the average number of hours per day during which current is being used, though even this is not in itself enough to give a true line of demarcation. According to the announcement, too, the "actual cost per unit is calculated by dividing the total cost by the number of units consumed," but, of course, the figure thus obtained will have to be used with the utmost care in making comparisons. With the limitations mentioned above the information, which is to be tabulated and circulated among the members, should be useful in assisting manufacturers to keep a check upon their costs, but we hope it will not in addition prove a thorn in the side of the supply authorities. It is also proposed to introduce an interchange of facts concerning the terms and conditions of supply agreements in the various areas. In this way it is hoped a check will be placed upon any attempt to give preferential treatment to any class of consumer.

Direct Current Conversion.

AN apparatus, whose object is the simplification of methods whereby direct current can be converted from one voltage to another, has recently been devised by the Société Romain Bon of Liège. It consists of what is essentially a direct current generator but with a fixed armature and a rotating field. Instead, however, of the usual arrangement of armature windings what are in effect a number of series transformers are used, the terminals of which are connected to a commutator from which current can be collected by a system of revolving brushes. This arrangement in combination with the revolving field and an elliptical air gap gives an equipment whereby any desired conversion can be realised by increasing or decreasing the number of ampere turns in the stationary coils. The makers point out that as the general conditions resemble those of a static transformer a minimum of iron and copper are required, and that there are no crossing leads at different potentials, thus facilitating insulation and reducing the risk of short circuit. Commutation is said to present no difficulty, though the usual design is modified by replacing the parallel bars with an arrangement of staggered contacts. Nevertheless, as the biggest machine that has so far been built is 1 kw., it is early days to be definite on this point, and we should not be surprised to find considerable obstacles to development from troubles of this kind.

Conditions in British Export Contracts.

WE recently referred to the prejudice aroused in Chinese business circles against British engineering and export firms on account of the introduction into contracts of clauses designed to protect manufacturers and exporters from the effects of strikes and of increased wages awards. Contracts for the supply of electrical engineering plant take many months to complete and in the present uncertain condition of things it is quite natural that firms should endeavour to protect themselves from loss. However, the consumer does not see this in quite the same light, and a somewhat similar feeling against these protective clauses seems to have been aroused in South America. We think it would be highly desirable to find some alternative method of dealing with the difficulty. In the course of a strong protest against the clause by the Valparaiso Chamber of Commerce to the Federation of British Industries it is pointed out that it is very prejudicial to the best interests of British trade as tending to foster demands for increased wages among British workmen. The Chamber thinks that the removal of the safeguard against loss on contracts would have a salutary effect on both employee and employer, and the Federation has been urged to take steps to have the clause eliminated from its members' contracts. It is stated that business has been lost in Chile even when the British prices quoted were more favourable, as buyers object to a condition which manufacturers in the United States and other countries do not insist upon. We desire to appeal strongly to employers and to Trade Union leaders to do something to stabilise the conditions of things, because unless there is a reasonable certainty as to costs of production it will be impossible to abandon the clause. If it should be necessary to continue it, then many engineering contracts will go elsewhere and the export trade of this country will suffer severely.

Foreign Students and Export Trade.

The question of encouraging foreign and colonial engineering students to come to this country for their training, has not received that consideration from British manufacturers and engineers which its importance deserves. In recent commercial reports on the Far East and South America, we read that there was a predilection for American machinery in those places, because many of the local merchants and engineers had acquired their engineering and business experience in the United States. After a period in America they returned home imbued with American ideas; they are acquainted with the operation of American tools and machinery, and naturally, when plant is wanted, they prefer to buy where they know most. At the present time America is attracting a number of Chinese students, and in addition efforts are also being made to develop education in China itself. For instance an American engineer in charge of the mechanical engineering department of the Peking University is organising a movement in favour of raising about £1,250,000 in the U.S.A. for the purpose of extending the work of the department. No doubt Great Britain has been doing a certain amount of useful work through the Hong-Kong University, and an arrangement has been made to employ a limited number of Brazilian engineering students in this country, but more strenuous and better organised efforts are needed if we are to capture and maintain our share of the Chinese and South American trade. There are vast possibilities in China and South America for the engineer, and therefore we welcome the announcement that the Federation of British Industries has advised its members to encourage the employment of engineers from the Argentine, from Czecho-Slovakia and other countries. We believe that this policy is the right one, and that it will ultimately assist materially in the expansion of our export trade.

Foreign Engineering Concessions

Like many other countries, some of the South American Republics are being forced by the shortage and high price of coal to take steps to develop their extensive water power resources. With this end in view they have recently invited tenders for concessions for hydro-electric works. But unfortunately the conditions attached to the grant of these concessions are not calculated to attract British engineers or capitalists. For instance, the Department of Public Works at Porto Alegre, Rio Grande do Sul, Brazil, asked for tenders for utilising about 30,000 h.p. on the river Jacuhy. The length of the concession offered was 30 years, when the works would pass to the State, presumably at a figure to be settled by the State Department. We also notice that the State of Alagoas is inviting offers for a telephone concession, with the right of obtaining a permit from the Governor to utilise local waterfalls, and in this case the maximum period is only 25 years. When it is remembered that the construction of the works would take two or three years, and that another five or six years would be required for developing the business and in attracting a power load, the effective period of the concessions is less than 20 years, which is totally inadequate to enable the concessionaires to obtain a fair return on their capital and to cover the risk incidental to such enterprises in a foreign country. Under the recent Water Power Law of the United States of America concessions are granted for 50 years. In addition two or three years are allowed for preliminary work, and at the end of the concession the undertaking can only be taken over at a fair market value. If South American States wish to attract capital for the purpose of developing water power schemes they would do well to follow the example of their Northern neighbours.

Trading Agreements.

Some time ago the members of the Electrical Contractors' Association formed themselves into a limited company for the purpose of negotiating trade agreements between the Association, acting for its members, and other traders, in order primarily to regulate the conditions of sale and supply of electrical material. This arrangement has worked very well, and there is widespread regret among those concerned that the activities of the Association cannot be extended. Unfortunately, however, a large body of the membership is opposed in principle to this policy, and we are therefore once again treated to the spectacle, which is seen so often in the electrical industry, of division where there should be unity. The whole question is one of organisation and of a weighing of the advantages which can be derived from such organisation. It is not a matter which should be rushed; on the contrary, every detail should be carefully considered. But it is eminently a case where combination is necessary; and we are sorry to hear there is some talk of the Trading Association being discontinued. It should surely be possible to prevent this.

The Slump.

At the present time most of the lay Press and, as a result, nearly everyone else, is prophesying a trade slump. Doubtless conditions are not what they could and should be. Anxiety over a coal strike, higher wages demands, the ca' canny policy, the operation of the Excess Profits Duty and the growing disinclination and inability of the consumer to pay the prices asked have all had their share in bringing about a decrease in buying, but nevertheless should there be a slump, with all the disadvantages that such a condition of things will bring, it will have been largely engineered, either by interested persons or by those who ought to know better, rather than brought about naturally. It is equally evident that it would be possible to avoid a slump. The world demand for goods is not yet satisfied. Could there be therefore a cessation of demands from organised labour for higher wages and utopian conditions of working and instead co-operation with employers to increase production not only would costs fall, but sales would increase and the slump would quickly be turned into a boom in which not only capital, but labour and the consumer as well would benefit. Under the present conditions home trade is slack, and the export trade is finding other markets with little advantage to anyone in this country.

Daylight Saving and Electricity Supply.

We should not be surprised to find that the decision of the Government to postpone reversion to winter time until October 25th will give central station engineers another grudge against the daylight saving idea. So far the chief objection to it has been the loss of revenue it causes, but now it will be accused, with a good deal of truth, of providing a peak at an unusual time. This, of course, will be most evident in industrial districts, for before the new period is over factories will be opening in the dark and the lighting and power loads will therefore be superimposed. Much the same thing will also occur at the other end of the day, with the results that the conditions usually associated with midwinter will be reproduced in October. The only thing that can be said is that owing to the later hour of commencing work things will be as bad as they would have been a short time ago.

Physical Theory and Relativity.

The formulation of electromagnetic relativity, mainly as a result of the successive labours of Larmor, Lorentz, Einstein and Minkowski, opened a new world of thought to physicists, involving the reconsideration of the very foundations of physical science.

Knowledge of Nature may be broadly, and exactly, defined as consisting of physics, the coherence of the known, and metaphysics, the synthesis of the knower with the known. Until disturbed by the formulation of electromagnetic relativity, physical science had retained almost unchanged its early foundations, rooted, not directly in perceptual experience, but in the pre-Aristotelian Greek conception of distributions of material throughout a space in itself without activity, conceived as a manifold of discrete points at a number of discrete instants of time, supposed to flow equably in measurable lapses.

The Function of Physics.

The function of physics is to discover the *attributes* of the material, and as Whitehead puts it, " the course of nature is conceived as being merely the fortunes of matter in its adventure through space." The inadequacy of such a foundation was recognised, even in ancient Greece, in respect to problems of abstract thought. It is quite logical, appears to provide the simplest possible representation of the external world, and serves for the practical purposes of existence, including the solution of all except the most recondite physical problems. But our perceptual knowledge has not the character assigned to it by the formulation, which can therefore have no other foundation than incorrect metaphysics. And the disentanglement of physics from the theological metaphysics with which it had been associated, by Galileo, Huygens, Newton, and some of their greater contemporaries and successors, greatly aided the development of both subjects; and later intrusions into physics, as a direct consequence of its inadequate formulation, of metaphysical elements such as Locke's theory of primary and secondary qualities of matter, proved distinct impediments to progress. Moreover, the corresponding disentanglement of pure mathematics from physics, begun in the last century and consummated by Whitehead and Russell in the present one, has already accelerated the growth of the former, and made it a still more efficient aid to the progress of the latter. Pure mathematics is now recognised as simply an elaborated system of deductive logic, a purely mental product and instrument extending the field of our thought as the telescope and the microscope extend the field of our vision.

The Relativity Principle.

The relativity principle in physics originated in the failure of the Michelson-Morley experiment in 1887, and of all subsequent attempts, made with apparatus of adequate sensitiveness, to obtain evidence of uniform motion relatively to the ether. The inherent impossibility of obtaining such evidence was therefore assumed as an axiom embodied in the statement that the speed of light *in vacuo* as measured by any observer would be unaffected by uniform translation of the observer relatively to the source. In the meantime, both Fitzgerald and Lorentz had shown that the null-result would be explained by a minute contraction, in the direction of motion, of any body moving through the ether, and Larmor and Lorentz showed by very different methods that exactly the requisite contraction was to be expected on the electromagnetic theory of matter. Ehrenfest raised the objection that if this were so, and a cart-wheel were spun about an axis fixed in the ether, the circumference would contract, while the motion of the spokes being entirely radial, they would remain unchanged in length. This was answered later.

The Newtonian laws of motion are unaffected by uniform translations of the observer relative to the body observed, and therefore their mathematical expressions are *invariant* in respect to linear transformations of the co-ordinates. Now Maxwell's electromagnetic equations for stationary media, which are in complete agreement with observation, are the basis of accepted electrical theory. Lorentz, therefore, starting with the expression in rectangular co-ordinates relative to axes fixed in the ether, sought for a transformation taking account of the suggested contraction, which should reproduce them, unchanged in form, in terms of new co-ordinates moving through the ether. He succeeded with respect to the free ether, but with a slight deviation in the case of electric charges, which could be eliminated only by an accompanying change in the time, making it depend on the original space co-ordinates, the speed of the moving system, and a constant c, identical with the speed of light *in vacuo*.

The Work of Einstein.

This suggests that every observer must have his own local time scale as well as his length scale, and Einstein assigned a physical meaning to this local time on the assumption of a comparison of the local times of different observers by means of light signals transmitted with the speed c. He then generalised the relativity principle into the statement that, assuming c constant, the mathematical expressions of the laws of nature are reproduced unchanged by the Lorentz transformation. Minkowski found that this transformation might be represented as a pure rotation in a fourfold continuum combining the local spaces and times of any observers moving uniformly (without acceleration) in any manner, and in which every position represented a point instant, and the whole history of a moving particle or light-ray in space and time was represented by a continuous line of point instants which he called a *world-line*. The contraction hypothesis then became consistent and complete, the contraction in length being compensated by an expansion in time, completely resolving Ehrenfest's paradox.

Larmor suggested, in a recent paper, that in the Minkowski time-space electrodynamic relativity seems to be secured by sacrificing the permanent existence of electrons, material particles, and space itself as independent of time; and this relativity can apply only to free ether. The material world vanishes that relativity may survive. This is with the old formulation. Whitehead's analysis in " An Enquiry Concerning the Principles of Natural Knowledge," reviewed in The Electrician of April 16th, 1920, and in " The Concept of Nature," by the same author, reviewed in this issue, is based on events, and finds its most general space and time expression in the Minkowski continuum, with complete metrical determination of both, never before attained—embracing also within it the local space and times corresponding to the perceptions of various observers, and the spaceless time of Newtonian physics, now for the first time proved definitely

Euclidean, as has been instinctively assumed by the common sense of mankind, but never hitherto formally demonstrated. This clearly suggests as the more direct and practical procedure in the further development of physical theory the persistence in the expression of natural phenomena in terms of matter and motion, in the Newtonian manner, guided and corrected in its more recondite aspects by more abstract formulations.

What appears to be the most pressing problem, the reformulation of ether theory in accordance with electromagnetic relativity, is shown by analysis to be quite conceivable, as Cunningham pointed out early in the year. Whitehead's work may be expected greatly to facilitate its accomplishment.

The Place of Gravity.

Einstein sought, further, to bring gravitation, of the nature of which we are ignorant, into the Minkowski continuum by assuming the identity of a gravitation field with any field of acceleration, and, after a suggestion of Riemann's, representing the presence of material particles by twists and kinks in the continuum, thereby distorting the scheme of electromagnetic phenomena, including the assumed constant speed of light, but not sufficiently to be experimentally detected. And to secure the required independence of the axes to which they were referred, of the mathematical expressions of the laws of gravitation and its relations to light, they also had to be distorted, and to an extent just sufficient to bring them within range of experimental observation in three cases. As Larmor has expressed it, "It is as if one found that a cap would not fit exactly over a surface, but that a close fit could be forced by slight local stretching." The fact that two out of the three cases were found verified in the eclipse observations of May 29, 1919, and the remaining one not absolutely disproved, seems to make it probable that to some extent at least Einstein's assumptions are justified, although his formulation may require modification, and physicists will await with intense interest the publication of the analysis by which Dr. Whitehead, as announced in "The Concept of Nature," has confirmed the two predictions of Einstein's which have been experimentally verified.

Research and Research Workers.

It is a well-known principle, hallowed by custom, that he who pays the piper calls the tune. A difficulty, however, arises when the provider of the feast insists in addition on directing how the tune selected is to be played and by what instruments. The result is often discord rather than harmony. We are led to these reflections by a study of the fifth annual report of the Committee of the Privy Council for Scientific and Industrial Research, which will be found summarised on another page of this issue. The Committee take this opportunity of dealing with the work that has been done under their direction since their establishment five years ago and also of indicating, at any rate by inference, what their future policy is likely to be.

Dual Functions.

The dual functions of this Department are indicated with sufficient plainness in its title. It is necessary, however, to emphasise this duality as it is often lost sight of, even by the Committee themselves. In our opinion, that useful kind of work which is conveniently included under the rather misleading term of research must be considered from two points of view which are best kept quite distinct. For there is first what may be called "scientific" research. This comprises investigations primarily undertaken by workers in pure science to gain a greater knowledge of fundamental principles or simply in a pure striving after knowledge. An example of this is to be found in Sir J. J. Thomson's work on positive rays. It often happens, of course, that this work ultimately receives an unexpected practical application as in the case of the thermionic valve, but that is not its primary object. There is, secondly, what may be called industrial research. This comprises investigations primarily undertaken to obtain an explanation of certain phenomena whose existence is known but whose operation is only partially understood. The work now being done on buried cables is an example which will occur to everyone of this class of work.

Two Classes of Worker.

Now, not only are these two classes of research entirely different in their aim, but the qualities required from the workers in them are dissimilar. The sort of man who makes a success in the first need be influenced by no commercial instincts. He must be a scientist, it is true, but he can be a sort of scientific poet, allowing his fancies to roam where they will, only controlled by the conditions imposed by himself and his own being. It is obvious that such work is not and cannot be primarily industrial in its aim.

The industrial research worker must be of different clay, mainly because his subject is given him and because he is necessarily trammelled by commercial considerations. While still a scientist he must be less of the poet and more of the business man. His deductions, if not his results, must be coloured by the object from which he is working. To employ a homely simile he must be more of the hack than of the race horse.

The Scientific and Industrial Research Committee have, we think, rather lost sight of this distinction. They rightly congratulate themselves on not inquiring into the work which is to be undertaken by "scientific" researchers before the grant is made, but at the same time they deplore the necessity of Industrial Research Associations having to establish their own laboratories because the large number of students render those in universities and technical schools no longer available. But as we have pointed out the two classes of work are absolutely different and should be kept quite separate.

A Delicate Plant.

There is one other point in which the general policy of the Committee is open to criticism. They do not seem fully to realise the delicacy of the plant with which they have to deal. This is clear if we compare what they have done in the past with what they propose to do in the future. In the past they have administered grants in what may fairly be called an open-handed and judicious way. They have encouraged the formation of Research Associations and the undertaking of suitable researches by scientific societies. In future they seem to want to go a step further. For there is towards the end of the report a discussion in quite the blue-book manner of such questions as the limits of co-operation, the agreements that should be made by research associations between themselves before undertaking certain "border line" work, the relation of the work of research associations to works practice and how research organisations may best confer to mutual advantage. It makes us a little fearful of what may happen as the result of all this, and we hope it will not be followed by the inauguration of a multiplicity of forms, the desire for statistics and amassing of data with all of which we are already only too familiar as a result of the intrusion of officialdom. The Committee has done, and can do, most useful work, but its greatest care must be to see that the plant of research is not stamped underfoot by the cloven hoof of bureaucracy.

The Design of Intervalve Transformers.

Application to Low-Frequency Aperiodic Magnifiers.

By J. K. CATTERSON-SMITH.

INTRODUCTION.

The procedure in designing iron-cored transformers for use in valve-magnifiers for telephonic circuits differs very much from that employed for ordinary transformers. There is little doubt that much of the trouble experienced in the past with this class of apparatus may be traced to lack of appreciation of the factors involved leading either to faulty design or wrong adjustment of the transformers and valves.

The rapidly extending use of such devices has resulted in a considerable variation in their design and behaviour, and it is the object of this article to show the lines along which satisfactory development may be expected. There is every reason to believe that in the future these low-frequency magnifiers will be used for many other purposes in addition to their application to the magnification of very small alternating currents, having frequencies of the order of 500 to 1,000 cycles per second, such as exist in various forms of microphone and telephone circuits, certain types of relay, and the detector circuit in wireless receiving apparatus.

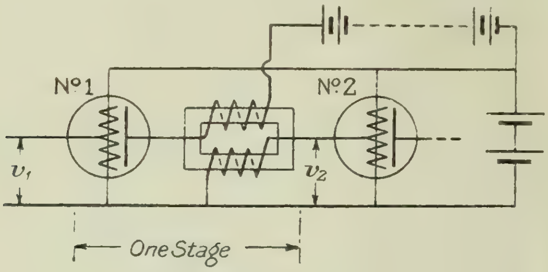

FIG. 1.—MAGNIFIER CIRCUIT.

PRINCIPLE OF THE MAGNIFIERS.

The main principle of these magnifiers is their relay action, the valve taking a minute power input liberates a relatively large power output from the local battery or other source. With the exception of certain cases of special relays the output is required to cease at the same time as the input.

The function of the transformer is to assist the valve, and its design should be such that the combination gives a greater magnification than the valve would give with series anode resistance alone. However, unless well defined conditions are realised it is possible that a very poor magnification will result, and in extreme cases it may be less than unity.

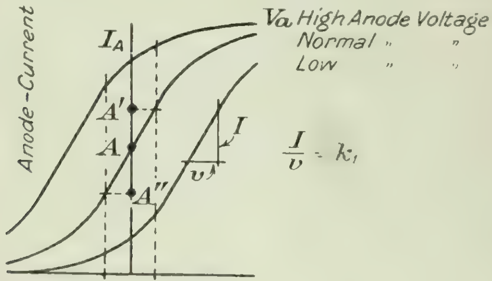

FIG. 2.—ANODE CHARACTERISTICS.

It is important to distinguish between "aperiodic" magnifiers in which the magnification depends upon the valve and transformer combination, and "tuned" magnifiers in which resonance and also reaction is employed to increase the magnification. The former type is considered in the present article and the formulæ developed do not apply directly to the latter.

One valve and its transformer constitute one stage of the magnifier, and it is convenient to consider the magnification per stage as being the ratio of the alternating voltages between the grid and filament of successive valves such as No. 1 and No. 2 valve. The circuit for one stage of a simple magnifier is shown in Fig. 1 where v_1 and v_2 are the successive grid voltages. The ratio of these two voltages is the product of the effective amplification at the valve and the transformation ratio of the windings. It may be said at once that with existing valves a high transformation ratio leads to a low effective amplification, and that in general the transformation ratio used varies from 1:2 up to 1:5. Ratios much higher than this do not appear to be practical.

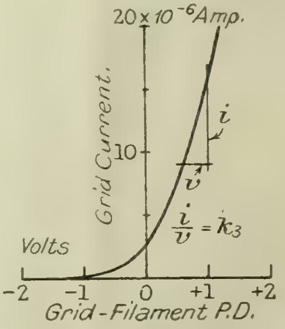

FIG. 3.—GRID CURRENT CHARACTERISTIC.

CONDITIONS AT THE VALVES.

The characteristics of the three-electrode "hard" valve used for magnifiers with suitable voltages applied are represented by Fig. 2 for the anode current and Fig. 3 for the grid current when the filament is carrying its normal steady current.

If in a particular case the grid of valve No. 1 is at the same potential as the negative end of the filament ($v_g = 0$) and the anode to filament voltage is "V_a normal" the anode current will have the value "A" shown in Fig. 2.

A variation in the grid voltage will cause a change in the anode current to such values as A' or A'' corresponding to the new grid voltage. Clearly this is *not* accompanied by any change in the voltage across the valve.

The slope of the curve determines the change in the anode current for a given excursion of v_g so that if the alternating voltage v_1 is applied to the grid an alternating anode current I will be superimposed on the mean anode current I_a and its value will be

$I = k_1 \times v_1$ where k_1 is the slope of the curve in "amperes per volt."

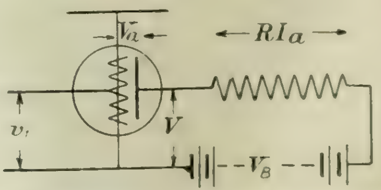

FIG. 4.—ANODE CIRCUIT SERIES RESISTANCE.

Under certain conditions the slope of the curve might be equal to 100 micro-amperes per volt change at the grid, *i.e.*, $k_1 = 100 \times 10^{-6}$, consequently an alternating v_1 at the grid of 1 millivolt would produce an alternating anode current of 0·1 micro-ampere if the anode circuit external to the valve is a resistance-less battery.

In order that a change shall take place in the anode voltage (*i.e.*, P.D. across the valve) it is necessary to insert a high resistance in series with the anode as shown in Fig. 4. The alternating anode current I will then produce a voltage drop $R \times I = V$ which is the alternating anode voltage.

The steady anode current I_a is supplied by the steady battery voltage V_b, which voltage is partly consumed in the series resistance R leaving the mean anode voltage V_a across the valve. Provided the series resistance is very high the anode voltage V may be considerably greater than the initial grid voltage v_1.

The actual voltage across the valve is $V_a \pm V$ under these conditions, and the amplitude of the anode current cannot be obtained from a single curve as in Fig. 2, for it now depends upon the two curves V_a+V and V_a-V shown in Fig. 5. It is clear that this change in anode voltage lessens the anode current change by an amount depending upon the distance apart of the two curves, and the effect may be more evident in Fig. 6, which shows the relation between the anode current and the anode voltage for several values of the mean grid voltage. The slope of these curves is sensibly constant over working ranges, being of the order of 10 to 50×10^{-6} ampere/volt. It is designated by k_2 so that the change in anode current corresponding to anode voltage change V will be $k_2 \times V$ ampere.

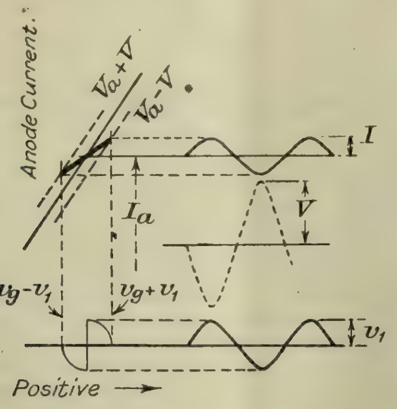

Fig. 5.—Anode Current and Voltage.

The complete expression for the anode current change due to the grid alternating voltage, v_1, is therefore

$$I = k_1 \,.\, v_1 + k_2 \,.\, V \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where $V = -RI$ (on account of the fall in anode voltage when v_1 is positive). This gives the anode alternating voltage

$$V = -v_1 \,.\, \frac{k_1}{k_2 + \frac{1}{R}}.$$

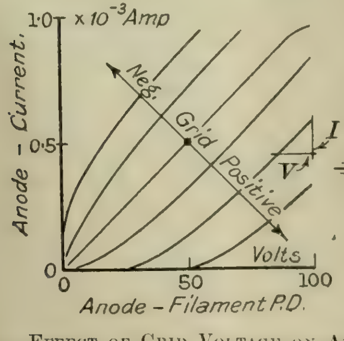

Fig. 6.—Effect of Grid Voltage on Anode Current.

The magnification expressed as the ratio of the two voltages, V and v_1, is the "voltage step-up" given by

$$\frac{V}{v_1} = \frac{k_1}{k_2} \,.\, \left[\frac{1}{1+\frac{1}{k_2 R}}\right] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Clearly the "step-up" is something less than k_1/k_2, because in all practical cases the terms within the bracket must be less than unity. The effect of the resistance of the next valve and its grid-leak, if any, is to reduce the value of R to a lower figure than that of the series resistance. In practice it is difficult to obtain a satisfactory resistance exceeding 100,000 ohms which will carry the steady anode current of the order of one milli-ampere. It is for this reason, and because of the higher magnifications possible, that the intervalve transformer is used.

IDEAL TRANSFORMER ACTION.

The writer believes that the behaviour of an intervalve transformer is more easily understood if consideration is first given to the hypothetical case of an ideal transformer having no magnetising current or losses.

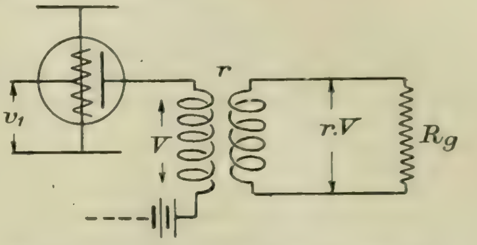

Fig. 7.—Primary and Secondary Circuits.

The ideal transformer acting as a perfect coupling (100 per cent.) between the primary and secondary circuit, the ratio of the turns in the windings being "r," is represented by the diagram Fig. 7, where R_g is the grid to filament resistance of the valve forming the load on the transformer. This load resistance depends upon the adjustments of the valve, as will be seen on referring to Fig. 3, the grid characteristic. A change of v in the grid voltage produces a change in the grid current i of an amount depending upon the slope. This slope is $k_3 = \frac{i}{v}$ of the order of 1×10^{-6} ampere/volt in certain cases. The resistance of the load is therefore given by

$$i^2 \times R_g = v \times i \text{ or } R_g = v/i = 1/k_3.$$

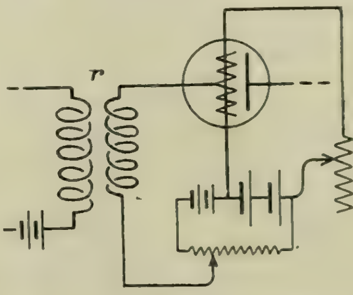

Fig. 8.—Grid Voltage Control.

The smaller the slope, k_3, the higher is the resistance of the load, a matter of great importance, and therefore the mean grid potential of the valve is set at a point generally negative to the filament. The influence of various anode voltages upon this characteristic is ignored here as it is usually slight, and it is assumed that the one curve such as Fig. 3 represents the conditions for all anode voltages in the working range. The adjustment of the grid voltage is obtained by bringing the transformer connection back to a sliding contact rheostat or grid potentiometer, as shown in Fig. 8.

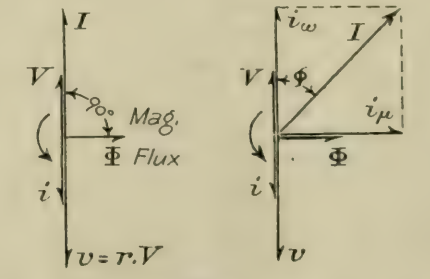

Fig. 9.

(A) Ideal. Transformer.

(B) Real. Transformer.

The phase relations of the currents and voltages are simple in the case of the ideal transformer, and are as shown by the vector diagram (A), Fig. 9. Because the output and input are equal the following are derived

$$V.I=-v.i=-r.V.i$$

and

$$i=r.V./R_g$$

therefore

$$V=-I\,.\,R_g\,.\,\frac{1}{r^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \qquad (3)$$

It has been shown in the previous section that an alternating voltage v_1 applied to the grid of valve No. 1 gives rise to an alternating anode current of the value shown in equation (1), consequently on substituting this in equation (3) the anode voltage with the ideal transformer is

$$V=-k_1\,.\,v_1\,.\,R_g\,.\,\frac{1}{r^2}-k_2\,.\,V\,.\,R_g\,.\,\frac{1}{r^2}$$

or the step-up is

$$\frac{V}{v_1}=\frac{k_1}{k_2+\frac{r^2}{R_g}} \quad \text{(at the valve)} \quad . \quad . \quad . \quad . \quad . \qquad (4)$$

This simply stated means that the transformer transfers the secondary circuit resistance to the primary or anode circuit, and as the latter must be kept very large, it is clear that the transformation ratio of the ideal transformer would be limited to moderate values depending upon the k_3 of the valve No. 2.

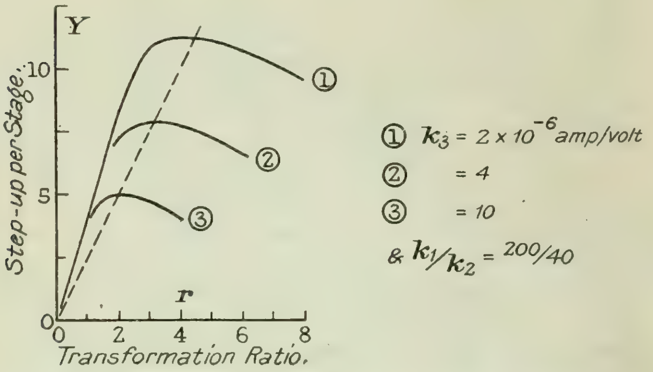

Fig. 10.—Magnification with Ideal Transformer.

Voltage Step-up per Stage.

The magnification given by equation (4) will be increased by the transformation ratio of the intervalve transformer, and the step-up per stage is

$$r\,.\,\frac{V}{v_1}=Y$$

or, on multiplying (equation 4) through by "r" the step-up per stage is

$$Y=\frac{k_1}{k_2}\,.\left[\frac{1}{\frac{1}{r}+\frac{r}{k_2R_g}}\right] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \qquad (5)$$

Graphs from this relation are shown in Fig. 10 for constant values of k_1 and k_2 but varying k_3, and it is apparent that for the ideal transformer the magnification reaches its maximum at a certain ratio r which is given by

$$r=\sqrt{k_2\,.\,R_g} \text{ or } \sqrt{k_2/k_3}.$$

The magnification per stage is therefore determined by k_1, k_2 and k_3, and the best ratio by k_2 and k_3.

If for any reason the secondary load is represented by a resistance less than $1/k_3$ it is safer to keep the expression for this ratio in the first form.

The maximum magnification is obtained on substituting this value of "r" in equation (5), giving

$$Y_{\text{max.}}=\tfrac{1}{2}\,.\,r\,.\,\frac{k_1}{k_2} \quad \text{(for the ideal transformer).} \qquad (6)$$

For example, with a valve having k_1, k_2 and k_3 equal to 280, 40 and 1×10^{-6} respectively, the transformation ratio would be $\sqrt{40}=6{\cdot}3$, and then $Y_{\text{max.}}=22$, which shows that high transformation ratios are not to be expected.

In a real transformer the presence of the magnetising current has the effect of lowering the magnification; at the same time it necessitates a somewhat larger ratio.

(*To be concluded.*)

The Electrical Signal Engineer.

By M. G. T.

In the "forties" railway signalling began to be developed, but purely mechanical apparatus was used. In the "eighties" Parliament required railways to provide interlocking, which would prevent conflicting and dangerous movements of points and signals, and in consequence it was necessary to centralise their control. The signal engineer did very heavy work for many years in meeting these requirements, and became a railway officer of considerable importance. The electrical side of the work was small, being confined to block working, and the arm and light repeaters which were introduced between 1850 and 1880. What electrical work was done was usually dealt with by the electrical superintendent, who also dealt with telegraphs and the few telephones then in use.

Between 1880 and 1890 electrical engineering began to develop. At Paddington, for instance, in 1884, the largest electric light works then in existence was brought into use. As time went on, electric train staff, token or tablet instruments, telephones, warning bells, electric point detection, track circuits, power-operated signals, complete power signalling installations, and many other applications, and variations of the above apparatus and circuits were developed. At the present time the electrical signal work is so heavy that the signal department on some railways controls the mechanical and electrical signalling, and a separate electrical engineer deals with electric traction, power applications in goods depots, docks, &c., and the lighting of stations, yards, offices and rolling stock.

The recent development of track circuiting and telephone train control has had an important and satisfactory effect on the movement of trains, and while the purely mechanical side of signalling would seem to be nearing the limits of development, the possibilities of electricity are only beginning to be understood and realised. To obtain the best results, an unusual combination of technical knowledge is required. An electrical signal engineer must be familiar with the broad principles at least, and as many of the details as possible, of traffic working, rules and regulations, Ministry of Transport requirements, Acts of Parliament relating to railways and telegraphs, Post Office wayleaves and easements, signalling schemes, interlocking and design of locking machines, design and erection of signal boxes, different systems of power signalling, automatic signalling, electrical and mechanical detection of points, electric locking, block apparatus and working, single-line working apparatus and methods, electric arm and light repeaters, signal lamps, level crossing gates, alternating and direct current track circuiting, design of power plant for signalling installations, telegraph construction and maintenance, cable work, telephone exchanges, telegraph offices, telephone train control offices, testing of all kinds, management of a small factory, making and repairing mechanical and electrical signalling apparatus, administration of a department of 2,000 to 3,000 men, with the constant and increasing amount of time which has to be given up to purely staff matters.

Mr. Roger T. Smith's presidential address to the Institution of Electrical Engineers brought out what large users of electrical power railways are, and also pleaded for the railway electrical engineer. No mention was made of the electrical signal engineer. The full advantages of electric traction and better working of goods depots could not be realised without up-to-date electrical signalling and telephone control methods. Neither does the recent circular from the Institution of Electrical Engineers make any mention of this work in the list of subjects suggested for Papers. The Institution of Railway Signal Engineers, however, caters for the work of the electrical signal engineer, and the explanation may possibly be that the larger Institution does not wish to poach on the other's preserves.

Modern Marine Problems in War and Peace.*

By C. V. DRYSDALE, O.B.E., D.Sc.

The Council of the Institution having decided that the time has come for the Kelvin Lecture to embrace other fields than those of Lord Kelvin's personal activities, have honoured me with an invitation to deal with scientific investigations carried out in marine problems during and after the war under the Admiralty at its various experimental stations. Apart from the interest and importance of the subject there is a fitness in coupling it with the name of Lord Kelvin, who did so much for the submarine telegraph and for navigation.

The problem of submarine detection enlisted the highest scientific talent of the country, and in this work the Institution co-operated both by the formation of its anti-Submarine Committee and by the service of its members in Admiralty stations and elsewhere. A variety of stations for experiment were established, notably at Parkeston Quay, Harwich and at Shandon on the Gareloch. Ultimately a unique mobilisation of the scientific talent of this country existed; had this been effected earlier the history of the anti-submarine war might have been very different. Unfortunately such mobilisation required experience and much valuable time was lost.

The Primary Objects.

Apart from the primary objects of these submarine investigations much information of a general scientific interest was obtained. It will be convenient to consider the work under four heads: (1) Detection, (2) Defence and destruction, (3) Navigational applications, and (4) General scientific research.

It is important first to form a clear idea of circumstances arising from the "physics of the sea," which influence the generation, propagation and reception of impulses, whether electrical, acoustic, magnetic, thermal, optical, &c. Seawater offers an excellent medium for mechanical impulses, but its high conductivity is a great obstacle to electromagnetic disturbances, except those of the lowest frequency. Thus at an ordinary frequency of 50 revs per sec., 94 per cent. of the amplitude is absorbed in about 100 metres. Optical, thermal and other forms of radiation are rapidly diffused, and chemical action is also purely local. Moreover, disturbances exist which easily mask the effects to be studied. Differences in the physical characteristics of sea and air gave rise to embarassing interference phenomena, complicated by surface waves, which also cause noises highly inconvenient to acoustic observations. We have also to take into account noises involved in the propulsion of ships and reflections from the bed of the ocean in shallow water.

Finally, there are earth currents and magnetic storms to be reckoned with. There are thus limits to the advantages of increasing the sensitiveness of detection, and our energies had to be largely concentrated on eliminating disturbances. Acoustic methods have a great advantage as the human ear is very sensitive to changes in the quality of sounds. But even assuming these difficulties overcome we have the further problem of ascertaining the direction of the source, and it is here that refraction, reflection and absorption play such an embarassing part.

Detection.

As regards the application of the disturbances, we may broadly distinguish between two methods: (*A*) Those in which the disturbance is emitted by the vessel to be detected; (*B*) Those in which it is emitted by the observing station or a separate source and is reflected or intercepted by the vessel to be detected. We may distinguish these methods by the terms, direct or homo-dynamic, and reaction or hetero-dynamic. We may further subdivide the hetero-dynamic method into: (*a*) Simple reflection methods in which the object is detected in the presence of the primary impulse, *e.g.*, ordinary vision; (*b*) Echo methods in which the primary impulse is interrupted during the reception of the reflected disturbance; (*c*) Shadow methods in which the impulse is intercepted by the object to be detected.

This simple classification is of great value in guiding research. The bulk of physical disturbances diminish in intensity according to the square or cube of the distance from the source, as well as by absorption. If the disturbance emanates from the vessel to be detected, it diminishes in this manner, but if it emanates from the observing station and is reflected from a small object such as a ship, both the emitted and reflected disturbances are similarly dissipated and absorbed, so that the effect received diminishes as the fourth to sixth power of the distance, and the absorption is squared. Hence hetero-dynamic methods, although they may deal with much larger initial disturbances, are ineffective in comparison with homo-dynamic methods, unless the emitted energy can be concentrated into a nearly parallel beam.

Experience shows that for electromagnetic waves of frequencies above 100 per sec. the attenuation in 100 metres is almost hopeless; however as waves may escape into the air and be detected above the surface signalling at wireless frequencies is not impracticable. Optical methods would be valuable, if effective, as actual vision is the most conclusive evidence of presence and direction; but even in the clear water of the Mediterranean the limit of visibility is only about 200 ft. and in home waters only 20 ft. Thermal and chemical methods offer little prospect of adoption.

Acoustic Devices.

Hydrophones have proved of considerable service. In the ordinary type a heavy circular metal case is provided with a diaphragm on one side to the centre of which is attached a button granular microphone. A "directional" hydrophone consists of a thin metal diaphragm supported by a heavy ring so that the water is on both sides of it. A microphone is attached to the centre of the diaphragm, mounted in a water-tight capsule. With sound waves striking the surface normally maximum sensitiveness is attained, but with the hydrophone edge-on the effects of both sides neutralise and no sound is heard. For fixed stations such hydrophones answer satisfactorily, but they are useless on moving ships owing to water-noises produced by the motion. Fair results have been obtained from hydrophones in water-filled streamline cases attached to the hull of a ship in which hydrophones can be rotated. Much work has been done on towed listening devices. Bi-aural methods depend on the fact that if sound falls upon two receivers separated by a short distance it reaches them at different times, unless the source is in the median plane between them. Hence if the two receivers communicate with the two ears the sound appears on one side or the other; the "cross-over" point is attained when the connecting bar is perpendicular to the direction of the source. This method has been of great value in locating aeroplanes, but is less easy to apply to hydrophones. The rotation of the bar carrying the microphone is troublesome, and accordingly various compensators have been devised, variable lengths of air being introduced between the receivers and the observer's ears. Instead of "binauralling" some observers prefer to work on the "sum and difference" principle. As regards directional hydrophones the method of arrangement, when attached to the tow, is important; by using three hydrophones arranged two abreast and one slightly in advance any ambiguity in determining direction can be eliminated.

While towed devices have had some success they are troublesome to handle, and the tendency is towards the development of listening apparatus for use on board ship.

In this case water and ship noises are difficult to eliminate, but the problem is assisted by the method of acoustic integration, which points to the use of large flat surfaces equipped with a number of receivers for reception. Special devices, involving the introduction of a phase difference into the microphone or other receivers attached to different parts of the diaphragm, have been introduced to avoid the inconvenience of rotating a large receiver. The Walser gear used in the French Navy employs two large "blisters" on the two sides of the ship, each provided with a large number of thin circular diaphragms. The sound waves received are focussed into a conical trumpet which can be rotated, and the observer ascertains whether the sound is loudest on the port or starboard sides of the ship, and then rotates the trumpets until a maximum is discovered. A second device of great interest, due to H. W. Hillier, makes use of the fact that the velocity of sound in water and hydrogen gas is nearly equal. If sound arrives at the end of a long tube at the same speed as in water, and if the tube is directed towards the source, sound entering at every part of it reaches a receiver in the same phase. This may be called "longitudinal" as contrasted with "transverse" integration. Another method or useful device for listening by non-integrating hydrophones depends on interference phenomena.

The above methods assume that a submarine is moving and emitting recognisable sounds. For detecting stationary vessels or other objects "echo" methods have been devised. By using powerful acoustic transmitters, such as the Wrightson syren or the Fessenden oscillator not only is sound-signalling rendered possible at long distances but distinct echoes can be recognised, and by working with narrow and confined beams very interesting results have been obtained. High frequency acoustic detection, with frequencies of 5,000 to 100,000 periods per sec. have also been used for iceberg-detection. Such methods have other promising applications as well as for locating submarines.

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*Abstract of the Eleventh Kelvin Lecture, delivered before the Institution of Electrical Engineers.

Had the submarine remained as noisy as when originally introduced existing devices would have amply fulfilled requirements as regards detection. But the use of improved methods have greatly reduced noise, while the need for detecting submarines when resting on the bottom or floating have also rendered other devices necessary.

Electromagnetic Methods.

These methods are usually based on the Hughes induction balance, which appeared to many an attractive principle for detection. Unfortunately this impression is illusory. The method is essentially heterodynamic, so that we have to deal with the attenuation of the magnetic field from the coils and again with that of the induced field from the object to be detected. Although the sensitiveness may be remarkably great when the object is close to the coils, it practically vanishes at a very moderate range. The practical possibilities of this method seem theoretically to be very small, and all experience has confirmed this.

Defence and Destruction.

Defensive and destructive methods are no less important than detection. A valuable device, now fairly well known, is the paravane invented by Commander C. D. Burney, R.N. This consists of a torpedo shaped body towed from the vessel to be protected and provided with vanes to keep it outwards and below the ship. When the towing cable meets the mooring rope of a mine it forces it away from the vessel, and the rope slips into jaws which cut it through. Explosive paravanes have also been devised for protection against submarines. Problems associated with the laying of mines and their motions in tides and currents are highly intricate and interesting. A problem of equal interest is the determination of pressures developed in water by explosions. One method, due to Mr. H. W. Hillier involves the measurement of pressure by the compression of small copper gauges similar to those used in ordnance tests. Distribution of pressure and variation with time can thus be studied, and interesting differences in the development and dying away of pressure are recorded for various explosives such as amatol and gunpowder. In the latter case the rise in pressure is much slower, and of smaller intensity, though longer maintained.

It has been found that these high pressure explosions travel in water with the same velocity as sound.

A second method of making such investigations suggested by Sir J. J. Thomson and developed by Mr. D. A. Keys, depends on the piezo-electric phenomenon, fully studied by the late Prof. Curie. If a crystal such as quartz or tourmaline is subjected to pressure along its optic axis it becomes electrically charged, and this charge is developed practically instantaneously. This charge furnishes a useful method of recording pressure change. For this purpose the cathode-ray oscillograph is used. A fine cathode ray pencil passes between the jaws of an electromagnet and also between two long brass plates connected respectively to a tinfoil coating attached to the crystal-receiver and to earth. The ray then passes into a camera producing a bright spot on a fluorescent screen. On exciting the electromagnet with alternating current this spot moves transversely across the screen in simple harmonic motion, while the small potential difference between the brass plates causes a motion in the transverse direction, proportional to the pressure at each instant. Accordingly a curve depicting the dying away of the pressure of explosion is traced out.

These researches are of great importance as they enable the destructive radius of various mines to be determined and the design of mines and minefields conducted on a scientific basis.

Navigational Appliances.

Fortunately much of the information and devices evolved during the war have most important application to peace-time navigation. For example, fog has always been a serious and dangerous obstacle, while the dangers of icebergs, derelicts and uncharted rocks are obvious.

The three chief desiderata for the safety and regularity of navigation appear to be: (1) Ability to find and enter a harbour in foggy weather; (2) Location of position in sea during fogs; (3) Detection and location of ships and obstacles in darkness and fog. These three requirements can now respectively be met to a considerable extent by the following devices: (*a*) Leader gear; (*b*) Sound ranging and directional wireless; (*c*) Echo detection.

Leader Gear.

This device which should come into practical use, consists of laying down a cable on the bottom along the track to be followed, and supplying it with alternating current of suitable frequency. By using coils of electrodes attached to the ship the induction or the return currents in the water can be made to give signals in telephones or other devices by which the course of the cable may be followed.

Attempts were first made in this direction in the St. Lawrence River by Prof. R. S. Owen in 1903, and during the war the idea was revived by Capt. Manson. Two coils of about 4 ft. square are fixed on the sides of the ship, and are connected to a change-over switch and three-valve amplifier and telephones. The cable is supplied with alternating current (500 ~ per sec.) which is cut up into signals by an automatic interrupter. Steering is effected by listening on the two coils alternately. In order to avoid the necessity for listening to telephones, the author attempted the step of employing tuned alternating relays to operate lamps on the navigating bridge of the ship, and thus to give continuous visual indications.

The tuning of the relay used was fairly sharp, and the frequency must be maintained constant within about ¼ per cent. This has the advantage that different cables can be used with different frequencies without mutual interference. Hence, in wide estuaries where there is much cross traffic, it is possible for the main and cross routes to be worked quite independently by using different frequencies. In order to keep absorption and distortion of the field small, low frequencies (10 and 20 ~ per sec.) were used. This makes the presence of the cable almost undetectable unless the frequency is known. When this device was first experimented with it was impossible to get definite port and starboard indications for steering purposes. An investigation of the distribution of the magnetic field, by observing the E.M.F.'s induced in the two inclined leader gear coils showed that even at these low frequencies it was greatly distorted. In order to avoid ambiguity it was necessary to limit the sensitiveness of the relays so that the steering indications were limited to a range of 60-70 yards on either side of the cable. Sharper indications of position are obtained by using a pointer indicator on the ohmmeter principle actuated by the contacts of the alternating-current relays. A triple alternating-current relay set is used, two of the relays actuating the port and starboard red and green lamps, while the centre relay is set to maximum sensitiveness and switches on a white "approach" lamp, indicating the first approach to the cable at a distance of ½ to ¾ mile. After this lamp lights, the ship keeps on the same course until the red and green lights glow and then steers along the cable by the latter. It has been found possible to operate both the aural and visual systems of indication simultaneously on the same ship and with the same cable. Leader gear promises shortly to be adopted for practical navigation. A cable about 18 miles long has been laid down at Portsmouth, and is available for use by vessels fitted with the necessary receiving apparatus.

Sound Ranging.

Leader gear naturally cannot be applied for navigation in the open sea. However a ship in a fog can easily ascertain or be given its position by directional wireless. A method which requires no observations on board ship is by means of submarine sound ranging. If a sudden impulse is produced at a given point the disturbance spreads out in all directions and can be received on three or more fixed hydrophones or shock receivers. If the explosion takes place at the centre of a circle passing through the receivers the impulse should reach all simultaneously, but if it emanates from any other position it arrives at different times. If these time differences are accurately determined and the velocity of propagation is known, the position of the source can be calculated. This device has been of great value for locating submarine explosions, as well as for locating guns in land warfare; it is obviously also applicable for locating ships.

Probably the most promising method of location would be by means of simultaneous wireless and sound impulses sent out at intervals from a fixed station. If the ship were provided with a wireless equipment and a hydrophone, both directional, the direction of the source would be easily determinable, and its distance by the interval of time between the arrival of the two signals—nearly a mile for each second of interval. Arrangements are being made for developing this method. Great improvements have also been effected in the ordinary three-receiver sound-ranging method with the object of simplifying the observation and determination of the source.

If a ship can locate its position in any weather, and guide itself to a harbour or through a channel in a fog, the only remaining danger is from obstacles such as icebergs, wrecks and rocks. Echo methods of detection may eliminate this danger. Echoes have frequently been obtained from ships, rocks and ledges, piers and other obstacles. It appears probable that icebergs of moderate size will be detected and located without difficulty. Probably the most reliable arrangement will be a combination of an acoustic device such as the Fessenden oscillator or Wrightson syren with high-frequency searching equipment. Another device which may be of considerable service in navigation is the obtaining of soundings by echo methods from the bottom.

Much work has been done on submarine and aerial signalling both secret and otherwise, with the object of permitting ships to communicate with one another and thus avoid collisions. The improved form of photophone invented by Dr. A. O. Rankine uses a mirror fixed on the lever of a phonograph diaphragm which forms an image of a bright illuminated grid on another similar grid. The amount of light transmitted varies with the vibration of the diaphragm and is concentrated on a selenium cell at the distant station. Clear speech is thus obtained and the device is easily adaptable to ordinary ship searchlights.

General Scientific Research.

The fundamental questions to be settled are the laws of propagation of acoustic, electromagnetic, and optical waves in the sea. It is also necessary to have methods of measuring the absolute values of the energy, &c., transmitted and received, and for investigating the properties of various transmitters and receivers.

Acoustic Research.—Even during the war valuable information was obtained in this direction. Submarine sound ranging has enabled precise measurements of the velocity of propagation of sound in sea water to be made, and this value may be taken as 15,120 metres per sec. at 16·7°C. as compared with about 14,500 metres per sec. for fresh water. Experiments on the variation of velocity with temperature are in progress at Shandon. Interference effects arising from reflection also require further study.

During the past year work on the metrical determination of sound intensities has been conducted by Messrs. B. S. Smith, and G. F. Partridge at Shandon. As a standard source of sound they use a transmitter excited by a high-alternating voltage derived from a valve oscillating set which produces sound waves of known amplitude. The received intensity can be observed by a standard receiver connected to a three-valve resistance amplifier and a thermogalvanometer. Potentiometer methods of measuring the amplification have been devised. The lecturer has proposed to extend these methods for a complete investigation of the transmission and reflection of sound in the sea, but to employ the alternating-current potentiometer for the measurements, as this determines both the magnitude and phase of the disturbance.

Electromagnetic Propagation.—This research, on account of the high absorption of sea water is highly important and much preliminary investigation has already been done. Preparations are now nearly completed at Shandon for a rigorous experimental investigation of these phenomena. Another point of interest is the existence of electrical currents in the sea due to tidal and wave motion in the earth's magnetic field, predicted by Faraday, and experimented with by Dr. F. B. Young. These require investigation, as their behaviour is complicated by the nature of the channel or sea bed. Their elucidation may have important consequences in relation to submarine telegraphy.

Optical Transmission.—Little work other than of an immediately practical and empirical character appears to have been done in this direction. It is desirable to have definite data concerning the optical absorption of sea water for various wave-lengths, and photometric arrangements are being made to determine it.

Testing and Training of Observers.—Finally, there is the observational element to be dealt with, particularly in acoustic detection and direction finding. Great differences are found between the discriminating and binauralling facilities of different individuals. Much work has been done in the training of listening officers at the HydropohneStation at Portland. Investigations are being made with the object of obtaining metrical data as to the acoustic and visual facilities of observers, particularly as regards colour vision.

Pulverised Coal in the Power Station.

A New Boiler House Fuel.

By L. C. HARVEY and E. E. NOBLE.

(*Concluded from page* 323.)

Running Conditions with Hand-fired Grates or Stokers.

A comparison between the conditions which take place when coal is burned hand-fired, or on mechanical stokers, and conditions when pulverised coal-firing is used, will clearly demonstrate the high efficiency value of the latter method.

When coal is thrown on to boiler grates by hand it is spread over an incandescent bed, the rapid heating of the green coal promptly distils off the volatile constituents, which pass into the combustion space and, mixing with excess air, are more or less completely burnt. The residue left on the grate becomes incandescent carbon, or coke, along with combustible foreign matter, or ash and clinker.

The oxygen in the air which passes through the fire bars unites with the first incandescent carbon encountered, forming carbon dioxide (CO_2), and then passing upward through the bed of fuel, a further molecule of carbon is added and carbon monoxide (CO) is liberated. This has to obtain its final molecule of oxygen to form CO_2 from the excess air in the combustion space. Owing to the high temperature of the fuel bed, which is seldom lower than 1,800°F., this action takes place even with a thickness of 3 in., and probably it would be necessary to reduce the thickness to 2 in. or less to prevent this action. With thin beds of coal bare places quickly form, allowing large quantities of excess air to enter the furnace, thus lowering the temperature in the combustion space and resulting in loss of fuel. The coal at these bare places either forms clinker or the tarry constituents fill the air spaces in the bars. The air passages become blocked and CO is formed instead of CO_2.

To overcome this, slicing and pricking is resorted to, which operation cools the furnace considerably, and is after all only a temporary expedient. The periodical removal of clinker upsets the furnace efficiency so seriously that only one boiler in a battery can be dealt with at a time, the others being forced in order to maintain a uniform output of steam.

Mechanical firing obviates some of these defects, to a greater extent in water-tube boilers than in the shell type, and the ash and clinker may, perhaps, be discharged continuously, the fire bed maintained at a more even thickness, and the air supply kept under better control, but the conditions vary so considerably with different types of mechanical stokers and boilers as to almost require individual treatment. In the Lancashire type, the grate is not wide enough to allow side automatic cleaning, which, if done, reduces the effectiveness of the stoker at cleaning periods to the level of a hand-fired grate, whilst stokers which discharge clinker at the end usually mean a heavy bill for burnt-out fire-bar ends, and warped bars requiring frequent replacement.

Hand-fired Grates and Waste of Fuel with Mechanical Stokers.

With both hand and mechanical firing there is a constant loss due to small coal dropping through the bars, or the discharge of unburnt fuel with the clinker. Water-tube boiler stokers deteriorate very rapidly under banked fires and forced rating, and are subject to burning out, resulting in the absolute collapse of the boiler as a power unit should the driving mechanism fail under peak load conditions.

It may be stated that in large equipments run on modern lines under careful conditions and supervision, the maintenance cost of mechanical stokers after the first six months of life, on pre-war costs, was from 1½d. to 3d. per ton of fuel consumed. This figure does not include complete replacement charges due to collapse of a stoker. It must also be remembered that present costs for stoker upkeep are at least twice as much as pre-war figures. Costs, however, vary with the type of stoker and particularly with the amount of banking.

Another loss in shell-type boilers is that due to arrested combustion, the burning gases becoming cooled below ignition temperature by contact with the flue tubes immediately the products of combustion pass beyond the grate.

Restricted Grate Area of Lancashire Boilers.

The width of grates of shell-type boilers is confined to flue diameters seldom exceeding 6 ft. in length by practical operating considerations. The ratio of grate areas to boiler heating surface varies between 22 and 29 to 1, and for hand firing, the quantity of coal burnt per hour is about 20 lb. to 22 lb. per square ft. of grate. On mechanical stokers 26 lb. to 28 lb. of coal per square ft. of grate can be burned, with economy.

Increased Heat Transmission with Pulverised Coal.

External combustion chambers are necessary when applying pulverised fuel to boilers of the Lancashire type, the products of combustion passing through brick-lined tubes into the boiler flues.

Fig. 4 shows such an arrangement, and it will be seen that free access can be gained to the blow-down fittings. Fitted in this manner heat is transmitted to the water in contact with the whole surface of Lancashire boiler flues, and thus a gain over hand or stoker firing of about 42 sq. ft. of heating surface is made for each 3 ft. 6 in. diameter flue. The temperature of gases entering the flues will be about 2,600°F., as against 1,800°F., for hand firing with "nuts" of 10,000 B.T.U.'s, or as against 2,200°F. for mechanical stokers working at their highest efficiency point.

As the transference of heat to water through boiler plates is proportional to the square of the difference in the temperature on each side of the plate, it will be seen that high external temperature is of the first importance. As an example, consider a square foot of clean flue with clean water under 120 lb. gauge pressure (350°F.), and a gas temperature of 1,800°F. for hand firing, 2,200°F. for mechanical stokers, and 2,600°F. for pulverised coal fuel firing. The constant for heat transmission through a $\frac{1}{2}$ in. M.S. plate may be taken as 0·0133. For hand-fired boilers we then have $(1{,}800-350)^2\times0{\cdot}0133=27{,}963$ B.T.U. transmitted per hour, or 28·8 lb. evaporation from and at 212°. For mechanically-fired boilers $(2{,}200-350)^2\times0{\cdot}0133=45{,}520$ B.T.U. per hour, or 47 lb. evaporated. For pulverised coal firing $(2{,}600-350)^2\times0{\cdot}0133=67{,}331$ B.T.U. transmitted per square foot per hour, or 69·4 lb. evaporation from and at 212°F.

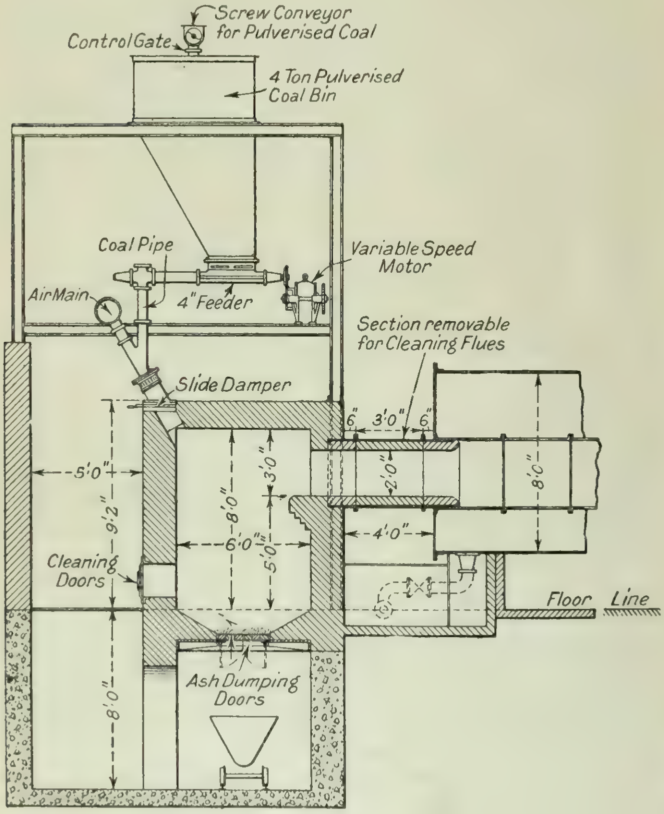

Fig. 4.

Banking and Off-duty Losses.

For either hand or mechanical firing of lump coal there is a constant loss of fuel each time the boiler is put off for cleaning. Take, for example, a pair of chain-grate stokers, each 6 ft. wide and 12 ft. long, burning coal normally 4 in. thick at a speed of 20 ft. grate travel per hour, and using coal classed as "peas," weighing approximately 5 lb. per square ft. per 1 in. deep. The mean thickness of fire would be, say, 3 in., hence 144 sq. ft. by 3 by 5, gives 2,160 lb. of coal on the grates during any instant of normal working.

The normal hourly consumption at 20 ft. travel would be $\frac{15\times20}{12}=25$ lb. per square ft. of grate. In slowing up to, say, half speed, the coal burns away leaving clinker only at the stoker ends, finishing probably with only 8 ft. of the bed incandescent. Over the last half-hour the temperature in the combustion chamber falls to 1,500°F or less, the drop in temperature being due entirely to an excess air supply, of at least 200 per cent. The coal consumed under these conditions would be, say, 1,000 lb., and the coke lost on the grate would amount to about half this, viz., 500 lb. Economies and losses can best be seen by taking examples.

ESTIMATED RUNNING COSTS OF LANCASHIRE BOILERS.

(Pulverised Coal Firing v. Hand Firing.)

Boiler Plant Data.

Pulverised Fuel.—Battery of 18 Lancashire boilers, 8 ft. diameter by 30 ft. long. Flues 3 ft. 3 in. diameter and 38 sq. ft. grate area. Two groups of 720 economiser tubes=1,440 total number of tubes.

Economiser feed 100°F. 120 lb. W.P. factor of equivalent evaporation 1·158. Heating surface of each Lancashire boiler, 1,000 sq. ft. Each economiser tube 10 sq. ft. heating surface and 1 cubic ft. internal capacity.

Volume of water in boiler at working level, 712 cubic ft.

Blow-down from economisers and boilers, steam for pumps and leakage=10 per cent. of water evaporated.

Working day 9 hours×5 days+3 hours on Saturdays. Sundays banked (boilers off when pulverised fuel fired).

Loss in pressure during night, 70 lb. (120 to 50 lb.)=(350°–298°)=52°.

Loss in pressure during week-end, 120 lb. (120 to 0 lb.)=350°–205°=145°.

Loss in economiser, same temperature drop as for boilers.

Coal, 11,500 B.T.U. per lb. as received, containing 10 per cent. moisture and 17 per cent. ash, at 35s. per ton delivered.

Pulverised Coal-Firing Data.

Fuel dried to $1\frac{1}{2}$ per cent. B.T.U. gained thereby=10·0−1·5=8·5 per cent., or 8·5×129 (the B.T.U. value for evaporating 0·1 lb. of water) =110 B.T.U. plus 11,500=11,610 B.T.U. per lb.

Working Results for Pulverised Coal and Hand Firing.

Of the 18 boilers in the presumed pulverised coal plant, assume 16 are working continually, evaporating 6 lb. water actual per square foot of heating surface per hour=1,000×6×1·1·158=111,168 lb., say, 111,200 lb. per hour from and at 212×48 hours=5,337,600 lb. per week.

Efficiency.—At 78 per cent. (running efficiency) of 11,610 B.T.U.= 9,053 B.T.U., or 9·333 lb. evaporation per 1 lb. coal for P.F. coal firing.

At 60 per cent. (running efficiency) of 11,500 B.T.U.=6,900 B.T.U., or 7·003 lb. evaporation from and at 212° per 1 lb. coal for hand firing.

Owing to the limited grate area it is not possible to get the required evaporation, together with 10 per cent. blow-down and pump steam and sundry losses, by hand firing at 60 per cent. efficiency, hence it is necessary to have 20 Lancashire boilers. The coal fired per hour will be an approximate minimum as follows :—

$$\frac{5{,}871{,}360\text{ lb. from and at }212^\circ}{48\text{ hours}\times7{,}113\times38\text{ sq. ft. grate}\times20}=22\tfrac{3}{4}\text{ lb. per sq. ft. grate per hour.}$$

Allowing two boilers per fireman we have $\frac{22\frac{3}{4}\times38\times2}{2{,}240}=\frac{3}{4}$ tons per man per hour.

The comparative results for coal consumption between the two systems may be seen from Table II.

Total cost of coal for hand firing=21,895 tons×35s.+2d. per ton, depreciation and maintenance of firebars, doors, tools, &c.=35s. 2d. per ton=£38,498 14s. 2d.

Labour Required for Pulverised Coal and Hand Firing.

Hours per working week, hand firing=48+28 hours=total 76 hours. Number of firemen, 10.

Hours per working week, pulverised coal firing=48+15 hours overtime=63 hours. Number of firemen, two.

Rate of wages for hand firing=70s. per week of 48 hours=$17\frac{1}{2}$d. per hour and $26\frac{1}{4}$d. per hour overtime.

Cost of labour per week for hand firing :—

	£	s.	d.
Normal working hours=10 men, at 70s. ...	£35	0	0
Overtime 28×10×$26\frac{1}{4}$d.	30	12	6
Total cost of labour for hand firing	=£65	12	6 per week.

Cost of labour for hand firing per annum=£3,412 10s.

Cost of labour per week for pulverised coal firing :—

	£	s.	d.
Two men at 70s. each	£7	0	0
Overtime 15 hours×2×$26\frac{1}{4}$d.	3	5	$7\frac{1}{2}$
Total cost of labour for pulverised coal firing	=£10	5	$7\frac{1}{2}$ per week.

Cost of labour for pulverised coal firing per annum=£534 12s. 6d.

Summary of Figures for Hand Firing and Pulverised Coal Firing.

	Hand Firing.	Pulverised Coal Firing.
Quantity of coal consumed per annum ...	21,895 tons	$14{,}793\frac{1}{2}$ tons
Cost of coal per annum, using equal grade of coal for both systems, and including 7s. on cost for pulverised coal	£38,498 14 2	£31,066 17 0
Cost of labour..................................	£3,412	£534
Total cost of coal, maintenance, depreciation, &c., and labour	£41,910 14 2	£31,600 17 0
Saving in favour of pulverised coal......	£10,309 17s. 2d. per annum.	

ESTIMATED RUNNING COSTS OF WATER-TUBE BOILERS.

(Pulverised Coal Firing v. Mechanical Stoker.)

Firing.—Assume that in this case we have a battery of four boilers, two per battery, each of 5,850 sq. ft. of heating surface, and an economiser unit of 10×12 tubes, each 10 ft. long=120 tubes=1,320 sq. ft. of heating surface. Take economiser feed water at 100°F.; working pressure, 200 lb.; superheat, 150°. Normal factor of evaporation 1·166×superheating 150°F. at 200 lb. pressure=1·08.

Total factor, 100°F. to 200 lb.+150° superheat=1·246.

Water in each boiler =5,850×8=46,800 lb.
Water in each economiser =1,320×6=7,920 lb.
Total water =54,720 lb.

Log Sheet for Boiler Room.

12 midnight to 5 a.m.= two boilers five hours at 29,000 lb. per hour each=290,000 total evaporation.

5 a.m. to 11 a.m.=three boilers six hours at 33,000 lb. per hour each =594,000 total evaporation.

11 a.m. to 8 p.m.=three boilers nine hours at 36,000 lb. per hour each =1,026,000 total evaporation.

8 p.m. to 12 midnight=three boilers four hours at 31,000 lb. per hour each=372,000 total evaporation.

Total steam per 24 hours ....=2,282,000 lb.

Sundays.

Two boilers working 19 hours at 31,000 lb. lb. of steam per hour each ....=1,178,000
Two boilers working 5 hours at 29,000 lb. per hour each ....= 290,000

1,468,000

8 per cent. blow-off allowance= $\frac{117{,}440}{1{\cdot}08}$ ......= 108,740

Total evaporation ....=1,576,740

Blow-off and leakages and steam for pumps =8 per cent. $\frac{182{,}560}{1{\cdot}08}$ (no superheat in this) 169,370 lb.

Total .... 2,451,370 lb.

Coal, 10,500 B.T.U. per lb., 10 per cent. moisture and 17 per cent. ash, costing, say, 34s. per ton.

Pulverised fuel working efficiency 80 per cent. with moisture content, reduced to 1½ per cent. (fuel used for drying allowed for in preparation cost), thus increasing the effective heat value (0·85×129) by 110 B.T.U. per lb. Coal, as fired, then=10,610 B.T.U., which, at 80 per cent. efficiency=8,488 B.T.U. per lb., or $\frac{8{,}488}{970}$=8·75 lb. evaporation per lb. of coal.

Table II.—*Lancashire Boilers.*

Details.	Pulverised coal.	Mechanical firing.
Coal to evaporate 5,871,360 lb. from and at 212° per week, including 10 per cent. " blow-off " and pump steam, &c.	Lb. 629,095	Lb. 825,440
Raising steam on Monday— $\frac{712\times\text{No. of boilers}\times 60\text{ lb.}\times 145^\circ}{\text{B.T.U. at given efficiency}}$	12,331	19,770
Raising steam daily— $\frac{712\times\text{No. of boilers}+1{,}440\times 57{\cdot}4\times 52^\circ\times 5}{\text{B.T.U. at given efficiency}}$	21,153	33,914
Laying off two boilers every 8 weeks— $\frac{712\times 60\times(205-60\text{ per cent.})\times 2}{\text{B.T.U. at given efficiency}}\times 8$ ...	172	224
20 boilers banked 12 hours for 5 days at 800 lb. coal per boiler	Nil	80,000
Coal lost on 20 grates at week-end— 760 sq. ft.×5 in. thick×3½ lb. per 1 in. (weight of coke)............................	Nil.	13,300
Loss by droppings through bars and unconsumed carbon in cleaning at 1 per cent. of 825,400 lb. (this may be often 2 to 3 per cent.)............................	Nil.	8,254
Totals { Pounds coal per week	662,751	980,902
Tons coal per week	295·87	437·9
Tons coal per annum, 50 weeks	14,793½	21,895
Pulverised coal firing saving in tons per annum..	7,101½	—
Running (or test) efficiency.....................	78 per cent.	60 per cent.
Commer. efficiency= $\frac{\text{steam for power}\times 100}{\text{coal purchased}}$ $\frac{5{,}337{,}600\times 970\times 100}{\text{coal purchased}\times\text{B.T.U.}}$ per week=	69½ ,, ,,	46 ,, ,,
Difference between running and commercial efficiency	8½ ,, ,,	14 ,, ,,

No account taken of capital value of eliminating four Lancashire boilers, valued at about £6,400.

Chain Grate Mechanical Stoker Firing.

Assume two stokers each 6 ft. wide by 14 ft. long.

Available grate area =154. sq. ft. 10,500 B.T.U. at 74 per per cent. efficiency =7,770 B.T.U.

Water evaporation per lb. of coal=8·01.

Maximum grate consumption =say, $\frac{39{,}000}{8{\cdot}01\times 154}$
=31·7 lb. per sq. ft. per hour.

Minimum grate consumption =say, $\frac{28{,}000}{8{\cdot}01\times 154}$
=22·7 lb. per sq. ft. per hour.

Average grate consumption =say, $\frac{121\times 2{,}240}{24\times 154\times 3}$
=24·4 lb. per sq. ft. per hour.

Approximate Cost of Equipment and Capital Charge for Chain-Grate Stokers.

Using two induced draught fans for two batteries of boilers working up to 25 per cent. overload, at 1¾ in. draught.

Two fans, each 55 in. diameter, 400 revs. per min., and special dampers and discharge ducts=£950

Maintenance, depreciation and interest at 12 per cent. of £950 ....=£114 per annum

Two 55 h.p. back-geared motors, starting switches and resistance coils direct current, 900 revs. per min.=£750

Maintenance, depreciation and interest at 12 per cent. of £750 ....=£90 ,, ,,

Eight stokers, 6 ft. by 14 ft., shafting and reducing gears, and 13 h.p. motor ....=£5,900

Interest and maintenance and depreciation, external to furnace, 8½ per cent. of £5,900 ....=£493 ,, ,,

Coal bunkers, to hold 500 tons, with elevator, conveyors, spouts, and 65 h.p. motor equipment, say, £6,600 at 12 per cent. interest, depreciation and maintenance ....=£792 ,, ,,

House over bunkers, &c., equivalent to house over pulverised coal bunkers, say, £1,100 at 11 per cent. interest and depreciation ....=£121 ,, ,,

Total amount per annum for interest and depreciation=£1,610

Table III.—*Water-Tube Boilers.*

Details.	Pulverised coal.	Mechanical firing.
Coal to evaporate 2,451,370 lb. from and at 212° per day, including 8 per cent. " blow-off," and pump steam, &c., per day	Lb. 280,160	Lb. 306,038
Raising steam in one boiler and economiser (off 6 hours) from 100 to 200 lb. 50°×5, 4,720 lb.	330	at 66·6 p.c. 400
Coal droppings through grates, ½ per cent.	Nil.	1,530
Banking for six hours	Nil.	1,120
Coal lost during nine hours overload, 2 per cent. of 1,026,000 in unconsumed carbon	Nil.	2,560
Coal lost on grates, one boiler off, and lighting up on Monday 154 sq.ft.×20 lb.	Nil.	3,080
Coal per week day......................	280,490	314,728
Coal per six days	1,682,940	1,888,368
Coal used on Sundays with 8 per cent. included evaporation of 1,576,740 lb., from and at 212°	180,000	209,330
Coal droppings through grates, ½ per cent.	Nil.	1,046
Totals { Pounds coal per week	1,862,940	2,098,744
Tons coal per week	831·67	936·83
Tons coal per annum, 52 weeks	43,246·84	48,720·36
Pulverised coal-firing saving in tons per annum..	5,473½	—
Running (or test) efficiency.....................	80 per cent.	74 per cent.
Commer. efficiency= $\frac{\text{steam for power}\times 100}{\text{coal purchased}}$ $=\frac{(2{,}282{,}000\times 6+1{,}468{,}000)\times 970\times 100}{\text{coal purchased}\times\text{B.T.U.}}$ =per week................................	75·1	66·7 .. ..
Difference between running and commercial efficiency................................	4·9	7·3 .. ..

No allowance made for laying off boilers, depreciation and interest.

Cost of Operating Chain-Grate Stokers, Coal Conveyors, &c.

	Total charges per ton of coal.
Interest and depreciation charges, as detailed above per ton of coal = $\frac{1{,}610 \times 240\text{d.}}{48{,}720 \text{ tons per annum}}$	=7·93(*a*)
Power used for driving stokers at $1\frac{1}{8}$d. horse-power hour= Fan motors, average hour =86 H.P. Stoker " " " =10 H.P. $\frac{9\text{s.} \times 24}{133 \text{ tons average day}}$	=1/7·48(*b*)
Cost of working conveyors 36 hours per week— $\frac{1\frac{1}{8}\text{d.} \times 36 \times 65 + 40 \text{ hours attendance at } 17\frac{1}{2}\text{d.}}{930{\cdot}5 \text{ tons per week}} = \frac{3333{\cdot}5\text{d.}}{930{\cdot}5}$	=3·58(*c*)
Cost of replacing stoker links, dumping plates, rollers and all metal in the furnace. Normal at $3\frac{1}{2}$d. per ton	=3·5(*d*)
Total overall cost of operating mechanical stokers and conveyors..	2s. 10·5d.

With coal of 10,500 B.T.U. 10 per cent. moisture, 17 per cent. ash, at 34s. ton delivered, the cost of fuel as fired will be 34s.+2s. 10·54d. =36s 10·54d. per ton.

Total cost of coal as fired per annum—
48,720·36 tons by 36s. $10\frac{1}{2}$d. ....=£89,828 3s. 3d.

The overall cost for pulverised fuel, using the same grade of coal as for stoker firing, will be :—

34s.+5s. $7\frac{3}{4}$d. (preparation charge including 16 per cent. depreciation and interest)=39s. $7\frac{3}{4}$d. per ton and 43,246·84 tons per annum will cost £85,727. 17s. On this reckoning the saving per annum for pulverised coal firing will be :—

	£	s.	d.
Stoker firing cost	£89,828	3	3
Pulverised coal-firing cost........................	£85,727	17	0
Net overall saving	£4,100	6	3

If, instead of high-grade fuel, one can use a low-grade coal having an analysis of, say, 9,460 B.T.U., 28 per cent. moisture, 17·8 per cent. vol., 44·8 per cent.C., 9 per cent. ash, and costing 21s. per ton, delivered, say, 50 miles from pit, and 8s. 9d. per ton preparation charges, &c., then the comparison would be :—

Cost of coal required for stokers	£89,828
Cost of coal required in pulverised form	69,670
Total saving in favour of using a lower grade fuel in pulverised form	£20,158

The comparative results for coal consumption between the two systems may be seen from Tables II. and III.

It will, therefore, be seen that as against mechanical stoker firing *under efficient conditions*, the application of pulverised coal will show a marked overall saving in cost of fuel when a cheaper grade can be used, but it must always be remembered that coal of totally unsuitable quality cannot be burned efficiently on stokers. Much coal now supplied is of this unsuitable quality, and the overall efficiency figure seldom reaches 74 per cent., whereas on the other hand, no matter what fuel is received it can be burned in pulverised form with a combustion efficiency of approx. 99 per cent. Therein lies the greatest value of pulverised coal systems.

Municipal Tramways Association.

(*Concluded from p.* 375.)

A Paper on " Operating Costs : Power Expenses," by Mr. A. L. C. Fell, was then read. We give this in abstract below.

Operating Costs: Power Expenses.

By **A. L. C. FELL, C.B.E.**

(General Manager of the London County Council Tramways.)

The principal item of working expenditure connected with the generation of electrical energy is fuel, and as this now represents from 75 to 80 per cent. of the cost of producing electrical energy at the power station, it is well worth while to devote some time to investigation, to see what is being, or can be done, to effect economies.

Transport of Poor Quality of Coal.

Before the war it was possible to issue a fairly close specification for coal, and payment was made for value received. Since 1914, however, anything available has had to be taken, and, as far as London and other places in the South-east and Southern area have been concerned, absolute rubbish has been supplied in innumerable instances, notwithstanding all the complaints made to the authorities concerned. During the war, tramway serivces had to be cut down to reduce coal consumption ; apart from diminished output of coal, the shortage of shipping and difficulties of transport were well known, and tramway authorities loyally endeavoured to effect economies, but these were, to a large extent, rendered nugatory, as ships were sent long distances from the North and East Coast to London with dark coloured material, consigned as coal, but in character more like the refuse from a slate colliery, containing in many cases over 30 per cent. of ash, which subsequently had to be barged out to sea and dumped.

To-day the situation is still unsatisfactory. As an indication of the state of affairs, the following particulars with regard to the coal supply to the London County Council's Greenwich Power Station during the year ended March 31, 1914, compared with similar particulars for the year ended March 31, 1920, may be of interest :—

	1913—14		1919—20
Tons of fuel burnt	166,040	...	176,460
Total cost of fuel burnt	£139,577	...	£348,395
Average price paid per ton for coal	16/9¾	...	41/11·3d.
Average calorific value British thermal units	13,350	...	10,780
Average percentage of ash	6·79	...	14·59

It will be seen that the fuel supplied in 1919-20 contained 7·8 per cent. more ash than that supplied during 1913-14, or a total increase in the waste material supplied to the Station of 13,759 tons. This waste material, paid for at 41s. 11·3d. per ton, represents a dead loss of £28,854 during the year. In addition, the extra cost of barging away the ashes at 3s. 8d. per cubic yard amounted to £6,306, and owing to the increasing cost of labour, this figure will become more serious as time goes on. The present cost of barging amounts to 4s. 9d. per cubic yard, or a total cost of barging the above quantity of ash would amount to approximately £8,170. In addition to this, it has been necessary to incur very heavy expenditure at the station for labour in connection with the removal of ashes.*

The whole arrangements with regard to grading coal should be co-ordinated by the suppliers and transport agencies, so that the lowest grade coal may be utilised where the least transport is necessary and the quality should improve as the distance from the source becomes greater.

Oil Fuel.

The introduction of oil fuel in electricity generating stations, which are not situated in suitable positions to obtain coal gas at the collieries, would offer great advantages. One of the principal items of expenditure in connection with fuel is transport, and oil could be delivered in bulk under advantageous conditions at a minimum cost for labour. In this form, fuel could be made available containing a very small percentage of waste material. Many years ago, experiments were made with oil fuel in generating stations, but the results were not very satisfactory, as only a limited quantity of low grade fuel was available. Since that time, the whole position has altered, and there is no reason why the possibilities of oil-burning should not be taken into consideration. This is a matter which should receive the careful consideration of the Electricity Commissioners.

In the autumn of 1917, under-feed grates were fitted to four boilers at the Greenwich Power Station, with a view to burning coke for steam raising. At first the results were not very successful, but after many experiments had been carried out, a type of arch was found, with which satisfactory results were obtained, and, at the price of coke at that date, considerable saving was effected by burning coke on these grates, especially when used in conjunction with coal on the sandwich system. Since that date, however, the price of coke has risen considerably, and, from a financial standpoint, there is very little advantage in using coke at the present time. Moreover, it is necessary to install special coke cutting or crushing apparatus, and generally to alter the shoots for the supply of this fuel.

In connection with the utilisation of coke, the question of storage is an important one, as broken coke occupies about 75 cubic ft. and coke breeze occupies about 60 cubic ft., as approximately against 45 cubic ft. per ton of coal, as coke has a calorific value of about 11,500 B.T.U. per lb., with 10 per cent. of ash, whilst coke breeze has a corresponding value of about 9,000 B.T.U., with 18 to 20 per cent. of ash. During the year ended March 31, 1920, about 25,000 tons of coke and coke breeze were burnt at Greenwich, this quantity representing about 14 per cent. of the total fuel. As an example of the results obtained, it was found that with Scotch nuts, at 42s. per ton, and coke breeze at 22s. 6d. per ton, the cost per 1,000 lb. of steam is approximately 19s. 6d. with approximately equal quantities of each fuel, as against 23s. 2d. with nuts alone.

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* The figures quoted would have been considerably higher as a larger amount of fuel would have been consumed in 1919—20 if it had not been possible to bring into commission more economical generating plant.

NECESSITY FOR A CHEMIST.

It has for some time been realised that it is essential to have a skilled boiler house engineer, who can devote his whole time to fuel combustion problems, but it should also be recognised that to get the best results it is necessary to have the assistance of a fully-qualified chemist at the station. At Greenwich the duties performed by the chemist, in so far as the boiler house is concerned, are as follows :—(1) Tests of fuel to determine calorific value, moisture, &c., both on supplies received and on representative samples taken from the bunkers. (2) Test of furnace ash, to ascertain whether all the combustible matter has been fully utilised. (3) Tests of flue gases, to determine whether the fuel is being burnt to the best advantage. (4) Tests of boiler feed water and condensate, to ascertain whether impurities likely to affect the boilers and plant in an adverse manner are present. (5) Tests on boiler water, to determine the concentration of salts and the necessity for blowing down. (6) Tests on water before and after softening, and on the lime used for this purpose. In addition, tests are carried out on deposits from leaking steam pipe joints and in all cases of boiler corrosion.

USE OF TRAILER CARS.

To deal adequately with this subject, a separate paper would be required, but here it is only necessary to state that on a system such as that which has to be dealt with in London, where there is an enormous peak load for a brief period in the morning and again in the evening, trailer cars have proved to be very economical, especially from a power-saving point of view, and a recommendation is now being put forward to the Ministry of Transport for an extended use of trailer cars on the London County Council system. The average energy consumption for a car and trailer is only approximately 30 per cent. higher than that for tractor only.

In 1912 a series of tests were carried out, when the average current taken for a tractor car was found to be 1·8 amperes per passenger, and for tractor and trailer combined 1·22 amperes, or a reduction of 32 per cent. per passenger due to the employment of the trailer car. The passenger seating capacity of the cars used for this test was tractor 62 and trailer 46 ; the cars were loaded with sand to approximate fully loaded service conditions. It should be noted that the journals of all the trailer cars in London are fitted with radial ball bearings. Tests taken on the level showed the tractive effort at the drawbar to be 17·02 lb. per ton of load with these bearings, as against 38·03 lb. per ton of load when the journals were fitted with bronze bearings, and to this fact the low energy consumption can be partly attributed.

CO-OPERATION IN TRAMWAYS UNDERTAKING.

All sections of a tramways department are responsible in some degree for the consumption of electrical energy, and it is necessary, if the best results are to be obtained, that, not only should the officers co-operate and study the position from a broad point of view, but the employees in all sections should be brought into touch with the work as a whole by regular lectures and demonstrations. So far, schools have been principally provided for the education of motormen in their duties. These should be extended, so that the education of all employees, as far as the tramways are concerned, may be made a strong feature of the organisation. Anything which makes the employees more competent and interested in their work will benefit the undertaking. One wishes it was possible to institute some scheme under which the staff and the employees would have a direct financial interest in the success of the undertaking. This would have a very direct effect, not only in the reduction of power expenses, but in the whole financial results. It is certainly a matter which should be considered by the Whitley Council. The Executive might be instructed to take the matter of charges for power supply from combined stations into consideration, and, if necessary, confer with the Incorporated Municipal Electrical Association.

DISCUSSION.

Councillor PALING (Bradford) said Mr. Fell seemed to be the only general manager who had discovered that there was some other item than wages which went to make up the costs of generating electricity. He was convinced that a great many tramway undertakings which were generating their own electricity ought not to do so, and he agreed with the Ministry of Transport that large power stations gave the best results.

Mr. C. J. SPENCER (London Suburban Traction Company) was sorry to see from the Paper that the bonus scheme which Mr. Fell has introduced was not a very great success. That had not been his own experience. The current consumption went down from 15 to 20 per cent. When wages were increased after the war the men suggested that the bonus scheme might be abolished, and the wages increased in its place. He agreed but regretted to say that the current consumption had gone back to what it was in pre-war days. Radial ball bearings were not equally good on motor cars as on trailers. Tramway men must keep well abreast of the times in the technical aspect. He instanced the designs of a motor which, horse-power for horse-power, was less than one-third the weight of the best motor on the market; it had an efficiency nearly 10 per cent. better, and was designed as a shunt machine and not as a series machine, so that the motor could be driven at any speed desirable. It had a worm drive, and not a gear drive.

Mr. R. G. CUNLIFFE expressed the view that the financial position of the British tramway industry could be improved by substituting modern operating plant for the out-of-date plant now so often used. The increased efficiency would more than repay the capital cost. Directions in which this might be done were increasing the size of the motor, using proper insulation and heat-treated gears, and improving controller, body and truck design, employing pressed steel and aluminium for points and using roller bearings, power brakes and field control.

Mr. A. B. FEARNLEY (Sheffield) wished in a friendly way to take exception to the wholesale depreciation by the last speaker of the methods and systems adopted in this country by tramway authorities. Experiments were being made with air brakes. He had also put in helical gears, and on his own tramway system there was not a single soft gear now used. Helical gears he watched melt away, and had taken them out. He hoped those he was getting now would give better results.

Mr. R. H. CAMPION (Chesterfield) mentioned the fact that he was burning six times the amount of coke that he was coal. This coke was hand fired, and was obtained from the coke oven retorts, as it was found ordinary gas works' coke was not suitable. Another method of burning coke was to mix it with tar, and this gave much better results than when burning oil alone. He had tried three bonus schemes without success, notwithstanding that in the last one he left himself out, as he had thought that might have been the drawback, but they were all turned down because the Committee thought they would create jealousy among the various members of the staff.

On THURSDAY, SEPTEMBER 16, two Papers on "Repairs and Depreciation in Relation to Capital and Revenue" by Mr. James Dalrymple and Mr. R. L. Horsfield, respectively were read and discussed together. Of these we give abstracts below.

Repairs and Depreciation in Relation to Capital and Revenue.

By JAMES DALRYMPLE.

(General Manager of the Glasgow Corporation Tramways).

It is invariably found that, where the financial position of a tramway undertaking is shaky, the cars and other plant are generally worn and the track rocky. The reason for this state of affairs is the absence of the necessary funds to keep their undertaking in a proper state of repair, and, generally speaking, we find that there are no funds in the renewal and depreciation account. Some people nowadays seem to have a great aversion for the word "capital" and it is extraordinary what opposition is encountered when one suggests that capital must be maintained. There are many municipal authorities to-day who seem to be quite prepared to give the highest wages to their employees, but, who, at the same time, entirely overlook the fact that in a short time, their capital, as represented by the track and equipment, will go out of existence, and that the time is fast approaching when there will be no track and no equipment capable of earning revenue. I have always held the view that in operating a tramway undertaking the capital must be maintained. This can only be done by keeping the concern in as complete a state of repair from day to day as possible, and, in addition, setting aside from year to year whatever amount of depreciation has taken place during the previous 12 months.

It may be said that the sinking fund should be sufficient to take care of depreciation and that as depreciation is not, generally speaking, a statutory charge, the revenue should not be made to bear this burden. My understanding is that the legislature intends that, by a given date, the debt on the undertaking should be entirely paid off. I do not think that it was ever contemplated that there should be a perpetual debt on any municipal undertaking.

I have recently been going carefully into the physical and financial condition of many tramway undertakings, and I find that it generally follows when there is too little spent in repairs there is nothing available to meet depreciation and renewal. Many tramway undertakings throughout the country are in a good state of repair, and have considerable renewal funds. I find, however, some undertakings in which renewals are being added to capital. I find others where too little is being placed to the renewal and depreciation funds, in order that a sum may be available for the relief of the rates. I find some other undertakings where the plant and equipment are being starved to obviate the necessity for an increase in rates. I find other undertakings where the renewal fund has been actually depleted in order to relieve the rates. In all these instances the tramway capital is being tampered with in order to meet the current administrative expenses of the municipality.

The two largest items under the heading repairs and maintenance are, of course, track and rolling stock. The renewal of the track is giving many of us much concern. Hitherto we have been reckoning on an average cost of about £4,000 per mile of single track, whereas the actual renewal is coming out at nearer £10,000. This increased cost has to be met in some way, and this can only be done by keeping our system in thorough repair, and by setting aside ample funds to meet renewal. We have under our care undertakings which could not be installed in these times for less than three times their original cost, and I would be very much surprised to learn that there is a single tramway undertaking in the country which has provided sufficient to meet renewal and depreciation. All tramway undertakers should at this time go very carefully into the physical condition of their plant and equipment, and budget for their future requirements to keep that plant and equipment in a condition capable of earning the necessary revenue.

Repairs and Depreciation in Relation to Capital and Revenue.

By R. L. HORSFIELD.

(General Manager of the Cardiff Corporation Tramways).

A sinking fund is established for the purpose of redeeming debt within the period of time prescribed by the sanctioning authority, and by its means we may say that municipal property is obtained. It may well be named the "Property acquisition fund." A depreciation fund is established for the purpose of restoring property, and may be called the "property restoration fund." Now, so far as tramways are concerned, if the last-named fund is abolished, or never established, we must be prepared to recognise and acquiesce in perpetual indebtedness, for it is obvious that we should not have an undertaking debt-free at any time.

It is, therefore, of the utmost importance that proper provision should be made to meet future necessities, as well as contingencies. The depreciation fund should stand apart from capital redemption and should be jealously guarded and kept inviolate. On the other hand, it should stand definitely and continually related to the revenue account. The declaration of so much "*profit*" without any provision for renewals is misleading. For wasting assets, that cannot be restored yearly, some provision should be made in the net revenue account, and no balance surplus should be treated as "*profit*" until that has been done. Alternatively, provision should be made annually, and accumulated, for obsolescence. The predominant question is, not what are we able to set aside from the revenue of the year, but what is the amount necessary to maintain the undertaking on a proper financial basis ?

Present-day conditions serve to emphasise the wisdom of those authorities who have in the past made provision for renewals, and it is clear that with the altered values as we find them to-day, the provision which was thought to be necessary in pre-war days, must be considerably augmented to-day. The statutory powers for establishing depreciation or renewals funds vary, but in many cases they provide for the accumulation nof such fund up to an amount not exceeding one-fifth of the aggregate capital expenditure. The County Borough of Walsall had in their local act of 1900 a clause similar to that above mentioned. The Tramways Committee wisely took advantage of this power and accumulated a renewals fund, which, in the year 1918, had reached its statutory limit. When they were promoting a Bill for further tramway and omnibus powers in 1919, in view of the increase in costs of material and labour which apparently are to remain more or less permanent, I advised them to seek authority to increase the maximum of their renewals fund allowed under the Act of 1900. The Local Legislation Committee before whom the Bill was considered, appreciated this wise precaution and granted a clause making the maximum two-fifths instead of one-fifth. When I took up my duties in Cardiff I was pleased to observe that the Tramways Committee had observed a similar cautiousness, and had made due provision for renewals of track and other portions of the plant, and at March 31 last had accumulated funds for this purpose to the extent of £182,690.

It may be interesting to observe here that the Orders under the Act of 1920 for Increased Fares require an adequate fund for "renewals." It is germane to consider the position of those authorities that have no provision whatever, that have piled up a debt that will outlive the assets, and the burden of which must be borne in future years by either tramway users or ratepayers. All such cases are object lessons that cannot be mistaken. It is noteworthy that with some authorities a tendency is springing up to borrow for renewals, which has the undesirable effect of keeping the maximum of debt alive, and it is to be hoped that this tendency will be checked at its inception.

DISCUSSION.

Ald. Fenton (Sheffield) saw a difficulty in putting the cost of maintaining the track on the right shoulders, but the highway authorities should at least bear a share. He suggested that the Executive of the Association should take the matter up in Parliament.

Ald. Paling (Bradford) said if the cost of tramways was made too high, they would not be used. He did not agree with putting the whole cost of maintaining an undertaking on the present generation.

Mr. H. P. Stokes (Plymouth) said that for highway authorities to charge the tramway authority 1½d. per 'bus-mile for the 'buses run by the latter, as was done in Plymouth, was making the same person pay for the use of the road which it maintained. In rate relief from so-called profits the ratepayers' money was returned to them in the sinking fund for debt redemption, whereas the shareholders in a company received dividends, but not their capital. Therefore he contended they were entitled to carry out renewals by means of new capital.

Mr. W. Murray (Walthamstow) said it was clear that many small undertakings could not make provision for renewals except by means of new capital, or by calling upon the ratepayers, or increasing fares considerably. He did not think it was fair to call on the present generation to provide the money for maintaining the undertaking for the benefit of the future generation, and he did not think it unfair to borrow capital for the purpose.

Mr. J. M. McElroy (Manchester) thought that both Papers set out ideals which were difficult to attain in the circumstances left by the war, and it would be necessary seriously to consider the question of re-borrowing for the purposes of renewals, especially in the case of small undertakings.

Mr. C. Furness (Blackpool) said that something like 70 per cent. of the capital on the undertaking had been repaid, and it was the intention to re-borrow to the extent of that 70 per cent. for the purpose of renewals.

Councillor West (Walthamstow) asked whether it would not be possible to borrow money for renewals and postpone the commencement of payments into the sinking fund.

Mr. J. B. Hamilton (Leeds) said the whole financial structure of British tramways had been built upon the basis of the repayment of debt within a certain period, and, if there was to be an alteration in the period, then a great deal of the money had been obtained by false pretences. In some cases Parliament had already sanctioned the re-borrowing of sums for a period which represented the life of a particular asset, off which a large proportion of the original loan had been paid, and it was only by proceeding on these lines that they would get the confidence of the public.

A Paper on "The Future of Capital Expenditure" was then read by R. S. Pilcher (Edinburgh). We give this in abstract below.

The Future of Capital Expenditure.

By R. S. PILCHER.

(Manager, Edinburgh Corporation Tramways).

The cost of some commodities required for the operation of a tramway system is only 100 per cent. up, but when we examine the costs of materials for the construction of permanent way and new cars, rise is considerably higher. The pre-war cost of permanent way construction may be put at £12,000 per mile of double track; at the present time the cost is in the neighbourhood of £40,000 per mile of double track, or over 230 per cent. increase. With regard to rolling stock—in pre-war days single truck top-covered cars with the latest electrical and mechanical equipment could be obtained for £900 each. To-day these cars will cost approximately £2,800, or over 200 per cent. increase. I have recently had to provide top covers for the Edinburgh cable cars, which are at present costing £550 each. These could have been obtained in 1914 for £120 each, and there appears to be no immediate prospect of the costs coming down for this class of work. The same abnormal increase applies to the construction of new buildings and to the provision of new plant, so that in this respect capital expenditure on new equipment or on new lines is very severely handicapped.

Capital expenditure requires new money, and money at present is only obtained at a high rate of interest. Pre-war money could be obtained at 3 per cent., now, even with the best security, 6 per cent. is required.

In considering this question we are, therefore, faced with the fact that new works require approximately 250 per cent. more capital for the same work, and that the rate of interest required is 100 per cent. up. The question of new capital expenditure would solve itself if the revenue to be derived from tramway undertakings could be made to increase in the same ratio as the working expenses. I think most of the transport undertakings have been on the slow side in raising the fares. The process of increasing the cost of travel must necessarily be slow and gradual, otherwise passengers will cease to ride or will ride less frequently. If the fares are raised gradually it will not be felt so much by the public ; and the decrease in passengers carried—which is so noticeable all over the country—will be but a temporary state. It is an extraordinary phase of the present public attitude that persons will willingly pay 100 to 200 per cent. for most commodities, but will not pay 100 per cent.

increase on the car fares. In the course of time, I believe, the public will get over this and will realise that the distance which can now be given for transport is only half what could be given in pre-war days. When this state is reached the financial position of the tramways will improve and the outlook for tramway capital expenditure will be more encouraging.

What effect is the high cost of new construction going to have on transport? I do not think that the development of transport is going to be retarded. If tramways are to be temporarily restricted, more attention will be given to the forms of traction which require the least capital expenditure, and this brings me to the consideration of the motor 'bus. I do not intend to enter into a discussion of the advantages and the disadvantages of the motor 'bus compared with the electric car. This subject would require a Paper to itself, but in speaking about capital expenditure one cannot but see the effect that high capital costs are bound to have upon the development of the 'bus. There is undoubtedly a great field for this vehicle, which can deal with extensions and new routes without any relatively great capital expenditure. How many tramway systems are there in this country where certain routes do not pay their way, and which have never paid sufficient to justify the laying down of the permanent way? It is probably cheaper to work these routes than to stop them, seeing that the capital has been sunk, but I believe that in the future when the question of the renewal of the permanent way has to be considered, many such routes will be worked by motor 'buses or other railless vehicles.

I have recently worked out some interesting comparative figures for new construction of tramways compared with motor 'buses in the City of Edinburgh, which I give as follows:—

System.	Capital cost.	Interest and sinking fund charges per annum.	Interest and sinking fund charges per mile.
Cost of new electric undertaking	£1,677,600	£109,127	4·547d.
Cost of converting cable system	695,700	56,014	2·334d.
Cost of providing a similar number of 'buses	456,640	64,131	2·672d.
Cost of providing 'buses to give the same seating capacity	729,900	103,155	2·886d.

I may say in the first instance that in considering the question of the form of traction to be adopted in Edinburgh, it is necessary to keep in mind that there are very considerable assets in the cable system which are convertible to electric traction, so that the problem in Edinburgh is not substantially different from those electric undertakings which have in the near future to face extensive renewals of their permanent way. Therefore, on this account we do not have to face the question of an entirely new electric undertaking. If electrification is carried out the cost will be as indicated in the table, viz., £695,700 for conversion. However, the figures which I give for an entirely new system are interesting in considering the question of capital expenditure, and the influence it will have in the future on entirely new systems or new routes. From these figures you will notice that the cost of a new system would work out at 4·547d. per mile as against 2·672d. per 'bus mile for a similar number of 'buses—the mileage being the same in each case—viz., 5,759,520. In these figures similar amounts are provided for plant and buildings. It will be seen that the 'bus has a considerable advantage in capital expenditure over the figures for a complete new electric system, even providing for the same total seating capacity. On the other hand, of course, it is generally admitted that the working expenses of the 'bus are higher than the electric car.

Although the total cost of operating motor 'buses per mile may be higher than it is with electric traction for a city such as Edinburgh, it must be kept in mind that the capital costs per 'bus mile remain at a constant figure in relation to the number of 'buses in operation, whereas with electric traction the capital costs per car mile increase in direct ratio to the decrease in the volume of traffic to be carried, or, the smaller the mileage run, the higher the capital costs per mile, and inversely the greater the car mileage, the less the capital costs per mile. When the suburban routes are considered, or routes which have not a heavy traffic, the cost of capital expenditure for electric cars becomes prohibitive. It is in these circumstances that the motor 'bus will become the cheaper vehicle to operate. The total cost of capital expenditure depends upon the frequency of the 'bus service. The 'bus may be made to pay where the service is infrequent, the only condition being that the vehicle will require to be fairly well filled with passengers. Future extensions and new routes will probably take the form of motor 'buses, or other vehicles not dependent on a costly permanent way. New transport will be provided and faster vehicles will be used and development will be quick. I have seen in some districts motor 'buses running along tramway routes practically in competition with the tramways and worked by the same operating authority. I do not think this is going to help either the tramway or the motor 'bus. The 'bus should be used where the tramway cannot be used, and the one vehicle made supplementary to the other; I do not think that they need be competitive.

It may be of interest to the Conference to know that, in Edinburgh, the intention is to run all the extensions with 'buses, and at the present time we are closing down four cable routes which have not a great volume of traffic, being under £270 per week per mile of route. The tramway rails are worn out, and it would not pay to renew the permanent way at present prices. Instead of spending new capital on a tramway where the traffic is not sufficiently heavy to pay the high capital charges motor 'buses are to be run. Only the future can tell at what point it will pay to lay tramway rails.

DISCUSSION.

Mr. H. **Webber** (Keighley) asked whether the author had taken into account the fact that a longer period was allowed for the repayment of loans on tramways than on motor 'buses.

Mr. J. M. **McElroy** (Manchester), in drawing attention to the sinking fund charges given in the Paper for trams and 'buses, said that, although the latter was lowest, it must be remembered that with double the number of 'buses to give the same seating capacity, the working expenses would necessarily be greater, and, although the capital charges would be low, the total cost was important.

Councillor **Paling** (Bradford) thought there had been too reckless an expenditure on road widenings. He also thought that tramway authorities should make more of their cars themselves, instead of buying them from contractors.

Mr. R. H. **Wilkinson** (Bradford) inquired as to the reason for the author's preference for a motor 'bus over a railless electric vehicle. He himself was constructing a railless vehicle to seat 50 passengers. This would be the means of saving large sums in track renewals.

Mr. E. S. **Rayner** (Hull) did not think it fair to give a bald comparison of sinking fund charges in the case of trams and 'buses without stating the car-miles run per mile of track. Again, running costs had to be considered, although they did not come into this Paper. The most unsatisfactory feature of motor omnibuses was that their operating costs were high and the fuel question was absolutely unstable.

Mr. C. **Furness** (Blackpool) said it would be interesting if the author could give the loan period for 'buses compared with the loan period for tramways. He believed that the tramways got double the period allowed for 'buses.

Mr. J. B. **Hamilton** (Leeds) said that from experience the trolley 'bus compared favourably with the petrol 'bus; but there was another form of tramway construction to which consideration should be given—viz., open track construction—which avoided the need for heavy foundations. This was not a practicable proposition in towns, but there were many places in the country where it could be adopted advantageously. This could be done at some 30 per cent. less than ordinary track construction. Moreover, this form of construction allowed speeds up to 20 miles per hour, instead of the 7, 8 or 10 now fixed, whilst maintenance costs were considerably reduced. The dominant feature in all forms of transport at the present time was speed.

Mr. R. S. **Pilcher**, in reply to the discussion, asked why it was that railless traction had not been more generally adopted than it had been. There were very few keen advocates of it. It was not so mobile as the motor 'bus, and this was a financial asset.

ANNUAL GENERAL MEETING.

At the Annual General Meeting of the Association, which was held on Thursday afternoon, the Council's report was adopted without discussion, and Mr. G. W. **Holford** (Vice-President and General Manager of the Salford Corporation Tramways) was elected President for the ensuing year. Ald. **Mayne** (Newcastle) was elected Vice-President, and the following were elected to fill five vacancies on the Executive Committee:—J. M. **McElroy** (Manchester), A. **Baker** (Birmingham), H. **Mozley** (Burnley), Councillor **Hyham** (Blackburn) and Councillor **Sellers** (Huddersfield).

Books Received.

[Copies of the undermentioned works can be had from The Electrician Office on receipt of published price, plus postage.]

"Tramway Motorman's Handbook," by W. S. Ibbetson. (London: E. & F. N. Spon.) Pp. vi.+208. 6s. 6d. net.

"The Motor Cyclists' A.B.C.," by Horace Wyatt. (London: George Newnes, Ltd.) Pp. 164. 2s. net.

"The Fireman's Handbook and Guide to Fuel Economy," by C. F. Wade. (London: Longmans, Green & Co.) Pp. 84. 2s. 6d. net.

"Direct-current Motor and Generator Troubles, Operation and Repair," by T. S. Gandy and E. C. Schacht. (London: Hill Publishing Co.) Pp. viii.+274. 15s. net.

Scientific and Industrial Research.

The Annual Report of the Committee of the Privy Council for Scientific and Industrial Research contains a review of the work which has been done since the Committee was established five years ago. The programme of the Department now falls under four heads: (*a*) The encouragement of the individual research worker, particularly in pure science; (*b*) the organisation of national industries into co-operative research associations; (*c*) the direction and co-ordination of research for national purposes; and (*d*) the aiding of suitable researches undertaken by scientific and professional societies.

It is emphasised that the only organised training grounds for the research worker are the universities, and attention is directed to the fact that these institutions are over-crowded with students, while their research laboratories are being used for the instruction of undergraduates, and the demand for teachers exceeds the supply.

Since the establishment of the Department, 136 maintenance grants have been made to students, and 89 to independent workers, 49 grants have been made to provide professors with competent research assistants, and 87 to give them laboratory or clerical assistance; during the same period 49 equipment grants have been made. The great majority of the grants have been made for work in the fundamental sciences, and no conditions are attached either as to the line of work to be pursued or as to the use to be made of the results. In making grants to individuals the Advisory Council are guided not so much by the theme as by evidence of scientific capacity.

ORGANISATION OF INDUSTRIAL RESEARCH ASSOCIATIONS.

Experience has shown that the plan of organising associations of industrial firms for the co-operative scientific investigation of their problems is sound, the present position being that 18 research associations have been established, while five others have been approved, and will shortly receive licences from the Board of Trade. The ten research associations actually at work have raised from their 2,300 members an aggregate income of nearly £40,000 in their first year of existence. Out of the "Million Fund" granted by Parliament for research associations £63,800 has already been expended, and it is estimated that the Department is committed to a total expenditure of nearly £450,000 on account of the established research associations, and to a further expenditure of at least £120,000 on account of those approved, but not yet licensed. Negotiations are now proceeding for the establishment of other research associations, and the total commitments out of the "Million Fund" are expected shortly to reach £800,000.

In discussing the attitude of industries to research, the Advisory Council refer to the possibility that results of greater value to industry might have been obtained if the "Million Fund" had been spent upon research at the National Physical Laboratory and other research laboratories rather than in making subventions to associations that have to buy staffs, equipment and experience at a time when all three are scarce and dear. They point out, however, that it is only after industries have done research for themselves that they can appreciate either its difficulties or its value, and further that if the money had been spent on research directed by the Government itself, its effect upon manufacturers would have been destructive of their self-reliance. As it is, over 2,500 firms have already guaranteed a minimum aggregate income for research of £38,400 a year for five years, and have shown already that they will considerably exceed their minimum guaranteed expenditure.

THE CONDUCT OF RESEARCH.

A considerable part of the introductory review of the early history of the Department is devoted to a description of the organisation of national research on problems which are of such wide application that no single industry can grapple with them effectively. These include the Fuel Research Board, the Geological Survey Board, the Food Investigation Board, and the Building (Materials and Construction) Research Board. While the transfer to the Department of the National Physical Laboratory has enabled to be brought the great resources of this Institution into their proper relation to the general scheme for the organisation of research.

The very important step has been taken during the current year of establishing a series of co-ordinating Boards for the organisation of the scientific work needed for the fighting services, so as to avoid unnecessary overlapping. Three Boards have been established, one for chemistry, one for physics, and the third for engineering; these, with the existing Radio Research Board, form the nucleus of the scheme.

At the outset of their work, the Advisory Council were able to prevent a number of important researches undertaken by scientific and professional societies from being abandoned through lack of funds. The total grants made to organisations of this kind in respect of 69 researches during the five years under review, amounted to £68,816. The financial assistance afforded to societies tends, however, to diminish, since some of the researches are being transferred to research associations, and some to the Department itself; in the latter case the Society often continues to assist by appointing a supervising committee. An additional reason for the diminution of the grants to societies is the fact that the call on their funds for aid for researches intended solely to increase knowledge has been lessened on account of the grants made by the Department to individual workers.

THE BRITISH ELECTRICAL RESEARCH ASSOCIATION.

Much consideration has been given to the size of the unit for research association. A research association is a relatively complex organisation, and the economic conditions even in apparently similar industries allows no general solution of the problem to be obtained on this point, while in certain industrial groups there are factors militating strongly against the establishment of such associations. A successful attempt has been made by the Institution of Electrical Engineers and the British Electrical and Allied Manufacturers' Association to establish a research association for the electrical manufacturing industry, membership of which will be open not only to manufacturers of electrical machinery, but also to firms engaged in the production of the different machines which comprise the whole of the plant of an electrical power station except the boilers. This association will be the first example of its kind.

THE BURDEN ON THE UNIVERSITIES.

The burden thrown upon the Universities has prevented the anticipation that the laboratories at these institutions would be available for the use of research associations while their own laboratories were being established. Several research associations have therefore had to consider at once the establishment of research institutes. Universities are, however, carrying out a certain amount of work for research associations, and this amount is likely to be increased in future. This being so the Committee record their views as to the nature of the agreement which should be made between research associations and existing institutions for research.

ASSOCIATIONS AND FUNDAMENTAL RESEARCH.

The Committee place on record the changing attitude of the research associations during the past year towards fundamental research. The earlier feeling was all in favour of turning out results of commercial value, and so helping the contributing firms to make large profits. But there are welcome signs that this attitude is becoming less common, and that industrial firms are more and more looking to research associations to concentrate on fundamental principles, leaving much of the application of these principles to the firms themselves.

SUBSCRIPTIONS.

The method of raising subscriptions from the industry for the support of research associations is also dealt with. Two research associations have adopted the plan of levying a fixed sum from all members, while four others have laid down a minimum contribution, but suggest that firms should make contributions having some relation to the size of the business they carry on. Four others base their unit of subscription on the capital employed by the subscribing firms. The British Iron Manufacturers' Research Association levies a fixed annual sum for every puddling furnace controlled by the subscribing firm, while the research association of the British Motor and Allied Manufacturers bases its subscription on every £100 of wages paid. Other contributions depend on output and on the number of persons employed. It is satisfactory to find that the urgent necessity of increasing as quickly as possible the supply of trained research workers is being realiesd not only by research associations but also by certain individual firms.

A large proportion of the report is taken up by examining in detail the various researches undertaken in the department for national purposes, under which heading are included the work done by the National Physical Laboratory, the Fuel Research Board, the Mine Rescue Apparatus Research Committee, the Food Investigation Board, the Radio Research Board, the Tin and Tungsten Research Board, the Oxygen Research Committee, the Gas Cylinders Research Committee, the Building Research Board, the Timber Research Board, the Lubricants and Lubrication Enquiry Committee, the Research Committee on the Corrosion of Aluminium and its Alloys, Enquiry Committee on the Standardisation of the Elements of Optical Design, the Anti-Glare Glass Research Committee, the Brass and Copper Cost Research Committee, the Copper and Zinc Enquiry Committee, the Zirconium Enquiry Committee and the Industrial Fatigue Research Board.

RECORDS BUREAU.

The Committee again call attention to the need for the establishment of a Records Bureau. Such a bureau could be of service in examining the programmes of research associations in order to ensure that the work is not being unconsciously duplicated, and when this occurs to arrange for a concerted attack upon the common problem, each association undertaking that phase of the work in which it is especially interested. Such a bureau is now being established under the supervision of Dr. G. C. R. Young.

GRANTS TO INSTITUTIONS.

The next section of the report deals with certain independent institutions to which grants have been made in aid of research. These include the Electrical Research Committee, which was formed by the Institution of Electrical Engineers and the British Electrical and Allied Manufacturers' Association. This Committee has now on hand eight lines of investigation, some of which have been carried out at the National Physical Laboratory. They relate chiefly to improvements in insulating materials, and their latest reports indicate that substantial progress of a useful nature has been made. As soon as the British Electrical and Allied Industries Research Association begins work these researches will be transferred to it and the grants made to the Electrical Research Committee will be discontinued.

During the year there has been a considerable extension of the system of grants to individuals, and it is pointed out that while the Committee are anxious to encourage co-operation of scientific staffs of Universities and technical colleges with those engaged in the industry or in the conduct of research having an industrial bearing, they have laid down that they are not prepared to recommend grants to research workers who only undertake specific investigations for industrial firms, unless it is made clear that the acceptance of a grant will preclude the firm from obtaining exclusive use of the results.

Patents.

During the year the department has been in close consultation with several Government departments regarding the question of the taking out and holding of patents for inventions made as the result of research either aided or entirely maintained by Government funds. After considering the whole question the Lord President of the Council has decided to appoint an inter-departmental committee to deal with these questions. During the year the department has received several applications from scientific societies for grants to meet the increased cost of scientific publications, but while fully sensible of the danger to scientific research which must result from a limitation of the facilities of publication it has not been found possible to provide assistance in the way proposed, though on one or two occasions when the public issue of a scientific document appeared specially important it has been issued through the Stationery Office and placed on sale as a Government publication. It is recognised that this is no substitute for the ever-increasing support which scientific societies must secure if results of research are to be made public on a scale customary before the war, but in the long run the increased cost of publication must be met either by an increase in the sale price or in increased subscriptions, or in both ways. The question of temporary assistance is another matter, and common action by scientific societies in the formulation of a policy to deal with present difficulties would be welcomed by the Committee.

Reviews.

The Concept of Nature. A. N. Whitehead, Sc.D., F.R.S. (London: Cambridge University Press.) Pp. viii.+202 14s. net.

In part this volume supplies points of view not presented in the author's enquiry concerning the Principles of Natural Knowledge (reviewed in The Electrician, Vol. 83, pp. 425-426); in part it traverses the same ground with an alternative exposition, mathematical notation being avoided, and the results of mathematical deductions assumed. Some of the former explanations have been improved, and others set in a new light, but some important points of the previous volume are not repeated here. The non-mathematician will be well advised in approaching the subject through this volume, and referring to the earlier one to supplement his knowledge. The mathematician will probably reverse the order. Each will find his task greatly facilitated by the combination.

The two opening chapters show how the presupposition of space and time as being that within which nature is set as an underlying framework of substance, of which it is the function of physics to determine the attributes, is the outcome of Greek thought; and that it results in a bifurcation of nature into causal and apparent components which does not express what we mean by our knowledge, and gives rise to the illegitimate intrusion of metaphysics into physics.

The author's analysis explains the differentiation of extension into time and space; gives a meaning to the observed facts of position and order in both, and of straightness and planeness in space, which emerges as definitely euclidean; explains the nature of motion; reconciles rotation with relativity—all without according peculiar character to light. He announces, moreover, his success in proving that in a gravitational field it gives those of Einstein's conclusions which are proved observationally—without allowing that physical phenomena arise from oddities of space—and reduces his theory to a greater conformity with the older physics. G. W. de T

Space, Time and Gravitation, an Outline of the General Relativity Theory. By A. S. Eddington, M.A., M.Sc., F.R.S. (London: Cambridge University Press.) Pp. vi.+218. 15s. net.

The author, in his preface, states that his aim has been to give an account of Einstein's theory of relativity without introducing anything very technical in the way of mathematics, physics, or philosophy, observing, however, that the new view of space and time, so opposed to our habits of thought, must in any case demand unusual mental exercise. A prologue in the form of a dialogue of Berkeleyan type, between an experimental physicist, a pure mathematician, and a relativist, is a happily chosen method of informally introducing the reader to the problem of which the Einstein theory is offered as a solution, and of answering in advance many questions which otherwise would probably present themselves to his mind while following the development of the theory.

Chapters I. to III. develop the theory, very simply and most interestingly, from the initial Michelson-Morley experiment to the Minkowski four-dimensional space-time, without raising any points not generally accepted by physicists—except the concluding paragraph of p. 26, which suggests that the author had forgotten his own warning on p. 35, that "the startling character of the phenomena arises from the natural but fallacious inference that they involve intrinsic changes in the objects themselves." Chapters IV. and V. introduce the controversial Equivalence Principle, and Einstein's interpretation of *ds* as a line element in space-time distorted or puckered around masses of matter, involving the objective existence of finite curvature in an empty region, and also the shift of solar spectral lines towards the red. The former leads to grave difficulties in respect to the limits of this space. The author considers the latter, contrary to the general opinion, to be favoured by the eclipse evidence, which is very fully dealt with. He, however, is simply expounding Einstein's theory, which, however it may have to be modified, will remain one of the greatest triumphs of human reason. The two remaining chapters discuss Weyl's attempt to express electric forces also as space puckering, and the author's views on the Nature of Things. Some useful mathematical notes, an historical note, and a good index conclude the volume. G. W. de T.

Shorter Notices.

Modern Machine Shop Construction, Equipment and Management. By Oscar E. Perrigo. (London: Hodder & Stoughton.) 2nd Edition. Pp. 384. 25s. net.

Consulting engineers, draughtsmen and workshop foremen concerned in the design and equipment of engineering machine shops, will find this book full of useful and practical information.

In many cases manufacturing plants are the result of expansion of a business they were designed to accommodate, consisting of poorly designed and cheaply constructed buildings, very often presenting the worst possible arrangement for economical working. It can be said that if the designers had had a moderate faith in the enterprise, they must have expected it would in time be necessary to enlarge. Therefore, a general plan might have been made, and such part of it erected as would make it easy to enlarge from time to time in conformity with one original design. In these economical days such a scheme has much to recommend it as it is desirable as much as possible should be spent on extensions and a minimum on alterations.

Part I. of this book deals with machine shop construction. Heating and ventilation systems are considered, and the important question of workshop lighting, both artificial and natural, is fully discussed and illustrated. The chapter on power is necessarily limited, and the remarks and illustrations of boiler settings apply to American boilers, seldom seen in the United Kingdom.

Part II. of the book deals with machine shop equipment. In this section an excellent chapter on planning the various departments is given. The equipment of tool rooms and stores is considered in great detail, and many extremely useful plans and charts are shown. Planning the drawing office, pattern shop, foundry and forge is dealt with in a comprehensive manner, and useful plans of actual arrangements are shown. Many practical hints on miscellaneous equipment are given with a great regard to detail. It is possible for every designer to obtain useful and reliable information from this portion of the book.

Part III. deals with shop management. Modern American methods which have proved successful are considered, and the systems as applied to each separate department are given in detail This part of the book is well worthy of study by English manufacturers, particularly as it deals with the relationship between employer and employed from an American point of view.

The book is well illustrated and can be strongly recommended to those requiring a practical work which shows in detail the growth of the machine shop from its commencement to the day of actual production. E. P.

Correspondence.

THE POLICY OF THE E.P.E.A.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: It is not easy, when one is dependent for information on reports in newspapers and other periodicals, to grasp all the essential details of a case in the midst of statements which are partial, or apparently contradictory, or obviously biased. The E.P.E.A. being, no doubt, in possession officially of all relevant data, came to a certain decision as to their policy in connection with the late dispute, acting in accordance with their plan of supporting that side which, they judged, consented to negotiate their claim, and so used constitutional methods of trying to effect a settlement.

But to an outsider, two questions occur: First, why did the E.P.E.A. judge between the parties from their respective attitudes to the dispute at a point which occurred so late in the development of the quarrel? Why, that is, did they not go back to the beginning of the dispute, which was the Penistone affair, and examine that? The "Times," in its issue of September 4, 1920, said, referring to the origin of the trouble, "Up to this point the dispute was a small, local affair. Moreover, the stoppage was unauthorised. But the National Executive of the E.T.U., *instead of making use of the recognised machinery*" (the italics are mine) "for the settlement of such quarrels by negotiation between the parties, elected to recognise the strike and to issue strike pay." According to this, then, it was the E.T.U. who first refused to use constitutional means of settlement, and, by precipitating a national issue, led to the deadlock in which the employers took up the firm stand which, one supposes, was the real reason of the ultimate settlement of the affair. So, really, the E.P.E.A., in accordance, with their policy ought to have got down from the fence on the employers' side after all!

Which brings me to my second question: Does not the E.P.E.A. recognise that the eventual deadlock was over something which neither the employers nor yet the E.T.U. would willingly arbitrate about, because the point at issue was far too fundamental? Would the E.P.E.A. agree, for example, to abide by the result of an arbitration on the question of whether their members should be absorbed into the general body of the E.T.U?

Frankly, as an outsider, I can well understand some of the senior members of the E.P.E.A. gnashing their teeth with rage at the whole business, and I hope the anger is not confined to the senior members. We are all greatly interested in the question of the organisation of Staff Trade Unions, and I feel, like many others, that the intervention of the E.P.E.A. will not increase the possibility of cordial relations between employers and such unions. In a recent issue of The Electrician I tried to show how essential it is to obtain a recognised status in the eyes of the Employers' Federation, but this sort of thing will kill our chance most effectually. It all goes to show how the adoption of a certain fixed policy may lead to a position the reverse of logical, and one altogether inimical to the best interests of the industry, and, as one outside the E.P.E.A., not eligible for membership in it, yet heartily sympathising with the tendency to organsation, I feel the recent performance to be something to cause to weep whatever gods there be who cherish the interests of engineering staffs.

By the way, to revert to the matter of newspaper reports, it will have been noticed that, while some accounts gave the correct preamble to the terms of settlement, namely, "As the Electrical Trades Union do not demand that foremen must be members of *a* Trade Union," others (I wonder why?) printed "members of *the* Trade Union." (The italics again are mine.) There is a difference!—I am, &c.,

Chief Engineer.

AMPERE-HOUR METERS FOR ELECTRIC VEHICLES.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The footnotes which appear under my letter in your issue of September 24th, contain such a distortion of my statements that I reluctantly have to deal with them at length.

Your previous notes certainly appeared to refer to all vehicle batteries, but you now imply that they referred to alkali batteries only. Obviously so, for lead batteries in vehicle service have an ampere-hour efficiency of nearly 90 per cent., they do not lose more than 10 per cent. of their charge if left standing for one month; and the temporary loss in capacity due to a drop in temperature of 40°F. is only 10 per cent.

In your original notes you referred to the ampere-hour meter recording 300 per cent. overloads for 5 minutes. "Carrying" was apparently meant instead of "Recording." I pointed out that records made by ampere-hour meters of heavy overloads are misleading because the capacity of lead batteries varies with the rate of discharge. I drew attention to the fact that they can serve a useful purpose in automatically cutting off the charge at a pre-determined point. When so employed they might be styled automatic controllers, but "they cannot be used as automatic controllers for any considerable length of time," as the state of the roads, the gradients on the route, the mechanical efficiency of the vehicle, &c., affect very appreciably the ampere-hour consumption per mile run. To say that it is impracticable to regulate the retardation is quite erroneous. It is as simple to adjust the rate of retardation of a Sangamo meter as to regulate a watch.

I notice you again refer to the needle of the meter creeping back to "zero" on discharge. Of the several hundred meters from which I receive regular records and data, all read forward on discharge and return towards "zero" on charge. There are good reasons for this. The needle engages with a contact at "zero" and thereby operates the charging switch. There is no definite "empty" point for a lead battery. It will not flop. Owing to diffusion of the electrolyte an exhausted lead battery will recuperate, on standing, to an extent usually sufficient to bring the vehicle to the nearest charging station.

In the concluding part of your notes I am accused of considering the question of protecting the battery of paramount importance. Naturally, for it is my business to do so, and it is a policy which has removed the stigma attached to lead batteries for use with electric vehicles, and proved them to be most suitable for the purpose. No one benefits if maintenance and upkeep are inflated by letting things rip. Why should a user be saddled with the cost of a new battery if insistence on observance of a few simple instructions can prevent the waste? Why should the "horny-handed driver" be regarded as a helpless and brainless automaton? I find him willing and able to carry out intelligently the few do's and don'ts which concern him, but he rarely has anything to do with the charging of the battery. It rests with the person who charges the battery to see it is properly charged, and for this purpose he is not dependent on the ampere-hour meter, as he has far more infallible guides when handling lead batteries.

In conclusion, let me remind you that the general use of ampere-hour meters arises from the requirements of the battery makers and is a necessary condition under which a guarantee on the battery is issued. Surely the object of the meters is known to the battery makers, and as chief engineer of the leading maker, I may perhaps claim to have some knowledge of the subject.—I am, &c.,

Heaton Chapel, Ernest C. McKinnon.
Sept. 27, 1920.

[We have omitted parts of Mr. McKinnon's letter in which he repeats certain statements made in his previous correspondence. Ed. *E.*]

Scientific Paper No. 381, "An Electron Tube Transmitter of Completely Modulated Waves," has been issued by the Bureau of Standards, Washington. In order to utilise a radio-frequency wave train of given power most effectively in a non-oscillating receiving system it must be completely modulated, at some suitable audio frequency. A convenient way of accomplishing this modulation, when an electron tube generator is used, is by supplying the plate circuit of the tube or tubes with an audio-frequency alternating e.m.f. An alternator may be used with suitable transformers to supply both the filament and plate circuits. A self-contained transmitting set of this type has been designed and built at the Bureau, and a description of the set, with photograph and diagrams is given. Overall efficiency as high as 35 per cent. is obtained with the set. Transmission and reception tests are described, in which the waves were received by heterodyne methods and also with a crystal detector.

Electricity Districts.

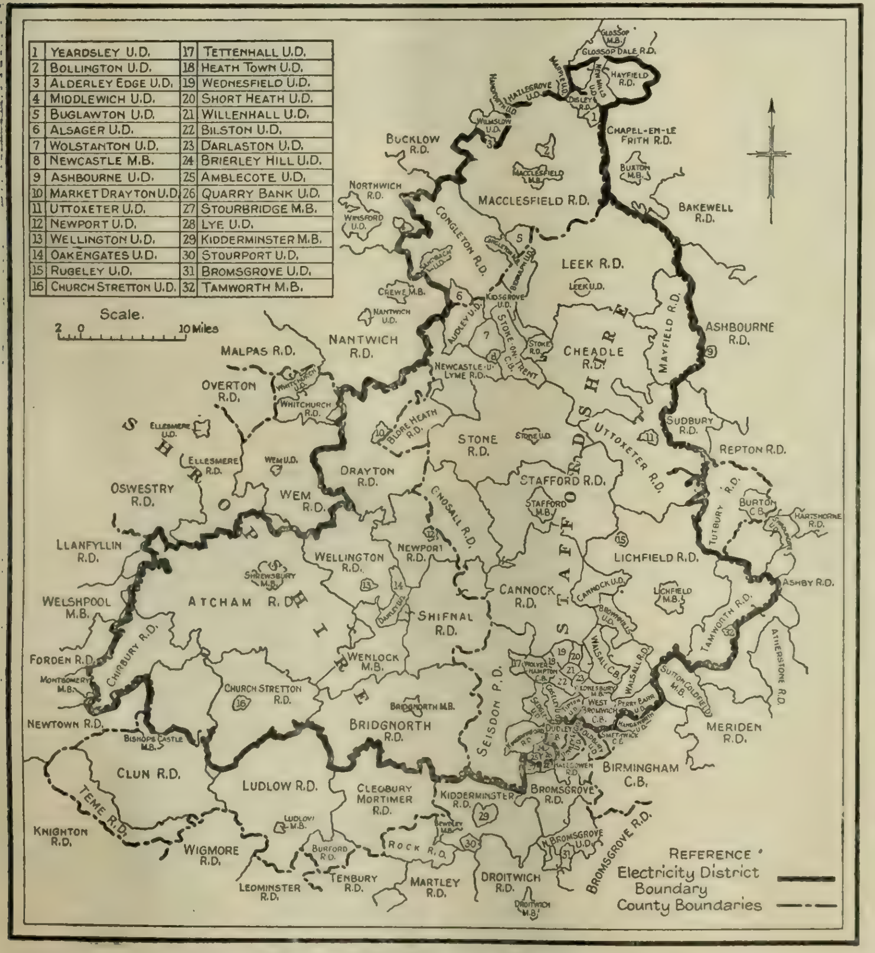
Two further electricity districts have been provisionally defined by the Electricity Commissioners, viz. the South-West and the North-East Midlands districts. In both cases local inquiries will be held into the existing organisation of electricity supply in the districts, and improvement schemes must be submitted by January 31 next. We hope to give maps of the areas in an early issue, and in the meantime we reproduce a map of the North-West Midlands area which was recently defined by the Commissioners.

South-West Midlands.

So much of the County of Salop as is included in the municipal boroughs of Bishop's Castle and Ludlow; the rural districts of Burford, Cleobury Mortimer, Ludlow and Teme; and the parishes of Bishop's Castle (rural), Clun, Clunbury, Clungunford, Edgton, Hopesay, Hopton Castle, Lydbury North, and Mainstone in the rural district of Clun.

So much of the County of Stafford as is included in the county borough of Smethwick and the urban district of Rowley Regis.

So much of the County of Warwick as is included in the City and county borough of Birmingham, the municipal borough of Sutton Coldfield; the rural districts of Atherstone, Meriden, Solihull and Tamworth.



Map of N.W. Midlands District.

So much of the County of Worcester as is included in the City and county borough of Worcester; the county borough of Dudley, the municipal boroughs of Bewdley, Droitwich, Evesham, Kidderminster and Stourbridge; the urban districts of Bromsgrove, Lye and Wolescote, Malvern, North Bromsgrove, Oldbury, Redditch and Stourport; and the rural districts of Bromsgrove, Droitwich, Evesham, Feckenham, Halesowen, Kidderminster, Martley, Pershore, Rock, and Tenbury, and the parishes of Berrow, Birtsmorton, Bushley, Castlemorton, Croome, D'Abitot, Earls Croome, Guarlford, Hanley Castle, Hill Croome, Holdfast, Kempsey, Little Malvern, Longdon, Madresfield, Newland, Powick, Queenhill, Ripple, Severn Stoke, Upton-upon-Severn, and Welland in rural district of Upton-upon-Severn.

North-East Midlands.

So much of the County of Derby as is included in the municipal boroughs of Buxton and Chesterfield; the urban districts of Bakewell, Baslow and Bubnell, Bolsover, Bonsall, Brampton and Walton, Clay Cross, Dronfield, Matlock, Matlock Bath and Scarthin Nick, North Darley, South Darley, and Whittington and Newbold; the rural districts of Bakewell, Blackwell, Chapel-en-le-Frith, Chesterfield, Clown and Norton.

So much of the County of Lincoln (Lindsey) as is included in the urban districts of Barton-upon-Humber, Brigg, Broughton, Crowle, Gainsborough, Roxby-cum-Risby, Scunthorpe and Frodingham, and Winterton; the rural districts of Gainsborough and Isle of Axholme, and the parishes of Appleby, Aulkborough, Bonby, Bottesford, Brumby Rural, Burringham, Burton-upon-Stather, Cadney-cum-Housan, Cleatham, Elsham, East Butterwick, Flixborough, Gunhouse, Hibaldston, Holm, Horkstow, Kirton-in-Lindsey, Manton, Messingham, Newstead, Roventhorpe, Redbourne, Saxby, Scawby-with-Sturton, South Ferraby, Twigmore, West Halton, Whitton, Winteringham, Worlaby and Wrawby, in rural district of Glanford Brigg.

So much of the County of Nottingham as is included in the municipal borough of East Retford; the urban district of Worksop; and the rural districts of Blyth and Cuckney, East Retford and Misterton.

So much of the West Riding of the County of York as is included in the City and county borough of Sheffield; the county borough of Rotherham; the municipal borough of Doncaster; the urban districts of Adwick-le-Street, Bentley-with-Arksey, Bolton-upon-Dearne, Dearne, Greasborough, Handsworth, Hoyland Nether, Mexborough, Rawmarsh, Stocksbridge, Swinton, Thurncoe, Tickhill and Wath-upon-Dearne; and the rural districts of Doncaster, Kiveton Park, Thorne, Rotherham and Wortley.

In both cases objections to or representations as to the areas of the proposed districts must be made by January 31, 1921, to the Secretary of the Electricity Commission. As the Commissioners think that the existing organisation for the supply of electricity in the districts should be improved local inquiries will be held and schemes for effecting such improvement should be submitted by Jan. 31 next.

Provincial Electric Supply Committee.

The annual general meeting of the Provincial Electric Supply Committee of the United Kingdom was held on Tuesday.

The chairman (Sir Harry Renwick, K.B.E.), in the course of his speech, said that the Electricity (Supply) Bill, which was in the early stages of Parliamentary consideration and which was very fully considered at their last meeting, had now become an Act, in, he was happy to say, a considerably modified form. In that modification the Committee took a leading part. The point of vital concern was the compulsory purchase of their generating stations and transmission lines, which was most inadequate and unfair. In spite of their efforts when the Bill left the Commons Committee the altered form of purchase clause was more objectionable than ever. He was pleased to say that they met with much more favourable consideration in the House of Lords and after very great efforts they succeeeded in getting the Bill amended to its present form, and thus at the eleventh hour saved the situation. The possibility of the proposed District Boards competing with them on unfair terms had also been averted. That result was only achieved by the strenuous and almost intermittent work of the Executive Committee in the weary months during which the Bill was before the two Houses. The preparation of the amendments themselves was a big task, to say nothing of getting out a full written explanation of every amendment put forward. The chairman proceeded to give an outline of their method of working, and he said that in putting forward amendments they paid very close attention to the wishes expressed by their various member- companies. In the course of the progress of the Bill they had very important interviews with the Home Secretary, with the Parliamentary Secretary of the Board of Trade and other Ministers, and with the Chief Electricity Commissioner Designate. Special thanks were due to the members of the Executive Committee, and particularly to those who formed the Parliamentary Sub-Committee.

Joint Councils and the Labour Problems.

The next matter of importance with which they had dealt during the past year was the National Joint Industrial Council for Electricity Supply. This Council had been placed in full working order during the year and District Councils had been formed throughout the country. "The Councils are necessarily subject to much criticism, and it is too early in the day to pronounce any final judgment, but in general their work up to the present has met with a considerable measure of approval from both sides, and certainly in our industry, appears to have worked better than in any other that I am aware of. We can say in their favour that every important matter relating to wages and conditions of employment have been reduced to system throughout the country. Every undertaking comes under some Council which relieves it of all trouble in considering questions of general advances and so on, and submits a recommendation on any and every point of labour which may come up for consideration. Whether any individual undertaking finds its wages bill increased under this new system, or whether it might be better off under the old go-as-you-please regime, it is impossible to say. On the whole, however, we are safe in conjecturing that things must be better all round when system is at work, as in these Industrial Councils, than when haphazard methods prevail. Certainly, we have seen something of the usefulness of the National Joint Industrial Council in the recent threatened strike. Speaking broadly, I am convinced that for the present industrial unrest salvation lies in the closer union and a better understanding between masters and men, and the elimination of the politician and Government interference. In connection with another problem we have been able to give some assistance. As you are probably aware, the Ministry of Labour organised a scheme for providing suitable employment for disabled soldiers, including monetary grants, where training is necessary. The scheme is a large and elaborate one, and a National Advisory Council was formed to administer the funds and carry out the scheme generally. I was asked by the Ministry to sit on that Council, and with the approval of your Executive Committee I accepted a seat. Under the scheme the country has been divided up into districts each with its local Advisory Committee, and at the request of the Ministry we have arranged, so far as our members are concerned, for engineers of the representative undertakings to sit on the local Committees where possible."

Miscellaneous Matterz.

Other Parliamentary matters dealt with were the Ways and Communications Bill, the Courts (Emergency Powers) Act of 1919, and the Rates of Wages (Commission) Bill. The last-mentioned Bill would probably be re-introduced next Session. He regretted that the Bill promoted by Messrs. Edmundsons to introduce a new basis for charging for electric supply was rejected in Committee of the House of Lords. Although unsuccessful, it had had its fruits in inducing the Ministry of Transport to give immediate consideration to the question of introducing a general Bill, which would, he understood, include a provision to reduce the present five years period between times of application for revision of charges. It would also bring those companies under the Act, which were now excluded owing to their orders dating prior to 1899. Further, in regard to tariffs, they were trying to obtain recognition of an alternative on an assessment basis on some method other than a flat charge. In that connection he might mention the concession which their Committee was largely influential in obtaining in the re-introduction of the minimum charge. During the war and, in fact, until a few months ago, where any company obtained an order increasing their maximum charges, the Board of Trade made it a condition that the minimum charge should be cancelled. That was so serious a loss to small companies that they made strong and repeated protest. They succeeded at last in convincing the Electricity Commissioners of the justice of their claim and in all recent orders they had again incorporated a minimum charge.

As to co-operation, he mentioned last year what they had done in that direction. He had to add that they had now a member representing them on the British Engineering Standards Association (Mr. Jackson, of the Northampton Company) who had taken a great interest in the technical work being done by that Association. Their Committee was also supporting the Electrical Development Association, and he took that opportunity of cordially recommending their constituent member-companies to give their individual support to that Association.

As to general matters, the question of revision of prices in battery contracts came up during the year, and Mr. Wigham kindly advised the Committee on it and drafted a letter which they sent round for the information of their member-companies. With regard to press work, they kept a watchful eye on reports in the papers, affecting their industry, with the object of correcting any misleading or incorrect statements. They had always held their services at the disposal of any member-companies on matters which came within their scope, and they had found that the assistance they had been able to give had been very much valued. Since the close of the year's work for 1919, several matters of importance had occurred. Chief amongst these was the Electricity (Supply) Bill, of this year. The Electricity Commisssioners had put into operation their powers of delimiting areas under the Electricity (Supply) Act, and eight areas had been provisionally delimited up to the present. They had given advice and assistance where asked for, their policy being to support where necessary the combined action of our member-companies in the respective areas. All general expenses had been met out of their annual subscriptions, and there was a balance to the good of £285.

In two recent issues of "Le Génie Civil" Dr. G. Tochon deals with the question of the development of the WATER POWERS IN THE BASIN OF THE DORDOGNE, a concession for which has been granted by the Government to the Orleans Railway Company. He points out that the maximum power available in this basin is about 1,400,000 H.P., but this, under present conditions is obtainable only during the spring and autumn floods. To bring the average power up to something approaching this figure a large amount of constructional work would be necessary. For this reason probably at present not more than 7 per cent. of the total power available is utilised, though schemes are under consideration for the employment of about 585,000 H.P., of which about 255,000 or 43 per cent. will be in the basin of the Dordogne itself. The scheme which the Government has thus authorised is interesting in two ways. It will allow the development on a vast scale of the hydraulic power in the Dordogne basin, and in the second place the work which it is proposed to carry out to this end will enable the substitution of hydro-electric power for coal for working the railways in the district, and thus bring about the saving of about three million tons of coal a year.

New Heating and Cooking Apparatus.

We regret that in our article on "New Heating and Cooking Apparatus," which appeared in last week's issue, there was an interchange and misdescription of two blocks. The illustration which is now shown as Fig. 1 was described as being the sheet metal 1 kw. fire, manufactured by the Yule Electric Company. In reality it is a fire recently placed on the market by the Arora Company, and has a sheet metal frame in satin and brass finish with a capacity of 2.25 kw. The illustration which we reproduce in Fig. 2 was described in the same article as the new Arora fire, but it is really Messrs. Jackson Electric Stove Company's new "560" radiator. It should be added that in the footline to Fig. 1 of the same article the works of the Jackson Electric Stove Co. were stated to be at Watford whereas they are at Luton.

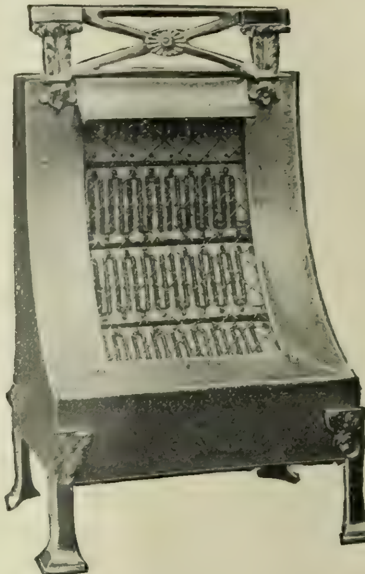
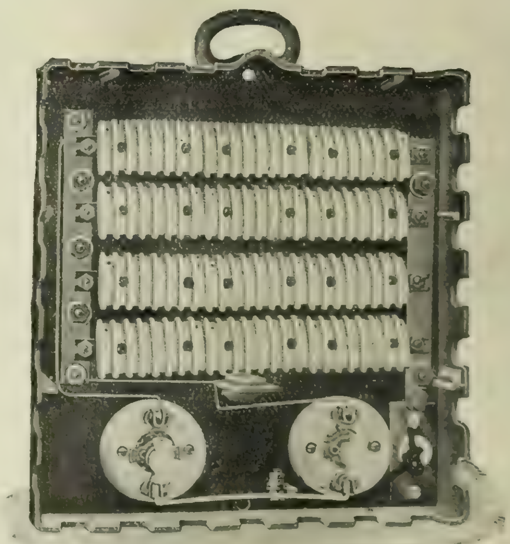


Fig. 1.—New Arora Fire. Sheet Metal Frame, Satin and Brass Finish, 2.25 kw.



[Fig. 2.—Jackson's "560" Radiator, showing Fire Bar and Connections.

We learn from the "Electrical World" that AEROPLANES are coming into use in the WESTERN STATES OF AMERICA for transporting materials for hydro-electric construction work and for inspection purposes. Mr. R. C. Starr, the engineer of the San Joaquin Light & Power Corporation is using a 185 H.P. biplane in order to economise in time required for inspection and supervision purposes, while the Southern California Edison Company is using bombing planes to transport materials for its new plants in the High Sierras, thus enabling work to be begun much sooner than would otherwise be possible.

Electricity Supply.

The Electricity Commissioners have extended until March 31, 1921, the time within which objections to or representations in regard to the London and Home District and the South-East Lancashire Electricity District may be made.

A temporary arrangement has been made under which Leeds electricity department will supply electrical energy up to 150 kw. to Morley Corporation, by means of the h.t. cables which supply current to the tramcars on the Morley route.

Bury (Lancs.) Corporation recently obtained sanction to borrow £94,000 for additional generating plant, but as the amount of the accepted tenders is £102,929 it has been decided to apply for authority to borrow an additional sum of £8,929.

Aylesbury Corporation, having been advised by Mr. C. H. Wordingham, that a rotary converter will be required for supplying current to Messrs. Hazell, Watson & Viney, have instructed the Borough Electrical Engineer to make inquiries with a view to obtaining the machine.

The Dearne District Light Railway Board object to the planning of the Yorkshire electricity districts on the lines proposed by the Electricity Commissioners, on the ground that it will impede the future joint development of those Dearne Valley townships which are already bound together by a close community of interest.

Oban Council has agreed to supply current for lighting the Callander and Oban Railway Company's premises at Oban for two years at 7½d. per unit. In order to retain the services of the burgh electrical engineer, Mr. C. Saddington, who has been offered an appointment at Kinlochleven, the Council has decided to increase his salary to £350.

Risca Urban Council are applying to the Electricity Commissioners for a special order authorising them to generate and supply electricity within the urban district of Risca; authorising them to collect and recover rents and charges for the supply of electricity, and the sale or use of any machines, lamps, meters, fittings or apparatus connected therewith, and to prescribe and limit the price to be charged for electricity, &c.

At a recent meeting of Slaithwaite Council an offer was received from the Huddersfield gas manager to light the 141 public lamps in the district until 11 p.m. from Oct. 1 to March 31 at £3 per lamp. The Yorkshire Electric Power Company also offered to undertake the public lighting. It was decided to arrange an interview with a representative of the Power Company and also to ask Huddersfield Corporation whether they were willing to supply electricity to the district.

Last week the Clitheroe Council decided to support Burnley, Colne, Nelson, Rawtenstall, and Darwen in their opposition to the proposed super-power station at Preston, but the vote was not a unanimous one. Ald. Whipp said he would like electricity to be available at Clitheroe for running the cotton mills; and Mr. Orme said they had been advised that it would be cheaper for Clitheroe to obtain a bulk supply from Blackburn than to erect their own works.

Carnarvon Council has adopted a proposal of the Electricity Committee, to call a conference of representatives of electrical undertakings in Carnarvonshire, Anglesey and Merionethshire to consider the feasibility of forming an Electricity Board for those counties.

Mr. D. O. Evans, local manager for the Electric Construction Company, said he understood the British Aluminium Corporation, which had valuable options over water-power, was prepared to sell the property which it recently acquired from the North Wales Power Company.

The Electricity Commissioners have informed the Dundee Electricity Committee that they will consent to the extension of the station at Carolina Pont on the understanding that only work of a preliminary character is done at present and they recommend the Council to consider the question of taking a supply from a hydro-electric scheme which is being considered. Mr. Hynd, the convener, states that the department had been approached by a syndicate and they had replied that if, before their extensions were completed, they had a definite proposal it would be considered.

The Bo'ness Town Council has asked the leesees of its Electricity Works, the National Electric Construction Company, to obtain terms from the Scottish Central Power Company for the supply of electricity in bulk. The burgh has spent £49,000 on the undertaking, but as fresh capital to the extent of £40,000 is now required for additional plant to meet the increased demand it is thought that a bulk supply scheme would be better, as it would involve less expenditure and only require the erection of a high-tension supply line, and some alterations at Bo'ness station which would only mean an expenditure of £12,000. The instalments of principal and interest for the next five years will continue to be paid by the Company.

Inverness Town Council is anxious to take its share in the movement for the reorganisation of electricity supply, and hopes that it will become the centre of an electricity district extending to Invergordon and Tain in the north, and to Nairn and Elgin in the east. Mr. L. B. Hogarth, consulting engineer, who attended last week's meeting of the Council, said that Inverness was the most suitable centre, with its great possibilities in waterpower.

Dean of Guild Fraser said it was nothing less than a scandal that the water-power in the Highlands had not been harnessed before now. They were unlike the Germans in many ways, but he had no hesitation in saying that they in the Highlands might take a leaf out of the German book as regards the utilisation of water-power. It was agreed to instruct Mr. Hogarth to make a preliminary survey of the area between Tain and Elgin, and to report upon the possibilities of the water power of Kilmorack and adjacent lochs.

Electric Traction.

The Scarborough Tramway Company have decided to close down the North Side route during the ensuing winter.

Durham County Council is considering a proposal to construct an Electric tramway from Gateshead to Bishop Auckland.

Halifax Tramways Committee has decided to have the tramway track to Stainland laid as quickly as possible, as early delivery of the rails is now promised.

The strike of Newcastle Tramwaymen was settled on Thursday of last week, the Tramways Committee having expressed their approval of the principle that every employee should be a member of a trade union.

In connection with proposals for the development of water power in the Highlands a projedt has also been brought forward for converting a portion of the Highland Railway to Electric Traction, energy being supplied from the new hydro-electric works.

The Minister of Transport has made an Order authorising the construction of light railways in the borough of Mansfield, the urban district of Mansfield Woodhouse and the rural district of Southwell, in extension of the light railways authorised by the Mansfield and District Light Railways Orders 1901 and 1907.

Colwyn Bay and Colwyn Council have decided, in view of the coming developments, to enter into a 10 years' agreement with their gas and electrical engineer, Mr. J. Smith, under which he will be paid £1,000 per annum for the first three years, £1,100 per annum for the three following years, and at £1,250 per annum for the remaining four years.

A further increase of fares on the Bradford Corporation tramways came into operation on the 1st instant, but Ald. Palin, deputy-chairman of the Tramways Committee, thinks it will be possible to reduce them again later on. This will, however, depend upon the alertness of the management in regard to the possibility of economies and up-to-date methods of working.

The price at which the Oldham, Ashton & Hyde Electric Tramways are to be purchased by the local authorities of Ashton, Hyde, Denton and Audenshaw has been fixed by the arbitrator at £142,000. The price asked by the company was £200,000. The tramways will then be run by the Corporations of Ashton and Hyde, Manchester (through Denton and Audenshaw), and the Stalybridge, Hyde, Mossley and Dukin-field Joint Board. Ultimately it is proposed to run a through service of cars from Manchester to Hyde, and join up to the Stockport tramways.

Sir Philip Dawson has added to his many activities by assuming the presidential chair of the Association des Ingénieurs Electriciens Sortis de l'Institut Electrotechnique Montefiore. In his Presidential Address he says how proud he was to have been able to contribute to the work of electrifying the railways of Belgium and expressed his sense of the honour done him by the award by the King of the Belgians of the Order of Leopold. Turning to more technical subjects, he dealt with the important question of the application of electric traction to main line railways, discussing the conditions under which this conversion is justified, as well as the causes which had brought about electrification in the past and which were likely to influence its employment in the future. Justification or otherwise of electrification in any particular case is to be found in the financial results which it produces. The employment of electric traction on main line railways is likely to have a large effect on the supply of electricity in the neighbourhood and particularly on its application in other branches of industry. This influence must, of course, vary according to particular cases, and in considering the question from this point of view Sir Philip discussed a number of typical cases. These included the case of a railway which traverses agricultural country such as is to be found for instance between Eastbourne, Brighton and Worthing, and where water power is not available. The second case is to be found in a non-industrial country where there is no coal available, but where a large amount of water power can be employed as in certain parts of Switzerland and Italy. The third division is to be found in a country where there are large coal or metal industries such as that served by the North-Eastern Railway, while the fourth class is that of a country with metallurgical resources and water power but no coal such as Sweden. It is evident that in the first case the demand for electrical energy caused by the railway will form the greatest portion of any demand for electricity in that area, and for that reason the requirements of the railway must receive first consideration. In the second case electric traction may have to be adopted for political reasons, while in the third the demand caused by electric traction is but a small proportion of the total amount of electrical energy required in the area. These factors must all have a bearing on the system chosen.

Catalogues, Price Lists, &c.

Messrs. Siemens Brothers & Company, Ltd., send us a folding card cut to the shape of a porous-pot type of Leclanché fluid cell, which is illustrated on the outside. A view of the Company's Woolwich works is given on the back. Particulars of agglomerate, sack, central zinc and other types of Leclanché cells appear in Catalogue No. 531.

In our issue of December 25, 1914, we gave details of the Western Electric Machine Switching Telephone System. A fully illustrated description of this system has now been issued by the Company in an artistic and well illustrated brochure so that there is no reason for those interested in the subject remaining in ignorance of the details of the working of this very interesting equipment.

Imperial and Foreign Notes.

The Department of Overseas Trade, 35, Old Queen-street, S.W., has been notified by the representative of an Indian house that his firm are buyers for their own account of electric lighting plants, motors (d.c. and a.c.), mining plants, pumps, electrical apparatus, fans, lifts, converters, switchgear, &c. Quotations should preferably be c.i.f. Calcutta and the date of delivery should also be specified. The name of the firm and of their London agents will be furnished by the Department to United Kingdom firms on application.

The Director-General of the Swedish State Railways, M. Granholm, is inspecting the United States and Canadian electric railways with a view to collecting data for use in connection with the electrification in the near future of the line between Stockholm and Gothenburg.

The Swedish General Shipping Association has petitioned the Minister for the Navy to make a request to the British authorities that Swedish shipowners who can show that their efforts to fulfil the requirements of the British Merchant Shipping (Wireless Telegraphy) Act have encountered insuperable difficulties shall be excused until the end of 1921 from complying with such requirements.

A proposal to transmit electrical energy a distance of 750 miles from the Belgian mining centres to Lombardy has been made by Prof. Guarini. He does not think the plan presents any insurmountable difficulties, and he points out that such a scheme has already been found to be workable in South Africa, where power generated at the Victoria Falls is transmitted the same distance with a loss of only 25 per cent.

The Department of Overseas Trade announces that the Purchasing Commission of the Republic of Latvia desire to purchase various articles, including telegraph and telephone spare parts, telegraph apparatus, material and spare parts for radio-telegraph stations, field telephones and indoor telephones, instruments, &c. Particulars from the Offices of the Commission, 4, Draper's Gardens, London, E.C.2.

The Committee on Legislation of the Argentine Senate recently considered a project for the institution of pensions to employees and workmen of private companies performing public utility services. There were also present (by invitation) the managers of the German Trans-atlantic Electric Company, United River Plate Telephone Company, Italo-Argentina Electric Company, Primitiva Gas Company, and the Cooperativa Telefónica, who expressed agreement with the principle involved and offered to co-operate with the Committee.

An important concession has been granted for the erection of Hydro-Electric Works on the River Moesi, near Benkoelen, Sumatra. Though the surveys are not yet completed, it is stated that 150,000 h.p. will be obtainable, at a cost of 100 to 133 guilders (about £8 6s. to £11 1s.) per horse-power. The cost of power per kilowatt-year is estimated to be about twelve guilders (about £1). It is also proposed to erect works for the production of nitrates from the air. Several firms of manufacturers in the United States are reported to be endeavouring to find capital to finance the scheme in the hope of thus securing contracts to supply the necessary plant.

Business Items, &c.

Chas. and Thos. Hy. Dales, electricians, &c., 113, Poole-road, Bournemouth, have dissolved partnership. Debts by Mr. Chas. Dales, who continues the business under his own name.

For the convenience of their customers the principal sales department of Pope's Electric Lamp Company, Ltd., will be established on and after the 4th inst., at 5, Arthur-street, London, W.C. 2, instead of at the works at Hythe-road, Willesden. Large stocks of "Elasta" lamps will be held at 5, Arthur-street, where Mr. E. A. Marx (sales manager) will be pleased to see all old and new friends at any time. Telephone: Gerrard 6,074 (2 lines); telegraphic address: "Duramentum,Westcent, London."

Claims against John Chas. Raine, Arthur Podmore and Chas. Hewitt (trading as Hewitt, Raine & Company), electrical engineers, 41, Lewis-grove, Lewisham, London, S.E., under a deed of assignment executed by them on July 8, are to be sent by Oct. 11 to Mr. W. J. J. Osborne, Balfour House, Finsbury-pavement, London, E.C.

Claims against Edward Wingfield Fuller Heath (trading as Heath, Wingfield & Company), 6, Hans-road, Brompton-road, London, S.W., under a deed of assignment executed by him on March 20, are to be sent by Oct. 11 to Mr. W. J. J. Osborne, Balfour House, Finsbury-pavement, London, E.C.

Bankruptcies and Liquidations.

Henry Turner, electrician, 31, St. Paul's-road, Southsea, has been adjudicated bankrupt.

A meeting to receive an account of the winding-up of the Electric and General Works Company (in vol. liq.) will be held on Oct. 6 at 54, Rue la Boetie, Paris.

Mr. A. H. Partridge, 3, Warwick-court, Gray's Inn, London, W.C.1, has been appointed trustee in the bankruptcy of Julian Jas. Symons (trading as the Zodiac Peerless Electric Lamp Company), 25, Denmark-street, Charing Cross-road, London, W.C.1.

At Halifax Bankruptcy Court last week Johnson Jagger, electrical engineer, was publicly examined. Liabilities were £1,307, and there was a deficiency of £733. Debtor attributed his failure to losses arising from defective work done by incompetent workmen, who also limited the output. Debtor, who was originally apprenticed to a firm of brass-founders, served three years in the Army, and had only seven months' practical experience in electrical engineering before he commenced business

Tenders Invited and Accepted.

Birmingham Corporation want tenders by Oct. 11 for four electric vehicles for removal of house refuse. Specification, &c., from Mr. J. Jackson, Council House, Birmingham.

Lincoln Corporation require tenders by 11 a.m. Oct. 8 for spray cooling plant. Specifications, &c., from Messrs. Preece, Cardew & Rider, 8, Queen Anne's-gate, Westminster, S.W.1.

Southampton Corporation require tenders by noon Oct. 8 for a 5,000 kw. three-phase, 50 ∿, 600-volt turbo-alternator, with condensing plant and accessories. Specifications, &c., from the Borough Electrical Engineer.

Tenders are required for wiring Marlborough House Kindergarten School, Dewsbury. Particulars from the Secretary to the Governors of Wheelwright Grammar School for Girls, Technical School, Dewsbury, to whom tenders by Oct. 4.

The Mersey Railway Company require tenders by noon Oct. 8 for the supply of electrical sundries, metallic and carbon filament lamps and fittings, ironmongery, &c. Forms of tender from the General Manager and Secretary, Central Station, Birkenhead.

Manchester Corporation want tenders by 10 a.m. Oct. 13 for steel-work and builder's work in foundations required in connection with the installation of two boilers at Stuart-street generating station. Specifications from Mr. F. E. Hughes, Town Hall, Manchester.

Bradford Corporation require tenders by 10 a.m. Oct. 28 for two natural-draught, chimney-type cooling towers, pipe-work, troughing, valves, &c. (Contract R. 160). Specifications, forms of tender, &c., from Mr. Thomas Roles, Electricity Offices, Town Hall, Bradford.

Sheffield Electric Supply Committee require tenders (by Oct. 12) for the supply of two 10,000 kw. steam turbines, condensing plant, pipe work, &c., alternators and exciters. Specifications from the general manager and engineer, Mr. S. E. Fedden, Commercial-street, Sheffield.

Sheffield Corporation want tenders by 10 a.m. Oct. 12 for two 10,000 kw. steam turbines, condensing plants, pipework, &c., and alternators and exciters for the Electric Supply Committee. Specifications, &c., from Mr. S. E. Fedden, Commercial-street, Sheffield.

The South African Railways & Harbours Department, Johannesburg, require tenders by Oct. 25 for metal filament lamps for train lighting. Specifications may be seen at the Department of Overseas Trade, 73, Basinghall-street, London, E.C.2.

London County Council require tenders by 4 p.m., Oct. 25, for the supply and maintenance of 125 bodies for electric tramcars, 125 maximum traction bogie trucks, and 125 electrical car equipments, with assembly of bodies, trucks, electrical equipments, &c., into complete tramcars. Specifications, &c., from the Clerk of the Council, Spring Gardens, S.W.1.

Manchester Electricity Committee invite tenders (by Oct. 8) for the supply of five 8,500 k.v.a. three-phase transformers and fans, &c., and also three 6,000 k.v.a. three-phase transformers and fans, &c. Specifications from the secretary (Mr. F. E. Hughes), Town Hall, and further particulars may be obtained from the chief engineer and manager (Mr. S. L. Pearce), Dickinson-street, Manchester.

The Electricity Committee of Manchester Corporation also invite tenders for the supply and erection at Barton station of three mechanical water screens and three grid screens, &c. Specifications from the Secretary of the Electricity Department (Mr. F. E. Hughes), and further particulars may be obtained from the chief engineer and manager (Mr. S. L. Pearce). Tenders, addressed to the Chairman of the Committee, by the 27th inst.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the Australian Commonwealth Postmaster-General's Department: telegraph and telephone instruments (schedules 546 and 549) (Oct. 20), and telephone instruments (schedule 548) (Nov. 3) for S. Australia; also New South Wales: Telegraph and telephone instruments and switchboard parts, schedule 753 (Nov. 25). South Australia: Telephone instruments, schedule 547 (Nov. 10). Queensland: Protectors, schedule 505 (Nov. 30); iron poles, schedule 506 (Nov. 24); and protected cable terminals and cable distributing boxes, schedule 507 (Nov. 24). Tender forms, &c., can be obtained at the office of the High Commissioner for Australia, Room 406, Australia House, Strand, London, W.C. 2.

Hammersmith (London) Borough Council are recommended by the Cartage, &c., Committee to authorise the payment of £600 to Messrs. Mossay & Company, representing an increase of £100 for each of the six electric vehicles now on order with them. This increase is on the price of the chassis, and a modification of the original quotation will also have to be made in regard to the bodies. The original tender was £1,556 per complete vehicle, subject to variation due to increased cost of wages, materials, &c.

Sydney (N.S.W.) Municipal Council have accepted the following tenders: Australian General Electric Company motors, £10,548, and rubber-insulated cable, £5,397; Lawrence & Hanson Electrical Company, Ltd., weatherproof cables, £2,735; Siemens Bros. & Company, submarine cables, £898; Australian General Electrical Company, 10,000 415-volt transformers, £20,995; Metropolitan-Vickers Electrical Company, six 50 k.v.a. 10,000/415 volt three-phase transformers, £1,850.

Miscellaneous.

During the progress of the International Commercial Motor Exhibition at Olympia, London, referred to in our last issue, an Imperial Motor Transport Conference will be held, from Oct. 18 to Oct. 21 inclusive.

Mr. Ernest J. P. Benn is opening the autumn session of the London Central Y.M.C.A. with a lecture on Economic Liberty, to be held at the Y.M.C.A. Hall in Tottenham Court-road, on Tuesday next, October 5, at 7.30 p.m. Sir Hugh Bell, Bart., will take the chair.

At the Northampton Polytechnic Institute, 280, St. John-street London, E.C. 1, evening technical courses in mechanical and electrical engineering will commence on Sept. 27. Full time sessional day courses in engineering and in technical optics will commence on Oct. 4.

The Air Ministry announce that an Air Conference, at which several interesting Papers will be read, is to take place in the Guildhall, London, E.C., on Oct. 12, 13 and 14. The primary object is to bring all sections of the community into contact with the practical aircraft work being done to-day.

An unfortunate tramcar accident took place at Lancaster on Monday, resulting in the death of a man. A workmen's car which left Bowerham got out of control when travelling down hill. The brakes failed to act, the rails being greasy through rain and sodden leaves. The car jumped the points and dashed into the front gardens of Springbank, knocking down a man named Stackhouse, who succumbed to his injuries.

According to the "Journal" of the American Institute of Electrical Engineers great difficulty is being experienced in the United States in obtaining paper for electrical purposes, and several experts of the Eestern Electric Company are, therefore, devoting all their efforts to developing some type of substitute. Owing to the shortage of manilla pulp paper wood pulp has recently been used, though it lacks several of the finer qualities of the former grades.

A Housing and Health Exhibition promoted by the Glasgow Corporation was opened on the 15th of last month. The exhibition is housed in the Kelvin Hall of Industries, Kelvingrove, and will remain open until October 9. There are several very attractive stands displaying electric vacuum cleaners, washing machines, fires, irons and other domestic labour saving appliances. Electric cooking appliances are also shown, as well as fixtures and shades for lighting. The exhibition is the largest of its kind held in Glasgow, and we understand that stall holders report good business from the large crowds of visitors.

In these days of civilisation to stigmatise any town as dirty is to insult it in its most tender spot. Mr. A. Richard Martin fell into this error in the June issue of "Smoke," when he included Cardiff among places "too foul to be lightly handled in the pages of a popular magazine." Mr. W. D. Smith, the development agent of Cardiff, in calling our attention to this, points out that the popular opinion that association with coal implies dirt is incorrect so far as Cardiff is concerned. The town has no smoke nuisances, the streets are electrically lighted and the whole district is well served with electric power. This being so we can well imagine that to call Cardiff dirty is to be terminologically inexact, and we were confirmed in this idea by a recent visit to the city.

The adjourned inquiry into the death of Edward A. Thornley, electrician, of Shelton, was held last week. At the previous hearing, evidence was given that on September 10 Thornley was in the act of turning off a switch, when it exploded. He was struck on the head by pieces of the switch, which resulted in his death. Mr. J. A. B. Horsley, H. M. electrical inspector of mines, stated that he had visited the colliery and examined the ruins of the switch. He found no defect of insulation in the cable, but he noticed some oil on the bottom of the switch-case. He removed the oil box of the switch, but found no sign of defect in the switch. On the isolator there was some indication of burning. He thought the explosion must have been very violent, but he could only surmise its cause. The small spark at the insulator contact might have been sufficient to ignite an explosive mixture of gas and air in the bottom of the switch box, but although the principle adopted at the colliery had been in existence for nearly 30 years, he had never known a similar accident. He believed it was a case of pure misadventure. A verdict of death from a fracture of the base of the skull, caused by an explosion was returned, and Mr. Horsley said that he was discussing with the manager the question of preventing such accidents in future.

The members of the Electric Lodge (No. 2087) held high festival at the Mitre Hotel, Hampton Court, on the 25th ult., when the reigning master, Mr. John E. Hood, speaking on behalf of that Lodge and of the North Kent Lodge (No. 2499), the Telephone Lodge (No. 3301), and the Kelvin Lodge (No. 3736), presented Mr. Edwin James Reid (of Reid Bros., the well-known telegraph engineers) with the masonic clothing and regalia associated with the dignity of Asst. Grand Supt. of Works, to which rank he had recently been appointed by H.R.H. The Duke of Connaught, K.G., Grand Master of the Order. The actual ceremony, which took place in the Lodge, was honoured with the presence of Grand Officers A. Burnett Brown (Dep. Prov. Grand Master of Middx.), P. P. Kipping and F. A. B. Lord, as well as of the Masters of the North Kent Lodge, the Telephone Lodge (Mr. W. Aitken, Master Elect), the Kelvin Lodge (Mr. T. W. Greaves), and numerous other gentlemen holding London and provincial rank. Another item of interest to the electrical profession was the election of Master for the ensuing year, the choice falling on Mr. E. E. Sharp, of Tok Switch fame. After the masonic ceremonial the Master presided at a very enjoyable banquet when the new Grand Officer was toasted right heartily and a most enjoyable evening was spent.

We regret to record the death of Mr. Robert Stewart Bain, managing director of the London Electric Supply Corporation and one of the pioneers of the electric supply industry. Mr. Bain was found unconscious in his office in Cockspur-street on Monday, and died soon afterwards from cerebral apoplexy. Mr. Bain, who was born in 1859 and was trained as a chartered accountant in the offices of Messrs. Monkhouse, Goddard & Company, of Newcastle-on-Tyne, became connected with the electrical industry in 1888 when he was appointed chief accountant to the London Electric Supply Corporation. At this time the company's generating station was situated under the old Grosvenor Gallery. In connection with the transfer of the company's works to Deptford after the fire which burned down the Bond-street Station and the long inquiry by Major Marindin in 1889 in connection with the apportionment of the districts in London to the various companies he rendered signal service. In 1892 he became secretary as well as chief accountant of the company. Financial difficulties ensued and as the result of a report by Mr. Bain on its financial situation Lord Wantage entered into possession of the undertaking as sole debenture holder, Mr. Bain being appointed receiver and manager for carrying on the business. The financial position soon improved under his wise direction, and on the re-organisation of the company he was appointed managing director. It was mainly due to Mr. Bain's business capacity and to Lord Wantage's pluck, perseverance and financial support, that Mr. Ferranti's bold scheme for generating energy at the high pressure of 10,000 volts at Deptford proved to be successful. Mr. Bain's death is a great loss to the industry and particularly to the electric supply branch of it which is at present undergoing a much-needed process of re-organisation.

Institution Notes.

The Annual Dinner of the Institution of Civil Engineers, which was to have been held on Oct. 6th, has been postponed.

The second annual dinner and reunion of the R.N.D. Signal Company will take place at the Holborn Restaurant on Friday, Nov. 5th. Morning dress will be worn. Tickets (10s. 6d. each) may be obtained from the Hon. Secretary, A. G. Hilling, 1, Glaserton-road. N.16.

At a recent meeting of the board of directors of the American Institute of Electrical Engineers, it was resolved to accept the invitation to become a charter member of the Federated American Engineering Societies, and the Institute pledged its hearty co-operation in the work thereof.

The ninth annual dinner of the Finsbury Technical College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly Circus, on Saturday, Nov. 13, under the presidency of Mr. John E. Raworth. Old students may obtain tickets (15s. each, exclusive of wine), and particulars from the hon. secretary, Mr. H. P. Guy, 209, Northumberland-park, Tottenham, N. 17.

The forthcoming general discussion on "The Physics and Chemistry of Colloids and their Bearing on Industrial Questions," which is being arranged jointly by the Faraday Society and the Physical Society of London, has been fixed to take place on Monday, the 25th inst., at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. The discussion will be presided over by Prof. Sir W. H. Bragg, K.B.E., F.R.S., and it will be introduced by Prof. Dr. Th. Svedberg, of the University of Upsala, who will give a general survey of the subject before discussion is opened in its various branches. Non-members of the above Societies may obtain tickets of admission from Mr. F. S. Spiers, 10, Essex-street, London, W.C.2.

In connection with the annual meeting of the Verband Deutscher Elektrotechniker, which was held at Hanover last week, a long programme for what was termed an "electrical week" was carried through. On the 22nd ult. the Deutsche Beleuchtungs-technische Gesellschaft met and on the 23rd ult. the first meeting of the Verband was held. Various alterations in its constitution were proposed and the subscription was increased. Organisations representing the electrical manufacturer, merchants, contractors, electricity companies, and other branches of the electrical industry also met and discussed the present conditions, which were stated to be very unsatisfactory on account of rising prices and shortage of raw materials. Papers were also read on water power development, on the utilisation of peat and on wireless telegraphy (two), the latter being by Graf Arco and Prof. Dr. Wagner.

The British Engineering Standards Association has issued two new standard specifications—viz., No. 94, for watertight glands for electric cables; and No. 97, for watertight fittings for incandescent electric lamps. Watertight glands for the following purposes are standardised: (*a*) Decks, (*b*) bulk heads, (*c*) cast metal boxes, and (*d*) sheet metal boxes. With the exception of the largest size, British Standard conduit threads are employed. The glands standardised are of simple form, six sizes in each case being provided.

Two types of watertight fittings—one of the bulkhead or oyster type and the other convertible either into a short or long pendant, or into a bracket—have been standardised. Two sizes of each type are included—one for metal filament vacuum lamps up to 30 watts, and carbon filament lamps up to 60 watts, at pressures up to 125 volts, and the other for metal filament vacuum lamps up to 60 watts, and carbon filament lamps up to 120 watts at pressures up to 250 volts. It is considered that these four fittings will cover the whole range of requirements for this class of work, and will be equally suitable for use on shore and on shipboard. Whilst the standard specification only fixes the dimensions necessary to secure interchangeability of the parts likely to be broken or injured, these dimensions, the Association points out, in effect practically settle the design of the fitting. Copies of the specifications can be obtained from the Association, 28, Victoria-street, S.W.1. Price 1s. 2d. each post free.

Companies' Reports, &c.

The directors of Ward & Goldstone, Ltd., have declared a dividend of 11 per cent.

The directors of Browett, Lindley & Company, Ltd., announce interim dividends of 4 per cent. on the ordinary shares, 3 per cent. on the preference shares and 3 per cent. (actual) on account of arrears.

The report of the Lima Light Power and Tramways Company for 1919 states that the profits were £P263,252, less bond service £P52,130, bond amortisation £P48,314, European expenses £P1,643, interest and discounts £P3,245, provision for bad and doubtful debts £P3,000, leaving a net profit of £P154,918, to which must be added balance brought forward (£P95,063), making available £P249,982. After placing to dividends £P107,990 and making certain appropriations for bad debts, &c., there remains £P95,091 to carry forward.

The report of the Cordoba Light, Power & Traction Company, Ltd., for the year ended March 31, states that the receipts from the electric lighting and power supply business were greater than in any previous year, and although the strike in November last affected the revenue from the electric tramways, this also showed an increase. The profit after meeting all charges was £31,226, to which was added £28,790 brought forward. The £500,000 promissory notes of the company mature on Dec. 1, 1920, and, subject to satisfactory terms for their renewal being arranged, the directors hope to be able to make an interim payment on account of the arrears of dividend on the 6 per cent. cumulative preference shares at an early date.

The report of the directors of the Direct West India Cable Company, Ltd., for the year ended June 30, 1920, states that the net result of the year's working is a credit balance of £17,748 6s. 10d., compared with £14,073 14s. 10d. for the previous year. The balance to credit of revenue account brought forward from last year is £94,145 2s. 6d., and with the above £17,748 6s. 10d. makes a total of £111,893 9s. 4d. Deducting £1,856 1s. 10d. expended on repairs, £15,000 special interim dividend of £1 5s. per share capitalised in September, 1919 (making the shares fully paid) and £1,800 interim dividend of 3 per cent. (tax free) paid in March last, there remains £93,237 7s. 6d. The directors propose to distribute a further dividend of 3 per cent. (tax free), making the total distribution for the year £1 11s. per share. This will leave £91,437 7s. 6d. to be carried forward, subject to Excess Profits Duty. The company's cable was interrupted for a few days near Jamaica, otherwise the cables have worked efficiently during the year. The insulation of the Bermuda-Turks Island section remains very low.

New Companies.

DIRECT ELECTRIC SERVICES (BURY), LTD. (170,264).—Private company. Reg. Sept. 16, capital £3,500 in £1 shares, to carry on the business of electrical and steam engineers and contractors, suppliers of electricity, &c. First directors are A. W. Sweetinburgh, F. D. Law, J. C. Carruthers. Reg. office, Back Fleet-street, Bury.

MULLARD RADIO VALVE COMPANY, LTD. (170 293).—Private company. Reg. Sept. 17, capital £30,000 in £1 shares (10,000 8 per cent. cumulative participating preference), to acquire and turn to account the benefit of inventions connected with radio-telegraphy and telephony and other methods of inter-communication, and apparatus, instruments, valves and appliances connected therewith, &c., and to adopt an agreement with B. H. Binder (liquidator of the "Z" Electric Lamp Company, Ltd.) and S. R. Mullard. So long as the Radio Communication Company, Ltd., Kilburn, Brown & Company, C. F. Elwell, S. R. Mullard and E. H. M. Denny hold 2,500 shares each, they may be represented on the board by one director. First directors are Sir Ralph P. Ashton, chairman (representative of Kilburn Brown & Company), B. Binyon (Radio Communication Company), C. F. Elwell and S. R. Mullard. Reg. offices, Orient House, New Broad-street, E.C.

PRESTEIGN ELECTRIC COMPANY, LTD. (170,355).—Reg. September 21. Capital £5,000 in £1 shares, to carry on the business of an electric light and supply company, &c. First directors are: Rev. H. L. Kewley, H. J. Sparey and A. M. Wilson. Solicitor and Sec.: F. L. Green, Presteign.

Arrangements for the Week.

Friday, October 1st (to-day).

Junior Institution of Engineers.

8 p.m. At 39, Victoria-street, London, S.W.1. Paper on "Notes on Factory Management," by Mr. H. Neville Munro.

Electro-Harmonic Society.

8 p.m. At the Great Hall, Cannon-street Hotel, London, E.C. First Smoking Concert of the season.

The Editorial, Advertisement and Publishing Offices of "The Electrician" *are at 8, Bouverie Street, London, E.C.4. Telegrams: Benbrotric, Fleet, London. Telephone: City 9853 (4 lines).*

The subscription to "The Electrician" *is £2. 12. 0. per annum in the United Kingdom, and £2. 14. 0. per annum Abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.*

Forty Years Ago.

(The Electrician, October 2, 1880.)

Overhead Wires.—An American contemporary thinks that while overhead wires are dangerous in one way, they may in another way act as preservatives against lightning.

Telephony.—A Manchester correspondent states that rumours are current that the Government is seriously considering the advisability of purchasing the rights of the various telephone companies.

Carbons.—Mr. Crompton, in his pamphlet on "The Electric Light for Industrial Uses," says: "The choice of these is almost the most important point of all, both for the perfect working of the machines as well as the lamps. It is quite possible for a machine and lamp to be seriously damaged by a bad carbon. Such a one having a point of great resistance in it far away from the arc, gradually heats up at that place and wastes away at a low red heat until eventually it breaks across and falls down, possibly short-circuiting the lamp, and if the machine is one giving a low-tension current this occurrence is certain to cause heating up of the bobbin coils. Beyond this serious defect, which is almost impossible to discover by examining the carbons before they are put into the lamps, the carbons now in the market have, more or less, the following faults, those being the best that are freest from any or all of them. These are: First, high resistance of the carbon itself independently of the arc; second, being of soft texture, so that they are rapidly consumed; third, throwing down an ash as they are burned; fourth, giving coloured lights even when the arc is short; fifth, noisiness, hissing and spluttering; sixth, forming an irregular or badly-shaped crater even when arc is well regulated; seventh, giving abnormally long arcs for the current passing, such being caused by the evolution from the carbons of gases of high-conducting power—such carbons make the arc into a kind of gas jet, and are impossible to regulate or to deal with in any way, eighth, want of straightness and regularity."

Benn Brothers Journals.

Some Features of the Current Issues.

Aeronautics: "R.A.F. Civil and Military"; and "Screw Propellers," by M. A. S. Riach, F.A.S.

"The Cabinet Maker": "Pre-War Prices of Furniture"; "Modern Cane Furnishing"; and "Association Work in Cane and Willow Trade."

"The Chemical Age": "Review of American Chemical Industry," by Dr. Hugh S. Taylor; and "Artificial Leather and Coated Fabrics: Recent Progress in Manufacture and Processes."

"Farm & Home": "What the Visitor sees in Lincoln (with plan of trial area); "The Root Crop"; and "Findon's Great Sheep Fair."

"The Fruit-Grower": Horticultural Trades Association Conference; "Agricultural Trade Unionism"; "North American Competition for British Market."

"The Gas World": A Special By-Product Coking Section; "The World's Trade in Thoria and Gas Mantles"; All gas news of the week.

"Gardening Illustrated": "Watering Fruit Trees under Glass"; "The Mixed Border"; and "Ferns in Windows."

"Hardware Trade Journal": "The Ironmonger's Storeroom"; "Safety First and Machine Tools"; and "Hardware and Machining for South Africa."

"Ways and Means": "The Pathology of Industrial Unrest," by D. A. Bremner; "Anglo-Spanish Trade," by H. Charles Woods; and "The Psychologist in Industry," by William Brown.

Prices of Metals, Chemicals, &c.

Tuesday, Sept. 28.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£107 0 0	—	£1 0 0
Electro Wirebars...	,,	£117 0 0	—	£1 0 0
H.C. wire basis......	per lb.	1s. $4\frac{1}{16}$d.	—	⅛d.
Sheet	,,	1s. 6d.	—	—
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. $9\frac{7}{16}$d.	—	⅛d.
Brass 60/40—				
Rod, basis	,,	0s. 10¾d.	—	—
Sheet, basis	,,	1s. 4¾d.	—	—
Wire, basis	,,	1s. 4⅓d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£37 0 0	—	£0 10 0
Foreign or Colonial	,,	34 17 6	—	£0 12 6
Tin—Ingot	,,	271 5 0	—	£4 5 0
Wire, basis	per lb.	0 3 6¼	—	¼d.

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 4½d.

Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 7½d.; plantation 1st. latex, 1s. 8¼d. to 1s. 8¾d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

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Notes.

Finance and Trade.

THOSE who prophesied that the increase of the Excess Profits Duty from 40 to 60 per cent. in the spring of this year would mean an almost overwhelming burden on the trade of this country and that stagnation and unemployment would be the inevitable result have not had long to wait for their prognostications to be fulfilled. Indeed, so generally is it recognised that the present condition of trade is in no large measure due to the crippling effect of this impost that there is a rumour that it is to be removed. This is, we fear, too optimistic to be true. But the Treasury are undoubtedly beginning to realise that the duty will not produce the sum expected from it, and that they will be faced not only with a dwindling revenue, but with the necessity of refunding sums that have been overpaid. Things being so, we are glad to learn that various important commercial bodies are already considering the general question of taxation, in order that their views may be laid before the CHANCELLOR OF THE EXCHEQUER in good time for next year's Budget. With a demand for the removal of this tax must go an equally definite call for economy both national and municipal. These are two ways in which the Government can help the industry of the country.

The Duty of Labour.

THE conditions imposed by excessive taxation, labour unrest and low production are having their inevitable reflection in increasing unemployment. Nevertheless this state of affairs has its bright side. For it is colouring the policy and actions of the saner Labour leaders with the ideas that constant wages demands and the unsettlement that they bring are not likely to lead either to industrial peace or to a real improvement in the workers' lot. "Peace," said Mr. J. H. THOMAS, the other day, "would not be obtained by Labour making demands that rendered it impossible to produce a commodity at a saleable price." There is more honest thought in that statement than in many of the creeds and theories which are now so stridently advanced as the only cure for industrial ills. Work for work's sake is unattractive enough but work with an interest and with an aim in view is worth doing. All this excitement about football, horse racing and agitation is only a hectic symptom of mental fever which can best be assuaged by persuading the worker that it is in his employment that he can find the most satisfying outlet for his energies.

New Zealand Industrial Legislation.

IT is some consolation, even though it be negative, that industrial strife is not confined to this country. Indeed, it seems almost universal at present; and nowhere is it more acute and recurrent than in New Zealand. The history of industrial legislation in that colony is interesting. When the existing Industrial Law was passed about 20 years ago an arbitration court was set up to deal with labour disputes. This court was empowered to fix standards of wages, working hours and conditions, and the result was industrial peace for 15 years. Subsequently, however, the question of the employment of non-union men was raised, and in the discussions that took place it was apparent that a powerful Trade Union could defy the law. The most militant unions being those formed by the unskilled workers in the transport industry, the employers were able to pass on to the public any increased wages, and therefore made some great concessions to the men to avoid trade dislocation. While, for instance, the Industrial Court granted a half-penny an hour to skilled workers the dockers secured two-pence or three-pence at "friendly conferences" with their employers. The efforts since made to re-establish the authority of the Arbitration Court caused some of the Unions to refuse to acknowledge its jurisdiction. The increased cost of living due to the war has intensified the difficulty, for the Court ruled equitably that part of the increase should be borne by Labour. The militant unions, however, secured the full increase by direct negotiation and the position therefore became more and more unsatisfactory. Last year the Government empowered the Court by statute to take into consideration the advancing cost of living in making its awards and also to review the decisions arrived at before the awards had expired. By this means the weaker unions have been temporarily retained within the jurisdiction of the Court, while some of the stronger ones have so far defied it that they strike when they please. A legal remedy for this unfortunate state of affairs is now being sought, but it is clear that the trouble is due to a lack of consistent policy on the part of the Government, and it therefore carries an important lesson for us.

Labour Troubles in Italy.

A GOOD deal that is instructive to British employers and employed may also be derived from a consideration of the recent labour disturbances in Northern Italy. A demand for a 50 per cent. increase in wages for metallurgical and engineering workers was refused and a lock-out was threatened. As a result the workers took possession of the factories which they attempted to run for their own benefit. It should be noted that they realised from the very beginning that this policy could not be carried through without the assistance of the technical staff who were, therefore, impressed into the employment of the new *regime*. Equally sound arrangements were not made for the supply of raw materials and on the commercial side, so that in spite of the good conduct of the workers and the strict discipline that was imposed, the experiment failed as the output gradually ceased. It may be added that had it not failed in this way it would have failed in another, as no wages were forthcoming on pay-day. This little trial trip in management has, we hope, taught the workers that there is more in their employers' duties than they have hitherto believed. At the same time it has taught the employers that the demands of the men are not solely made in a revolutionary spirit, but with the desire to improve what in Italy is a harder lot than in many other countries. We are glad to see that the outcome of this interesting experiment is to be the formation by law of a joint body of employers and employed on the lines of the Whitley Councils, wherein both sides can meet in amicable discussion, though unfortunately the preliminary meetings held with a view to forming these bodies were not carried on without the occurrence of misunderstandings. This is a pity considering the essential soundness of the idea.

Provincial Electric Supply Committee.

THE work accomplished by the Provincial Electric Supply Committee shows the utility of an organisation for protecting the interests of electricity supply companies. The war had a deleterious effect upon some of the smaller privately owned electricity undertakings, and it was felt that only by combined effort could anything be done towards obtaining modifications of the legislative proposals or departmental regulations. So satisfied were the members with the result of the activities of the Committee that it was re-elected *en bloc*. Naturally, the Electricity (Supply) Act and the organisation of the National Joint Industrial Council occupied a good deal of the time and attention of the Executive; and it is satisfactory to learn that the Joint Council is now in full working order and that it promises to fulfil the objects for which it was formed. We agree with the chairman, Sir HARRY RENWICK, that at present salvation lies in a "closer union and better understanding between masters and men and the entire elimination of the politician and Government interference."

Industrial Accidents and Safety First.

IN a Paper read by Mr. G. BELLHOUSE, Deputy Inspector of Factories, at the recent "Safety First" Conference, it was stated that there were 1,384 fatal industrial accidents last year, while there were 40,000 accidents due to machinery and 84,000 to other causes. These are startling figures, and as very many of the accidents, fatal as well as non-fatal, are due to inadvertence, carelessness, inattention to rules, or to lack of instruction it will be seen that there is great loss of life in this country, and an enormous waste of time and money, all due to causes which might be prevented. The British Safety First Industrial Association, which convened the Conference, is therefore carrying out a useful campaign of instruction and enlightenment in inquiring into the causes of accidents and their prevention. From a modest beginning it has developed into an efficient organisation, and as its work is of first class importance from the industrial and economic points of view, it deserves the whole-hearted sympathy and support of manufacturers as well as of the general public. Among other interesting contributions to the Conference were Dr. J. C. BRIDGE's Paper on "First Aids in the Factory and Workshop," "Safety First" at the B.T.-H. Company's works by Mr. GEO. RALPH and Mr. E. HOULT's Paper on the organisation of a Works Council in connection with "Safety First." Mr. LEON GASTER also put in a plea for general regulations under the Factory Acts to provide for the adequate lighting of factories.

Safety and Sense.

THE constant neglect of workers for their own safety, even when almost every precaution that the wit of the Home Office can devise has been taken, is well brought out in the Annual Report of H.M. Electrical Inspector of Factories, an account of which will be found on another page of this issue. In one case a more than usually enterprising specimen of the *genus* boy on being told to connect up a 200 volt portable drill climbed a ladder on to the switch gallery, got over a rail and entered a passage way of E.H.T. cells protected by screens 5 ft. high. He then proceeded to connect the lead to a 10,000 volt conductor. It is only right to add that he was not killed and that it was probably pre-ordained that he was not born to be electrocuted. Apart from incidents of this kind, which point very clearly to the necessity, not only for a "safety first" but a "sense first" council, Mr. RAM's report discloses a generally satisfactory state of things, though there are still examples of bad and dangerous work, notably in generating stations and sub-stations belonging to supply authorities. These generally consist in the unnecessary exposure of live parts or in such pieces of carelessness as the wrong connection of fuse boxes, so that the fuses were alive when they were meant to be dead. The need for the greatest care in these and other matters relating to electrical installations is emphasised by the expansion of the use of electricity in factories of all kinds. This will result in more and more unskilled labour coming into touch both figuratively and actually with electrical apparatus. It is therefore of great importance that every care should be taken to make it safe and to ensure as Mr. RAM truly remarks, that the desire for cheap installations is not met by eliminating safeguards.

A Scientific Index.

IT is over 20 years ago since the Royal Society suggested the compilation of an international catalogue of all works on scientific subjects published during the present century. Such a publication, whose preparation went on steadily until the outbreak of the war, is obviously not only one of great value but requires stupendous and meticulous labour. Its compilation would be arduous if the output of all publications ceased during its preparation, but the difficulties are considerably increased by the continuous appearance of fresh works. The very wise principle has therefore been adopted of arranging for each country to prepare its own list, such preparation being followed by a central scrutiny and classification. The war, however, put great difficulties in the way of continuing this work, it prevented co-operation and caused the loss of certain information, while the increased cost of printing and binding have also added to the difficulties of producing what is naturally a subsidised work. It is to be hoped, however, that the discussions which took place at Burlington House last week will enable a solution of all these difficulties to be found and allow these labours, which are of such great scientific importance, to be brought to a successful conclusion.

Absolute Co-efficients of Diffuse Illumination.

Although in illuminating engineering the influence of the reflection of lights from surfaces, walls, ceilings, &c., is so familiar it is surprising that comparatively little is known about the absolute co-efficients of diffuse reflection. The *relative* reflecting power of surfaces is easily ascertained, although even here results are apt to be upset by the fact that materials exhibit different degrees of polish, and hence the comparison works out differently at different angles, but the absolute reflecting power of diffusing surfaces is rarely determined, and the process of ascertaining their integral effect is not easy. The classical researches of Sumpner many years ago shed light on this subject, but they have not yet been much followed up by other observers. We notice in the "General Electric Review (U.S.A.)" a contribution by Mr. F. A. Benbow describing a method based on the use of the integrating sphere, sections of which are cut out and replaced by areas coated with the material to be examined. Assuming that such a sphere is available the method seems simple, as it does not involve knowledge of the actual candle-power of the source, nor of the constant of the instrument, but only that these two factors remain constant during the experiment. The procedure, however, appears to be accurate only for surfaces of high reflecting power—at least above 50 per cent. The author describes a test on magnesium carbonate for which he gives the apparently high value of 97·4 per cent. It appears that this figure derives some support from other tests, but it certainly comes as a surprise. It has hitherto been generally assumed that the diffuse reflecting power of the "whitest" materials obtainable does not exceed 90 per cent., and we believe that Sumpner's values for white blotting paper and similar materials were well below this figure. The matter is of considerable scientific interest and has so great a practical bearing that we should like to see confirmatory tests.

Education and Endowments.

It is not generally realised how much in the past education has relied upon private generosity for its sustenance. Until comparatively modern times little or no assistance for this purpose was provided from the taxes, and the expenses of most higher education and a good deal of that of the more elementary kind were met from fees and the pockets of enlightened donors. Many of these ancient endowments are still in existence, but owing to the depreciation of land values and to the large increase in the number of those attending the universities they are no longer adequate for the purpose, while the heavy exaction that is made by the State and local authorities for educational purposes has caused an inability to provide fresh endowments, so that education is becoming more and more machine made and less and less a matter for private interest. There are, however, pleasing exceptions to this rule; among the latest of which is the gift by Mr. T. D. Owen of the sum of £10,000 for the endowment of a chair of Electrical Engineering and Hydro-Electrics at the University College of North Wales. In saying that this sum is not enough for the purpose we have no wish to be ungenerous, but merely to inform other rich men in the engineering industry that here is an example worthy of being followed. Another thing! We hear a good deal about co-operation nowadays; the endowment of a "B.E.A.M.A." chair of electrical engineering at the University of London would be a fitting illustration of co-operation, not the less praiseworthy because not entirely altruistic.

Electricity and Smoke Abatement.

That there must be a loss both financially and hygienically in all our large cities owing to the soot and smoke suspended in the atmosphere permeating them is a fact sufficiently patent to any one who cares to think about it. Not only is the use of artificial light necessary at times when it would not otherwise be required, but expenditure in ensuring the preservation and cleanliness of buildings and other objects exposed to this atmosphere has also to be undertaken. This expenditure is considerable; and, in fact, as long as twenty years ago Mr. Rollo Russell estimated that the annual cost to Londoners for this reason alone was £5,000,000. A recent investigation undertaken in the University of Pittsburg on this subject shows that in Pittsburg the loss is nearly £2,000,000, or about £5 per annum per head of population. On the same basis the losses in London at the present time would be £22,610,000, in Glasgow £3,920,000, in Manchester £3,570,000 and in Sheffield £2,270,000. We believe, however, that Pittsburg is an exceptionally dirty town, and that therefore, with the exception of perhaps Sheffield, these figures are exaggerated. They are, however, sufficiently startling to make us wonder whether this is not an item of expenditure which could not be very much reduced or even removed altogether. We know that such a state of affairs could be very much improved, and should be very much improved, by the greater use of electrical apparatus. But there is another consideration besides money for, as Mr. S. L. Pearce pointed out in the evidence which he recently gave on behalf of the Institution of Electrical Engineers before the Departmental Committee on Smoke and Noxious Vapour Abatement, "it should be recognised that the health of the workers is becoming more than ever one of the chief national assets, and for that reason only the improved conditions resulting from the more general application of electricity to domestic requirements will possess immeasurable value."

Another Signalling System.

We wonder how many inventions intended to give the engine-driver audible or visual indication in the locomotive cab of the state of the semaphore signals have abode their hour or two and gone their way. We ourselves have attended several demonstrations of such equipment which, to us, appeared to operate satisfactorily, but which never seems to have got beyond the advanced experimental stage. This, in the face of the oft-repeated recommendations of the Board of Trade inspectors and of the desire of the public for safer travelling, seems rather curious. Are we to put it down to the conservatism of the railway authorities or to our inability to discover the "snag" which prevented its successful operation. We are inclined to think the latter supposition correct. For it is becoming more and more evident that the presence of the electrical press is not desired when new apparatus is being tested, either because they know too little or because they know too much. The latest example of this policy is to be found in the demonstration given of the Regan safety device at Fairlop on the Great Eastern Railway, in which, it being an electrical system, we could not be expected to be interested. We gather from the notices that have appeared that the apparatus is of the kind with which many such gatherings have made us familiar. We should not wonder if it suffers the same fate as its forbears.

Women in the Progress Department.

Among the questions which periodically agitate men's minds is that of the proper place of women in the world or of that particular portion of the world with which they are concerned. On the other hand, this is a question with which woman does not concern herself. She is generally quite certain of her own place in any part of the world—and of man's too. And she has an uncanny way of being right more often than not. Mr. W. J. Hiscox in treating of the place of the woman in the progress department is therefore dealing with a dangerous subject, and in deciding that the proper place for the woman in the progress department is somewhere near the bottom is reaching a conclusion which, while pleasantly definite, may also be entirely wrong. We will not follow Mr. Hiscox through his arguments. These are above suspicion, but we would point out that in employing a form of extrapolation in his consideration of this question he is leaving firm ground. Woman has done some extraordinary things in the past, and she will do some extraordinary things in the future. She has already started a large factory in the Midlands where female labour is to be employed throughout, so she may even one day manage a progress department.

The Electrification of Railways.

The interim report of the Electrification of Railways Advisory Committee, appointed by the Minister of Transport in the early part of the present year, possesses the negative virtue of going straight to the point, even though it is encrusted with a good deal of that verbiage which is so dear to the official mind. The point to which it takes us is, however, not very far along the road to that real standardisation of systems which it was appointed to consider In effect the Committee recommend that the future standard system of working the electric railways of this country shall be direct current at 1,500 volts, but the existing 600 and 1,200-volt railways may continue in use, their extension being subject to the approval of the Ministry. In addition, the use of 750 volts or of some multiple of 1,500 volts may be approved; while the London, Brighton & South Coast Railway is to be permitted to continue using the single-phase system, at any rate on its suburban lines. Both overhead and rail collection are to be permitted as long as their designs comply with the recommendations which are to accompany a second report, and with this second report are also to be submitted designs for rolling stock capable of operating at either 750 or 1,500 volts, and on either the overhead or rail collection systems. Three-phase generation is recommended, the frequency employed being that approved by the Electricity Commissioners for use in the particular district; and no loss of efficiency is anticipated by using frequencies as high as 50 for traction purposes.

An Interesting Decision.

Considering the experience which has been obtained with direct-current railways in this country and the constitution of the Committee, the decision to adopt this system is not surprising. On the other hand, in deciding to adopt a standard pressure of 1,500 volts most of the members of the Committee must have relied more upon evidence than upon experience, though for all that we think their conclusion is the correct one in view of the development of electric traction which is likely to take place in the future. Indeed, the centralised policy which such a recommendation inaugurates, might have been pushed much further. For, as regards a real standardisation of systems, the report leaves us very much where we were. It deals with standardisation in future, but not in the present, and the policy which it recommends will not bring about that end which it considers so desirable.

Opinions as to whether this lack of definiteness will be harmful to the future of electrification on railways in this country or the reverse, will depend on the individual view that may be held on through running and interchangeability of rolling stock. The Committee evidently think that such through running and interchangeability are desirable, for they admit that their decision to leave the Brighton line as it is will be an obstacle in the way of these consummations. On the other hand, as we mention above, they recommend the adoption of voltage little used in this country as standard, and do not press that existing direct-current railways should be altered to comply with it. Such a policy is likely to be of little assistance to standardisation.

Lukewarm Advocacy.

We are therefore led to the conclusion that their advocacy of the interchangeability of systems and of the need for through running is a little lukewarm; and it is not really surprising that this should be the case. In a popular phrase, "certain facts emerge" from our lengthy experience of railway operation. They include the necessity for standard running and loading gauges, the provision of adequate through running facilities, certain conventions with regard to signalling and other operating traffic and administrative regulations.

The only one of these that need be considered here is the provision of through running facilities. It is obviously necessary that if these are to be given both passenger and goods stock must be capable of running through, but it is important to notice that even with steam operation, where no such difficulties as those which were considered arise, there is very little through running of locomotives. As far as main line passenger and goods traffic are concerned, the adoption of different systems of electrification on different lines will not, therefore, introduce any more complications into the working of through traffic than exist at present, nor if a standard system of electrification be adopted will these conditions be much simplified. For one thing, labour conditions prevent one locomotive proceeding more than a certain distance, as a change of crews does not seem to be an acceptable policy.

Suburban Traffic.

There remains the question of through running of suburban traffic. This takes place to a limited extent at present, but with the use of multiple unit stock it is obvious that it can only be extended where the railways concerned use the same system. Where the systems are not the same it is equally obvious that through running is impossible. Nevertheless, this imposes no great disability on the travelling public, as suburban traffic mainly radiates in different directions from the centre and *vice versa*; and there is very little movement either circumferentually or tangentially. Such traffic of the latter class as there is could, it is true, be dealt with by through trains with standardised electrical equipment, but except for race, football and other favoured traffic it would hardly be economically sound to do so. In our opinion the advantages to be derived from standardisation from the traffic point of view are rather hypothetical than actual, and in thus arguing we arrive at the same conclusions as the Committee, though by a different road.

Extensions and Standardisation.

The need, and indeed the possibility, for standardisation recedes still further into the background when we consider the extension of existing lines. Extension on any other system than that used at present is obviously impossible, and the Committee's recommendations can therefore apply only to new lines or to those where for some reason or other it is found desirable to change from low to high-tension working. Having in view the financial situation and the economical unsoundness of carrying out large schemes of alteration, the Committee have come to the only possible conclusions, but once again they have hardly advanced the cause of standardisation. More may, however, be expected from their subsequent report when questions of design will be considered. Here a good deal of useful work can be done with benefit to manufacturers, engineers, railway companies, and the general public. We may conclude with the cynical reflection, that though the Committee consider it desirable that their decisions on certain general points should be made public as soon as possible, and that therefore they prepared this interim report, the same view was apparently not held by the Minister of Transport, as the report is dated July 12, 1920, and was only issued last week. We expect this sort of thing from some of the older Government departments, but we understood that the Ministry of Transport was much more businesslike.

Pessimism in Trade.

The series of reports which have recently emanated from the British Trade Commissioners are nearly all framed in an unjustifiably severe and critical style. In fact, it seems to have become the fashion for these Government officials to blame British manufacturers and exporters for anything that may be amiss with our export trade or for any failure to recapture at once our pre-war position in the Colonial and foreign markets. This is not good policy, and in this particular matters are going from bad to worse. For while the reports on the Australian and New Zealand markets were full of fault-finding they were optimistic compared with that produced by Mr. W. G. Wickham on South African trade in 1919.

A Sweeping Indictment.

This gentleman sums up the situation in the following striking terms : " To all interested in British manufacture, whether as importers, agents or consumers, it has been a year of disappointment. Every forecast has been upset, every estimate of manufacturers as to the time required for re-equipping and reorganising works has been wrong. The South African market at the end of 1919, as at the beginning, was waiting for the British goods which did not arrive." He adds that British manufacturers are said to have raised prices to a level which South Africans were unable to pay and they have charged advances upon goods in stock ; they have failed to reorganise production and distribution ; they have thrown too great a financial burden upon agents, &c., with the result that " British trade with South Africa has gone down, and American trade has gone up."

This is all very disappointing, but the whole of the blame cannot be attributed to the manufacturers. The report is, already to a certain extent, ancient history, and it must in fairness be pointed out that during a portion of the period covered by it British factories were still organised for the production of munitions, and for the remainder of the year the troublesome process of reorganisation on a peace basis was going on. In addition, the difficulties with regard to transport, the shorter hours and higher wages of workmen, the heavy hand of Government control and many other things, which are apparently unknown to, or at least are unregarded by, Mr. Wickham, must be taken into account in apportioning the blame for the situation to which he calls attention. It cannot, therefore, be said that last year was a normal year, and that what happened therein is, therefore, any real criterion of what British industry can do.

Imports in 1919.

Turning to the question of South African trade in more detail, it appears that the value of the British goods imported into that country fell by 4½ millions, while that of American goods rose by nearly 5 millions above the highest aggregate previously recorded. The British percentage of 45·46 of the total goods imported compared with an average for the previous six years of nearly 56 per cent., while America's percentage reached 24·14 per cent. against 13·87 in 1918, and 9·52 in 1913. On the other hand, Japan appears to have lost ground. In the case of motor cars, the share of the United States was 79 per cent., and of Canada 20 per cent. It is disturbing to note, says Mr. Wickham, with reference to electrical goods, that orders for insulated cable, far from being confined to the United Kingdom, went to the United States to the extent of 22 per cent., and that Japan took a further 9 per cent., valued at £24,000. Even so, the United Kingdom retained hold of this trade more effectively than it did of other branches of the electrical trade. The total value of the imports of electrical goods (other than cables) from the United Kingdom for the year was £279,000, and from the United States £366,000. In regard to machinery and engineers' supplies, there was increasing competition from the United States in many lines, such as boilers, traction engines, &c., in which previously the United Kingdom had been without peer. The total value of the articles included in this group was £2,469,832, and of this America was responsible for £1,071,914. Though Japanese competition is not so widespread as American, it must, however, be taken seriously by British manufacturers, as Japanese goods do, and will, find a market at a price. The one bright point in the report is the fact that the trade with Canada was on an unprecedented scale, imports being double the value of those in any previous year, or slightly ahead of Japan. Imports from Australia were also of greater value than before, and would have been very much larger if freight space had been available.

A Change for the Better.

It is not long since both official and unofficial pronouncements of this kind used to institute invidious comparison between what this country was doing and the operations along the same lines which were being carried on in Germany. Such a course was easy, for it is never difficult to prove by statistics that this country is doing worse than a certain competitor in all branches of trade, and even than all competitors in one branch of trade. Now that that particular gambit is closed the official variation seems to be to decry in a general way everything that our traders are doing. If Mr. Wickham is typical of our Trade Commissioners, these officials seem singularly to have failed to realise what the object of their appointment is, viz., the assistance of British trade. He complains of " that national self-depreciation which is so peculiar to Britishers and so irritating as a handicap to those who try to push the sale of British products overseas." Yet it can hardly be said that he is free from that irritating habit, or that his action in this instance will do much to help British trade. Nevertheless, he deserves our thanks for drawing attention to a state of things which should obviously be altered without delay. What we should now like to know is how that alteration can best be brought about ; perhaps he can tell us.

It is only fair to add that the report contains a good deal of useful information about trade conditions in South Africa, animadverts judiciously on the necessity of quoting reasonable prices and prompt delivery, and on the need for improved methods of distribution and publicity.

The Design of Intervalve Transformers.

Application to Low-Frequency Aperiodic Magnifiers.

By J. K. CATTERSON-SMITH.

(*Concluded from p.* 390.)

Effect of Magnetising Current.

Unless the reactance of the primary winding is indefinitely large a magnetising current will flow and cause a change in the phase of the anode current. The circuit conditions are made simpler to follow if the windings shown in Fig. 11 are replaced by their equivalent circuit as in Fig. 12, where the alternating anode voltage V supplies

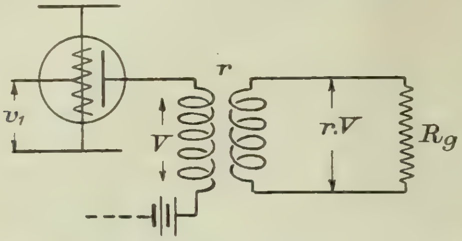

Fig. 11.—Primary and Secondary Circuits.

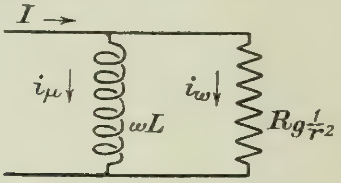

Fig. 12.—Equivalent Circuit.

(*a*) the load current component, i_w, in the equivalent resistance $R_g \, . \, \frac{1}{r^2}$ and

(*b*) the magnetising current component, i_μ, in the parallel path of reactance ωL.

The anode current is the resultant of i_w, which is in-phase with V and i_μ, which lags $\frac{1}{4}$ period to V, consequently

$$I = \sqrt{i_w^2 + i_\mu^2}$$

lagging by the angle φ, as shown in the vector diagram (B), Fig. 13.

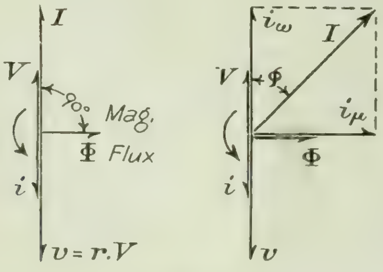

Fig. 13.

(A) Ideal. Transformer.

(B) Real. Transformer.

Ignoring copper losses and iron losses and voltage drop due to magnetic leakage, the following hold for the parallel circuits—

(*a*) $i_w \times \frac{R_g}{r^2} = V$ (anode alt. P.D.)

(*b*) $i_\mu \times \omega L = V$,, ,,

(*c*) $I \times Z = V$,, ,,

(*d*) $i_w \div I = \cos \varphi = \frac{Z \, . \, r^2}{R_g}$

(*e*) $Z = 1 \div \sqrt{\left(\frac{r^2}{R_g}\right)^2 + \left(\frac{1}{\omega L}\right)^2}.$

It is evident that the anode current attains crest value when the anode voltage has fallen to $V_{\text{max.}} \cos \varphi$ and the grid voltage to $v_{\text{max.}} \cos \psi$.

Equation (1) now takes the form

$$I_{\text{max.}} = k_1 \, . \, v_{\text{max.}} \cos \psi - k_2 \, . \, V_{\text{max.}} \cos \varphi, \quad . \quad . \quad (7)$$

where $V_{\text{max.}} = Z \, . \, I$

on multiplying through by "r" and re-arranging,

$$Y = r \, . \, \frac{k_1}{k_2} \left[\frac{Z \cos \psi}{\frac{1}{k_2} + Z \cos \varphi} \right]. \quad . \quad . \quad . \quad . \quad . \quad (8)$$

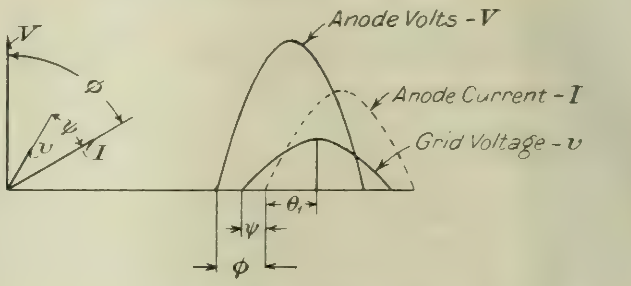

Fig. 14.—Grid Voltage Phase.

The phase relations are shown in Fig. 14, and are

$$I' = I_{\text{max.}} \, . \, \sin \theta,$$
$$V' = V_{\text{max.}} \, . \, \sin (\theta + \varphi),$$
$$v' = v_{\text{max.}} \, . \, \sin (\theta + \psi),$$

from which it follows that the grid voltage v' is at minimum value when

$$\theta = \tan^{-1}\left(\frac{1}{k_2 Z} + \cos \varphi\right) \div \sin \varphi,$$

and calling this value θ_1 gives $\psi = (90 - \theta_1)$.

Equation (8) may now be completed by substituting for $\cos \psi$, and $\cos \varphi$, which gives the step-up per stage

$$Y = \frac{k_1}{k_2} \, . \, \frac{r}{\sqrt{1 + \left(\frac{1}{k_2 Z}\right)^2 + \frac{2r^2}{k_2 R_g}}}. \quad . \quad . \quad . \quad . \quad (9)$$

Examination of this expression reveals the following :—

(i.) ωL must have a large value,

(ii.) the step-up is not a simple function of the ratio r,

(iii.) the ratio r has a rather critical value.

Making use of equation (9) the graphs of Fig. 15 have been

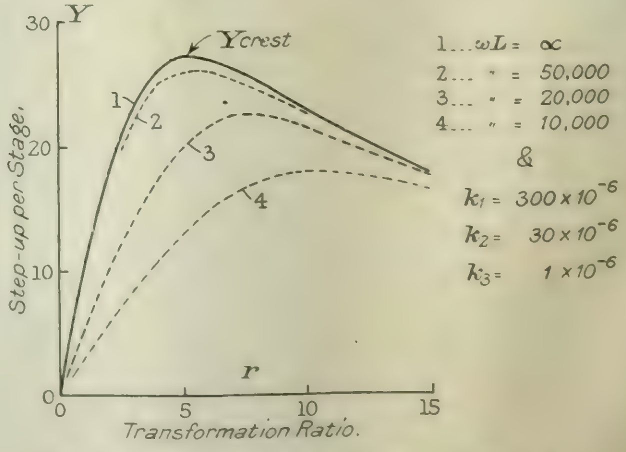

Fig. 15.—Influence of Reactance upon Step-up.

plotted to show the step-up per stage for valves having $k_1 = 300 \times 10^{-6}$, $k_2 = 30 \times 10^{-6}$ and $k_3 = 1 \times 10^{-6}$ ampere/volt.

These graphs are enveloped by that for infinite reactance ($\omega L = \infty$) in which circumstances $Z = \frac{R_a}{r^2} \cdot \cos\phi = 1{\cdot}0$ and $\cos\psi = 1{\cdot}0$.

The crest value of this curve occurs when

$$r = \sqrt{k_2 R_r} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

and then equation (9) becomes

$$Y_{\text{crest}} = \tfrac{1}{2} \cdot \frac{k_1}{k_2} \cdot r, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

which, of course, is identical with equation (6) obtained for the "Ideal" transformer.

This theoretical upper limit to the magnification is approached when the primary has a reasonably large inductance, and then equation (10) will be found very useful for estimating the probable magnification of a given piece of apparatus, without recourse to the more cumbersome expression (12) in the next section. These last two equations (10 and 11) show that any increase in k_2 is followed by a serious reduction in the magnification, other things being unaltered. This is not altogether obvious from the equations, but is quite clear when their graphs are plotted as in Fig. 15, where various values of k_2 have been taken for k_1 constant at 300 10^{-6} ampere/volt. The abscissa scale in R_g ohms shows the influence of k_3 and the radial broken line the transformation ratio r.

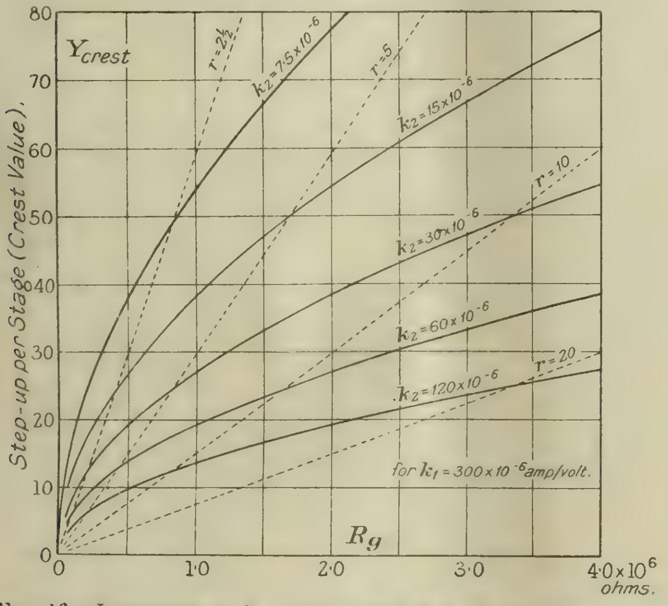

Fig. 16.—Influence of k_2 and k_3 upon Step-up per Stage and Transformation Ratio.

It is most instructive to compare Figs. 15 and 16.

Step-up for any Value of Reactance.

For any practical value of the reactance, which it is proposed to adopt in the primary winding of the transformer, the maximum step-up per stage may be obtained from equation (9) by putting $\frac{dY}{dr} = 0$ which shows the Y occurs when

$$r = \sqrt[4]{(k_2 R_g)^2 + \left(\frac{R_g}{\omega L}\right)^2} \quad . \quad . \quad . \quad . \quad . \quad (12)$$

Application to Transformer Design.

A suitable intervalve transformer is required for valves having k_1, k_2, and k_3 equal to 250, 25 and $0{\cdot}3 \times 10^{-6}$ respectively.

(*a*) Upper limit. Infinite reactance.

Equations (10) and (11) give $r = \sqrt{25 \times 3{\cdot}3} = 9{\cdot}1$

and then $Y_{\text{crest}} = \tfrac{1}{2} \times 9{\cdot}1 \times \frac{250}{25} = 45{\cdot}5$ per stage

(*b*) Trying a reactance of 50,000 ohms.

Equations (12) and (9) give $r = \sqrt[4]{7000 + 4450} = 10{\cdot}3$ and $Y_{\max.} = 42{\cdot}5$ which is 93 per cent. of Y_{crest}.

Thus a suitable transformer would be one having a total primary reactance of 50,000 ohms, and a transformation ratio of 1 to 10. The question as to whether this is a practical proposition depends upon whether trouble from capacity in the windings is likely to arise. Such capacity making the circuit liable to resonate at the frequency of the currents being magnified and causing the system either to operate as a tuned circuit or possibly to set up "howling" in the telephones. There are methods available for suppressing this troublesome defect when it arises; but space will not permit a discussion of these in the present article.

The Magnetic Circuit.

A little consideration of the conditions described indicates that resistance drop in the windings is objectionable; but even with No. 47 S.W.G. copper wire the drop from this cause is negligible as also is the magnetic leakage drop.

The requirement of a large reactance makes it advisable to adopt a closed iron magnetic circuit with a relatively high inductance per turn in order to minimise the capacity of the winding; thus a large section of iron should be used, and at the same time as short a mean magnetic path as possible.

The type of transformer core most nearly satisfying this is the ordinary "shell" core, either in the form shown in Fig. 17 composed of extra thin gauge transformer steel stampings, or in the form shown in Fig. 17, composed of steel wire completely enclosing the coils. The former has the advantage of simpler construction, but the latter gives a minimum external magnetic field.

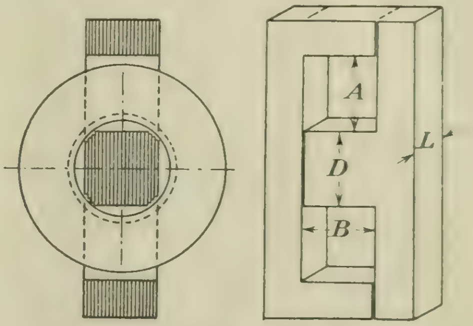

Fig. 17.—Laminated Core Shell Type.

Experience shows that for small gauge wires the coils should be of circular form, more especially if high-speed automatic winding machines are employed for their manufacture.

For these reasons the proportions of the cores should approximate to $A = B = D = L$. It is often better to make $A = 0{\cdot}5D$ and $B = 1\tfrac{1}{2}$ to $3D$ in order to increase the iron section and keep down the turns, and at the same time give a more convenient shape.

Calculation of Inductance and Dimensions.

The magnetising current taken by the primary winding is exceedingly small; *e.g.*, with ωL equal to $0{\cdot}05 \times 10^6$ ohms, the magnetising current is only 20 micro-amperes per volt. Hence in spite of the large number of turns needed the magnetising force (H) is so low that the effective permeability is only about 200 or 300.*

The inductance of the windings is obtained from

$$B = \mu \,.\, H$$

$$H = \frac{4\pi}{10} \cdot \frac{i_\mu \times \text{turns in winding}}{\text{length of iron path}}$$

$$\Phi = B \times \text{iron section}$$

$$L = \Phi \times \text{turns} \div i_\mu \,.\, 10^8$$

from which $L = \frac{4\pi}{10} \cdot \mu \cdot \frac{\text{iron section}}{\text{iron length}} \cdot (\text{turns})^2 \,.\, 10^{-8}$ henries (13)

where μ may be taken as approximately 250 for lap-jointed 0·25 mm. transformer steel.

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* See A. Campbell, "Proc." Physical Society, 1920. "On the Magnetic Properties of Silicon Iron in Alternating Magnetic Fields of Low Values."

That the flux density is extremely small will be seen from the following example :—

An iron core is wound for $\omega L = 0{\cdot}05 \times 10^6$ ohms at 800 cycles per second. The core has a cross section of 2·0 sq. cms. and a mean magnetic path of 10 cms. The inductance at 800 cycles is 10 henries, and the inductance per 1,000 turns is from equation (13), thus

$$L = \frac{4\pi}{10} \,.\, 250 \,.\, \frac{2}{10} \,.\, (1000)^2 \,.\, 10^{-8} = 0{\cdot}63 \text{ henry},$$

and the primary winding must have

$$1{,}000 \times \sqrt{\frac{10}{0{\cdot}63}} = 4{,}000 \text{ turns.}$$

The E.M.F. of the winding is given by

$$E = 4{\cdot}44 \times f \,.\, \Phi \,.\, \text{turns} \,.\, 10^{-8} \text{ volt},$$

from which $\Phi = 0{\cdot}0070$ line, and $B = 0{\cdot}0035$ line/square centimetre per millivolt across the primary winding.

At such low densities the iron losses do not appear to influence the design to any appreciable extent.

CORE DIMENSIONS.

The leading dimensions of the core, A, B, D and L may be decided upon by trial, or they may be calculated by the expressions :—*

Type Fig. 16.

$$A \,.\, B \,.\, D \,.\, L. = 0{\cdot}45 \times \frac{mV \times mA}{f \times f_i \times f_c \times \Delta \,.\, B_{\text{max.}}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

Type Fig. 16.

$$A \,.\, B \,.\, D^2 = 0{\cdot}57 \times \frac{mV \times mA}{f \times f_i \times f_c \times \Delta \,.\, B_{\text{max.}}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

where mV = alternating millivolts on primary,
mA = milli-amperes total primary current,
f = cycles per second,
f_i = iron space-factor ; 70 to 90 per cent.
f_c = copper space-factor ; 15 to 25 per cent.
Δ = primary winding current density in amperes/square millimeters 0·1 to 0·5.
$B_{\text{max.}}$ = flux density ; 1 to 10×10^{-3} lines per sq. cm.

CALCULATION OF AN INTERVALVE TRANSFORMER.

Specification A.—Type Fig. 18 for 5 micro-volt-ampere. Primary for 5 millivolts at 800 cycles to carry 1 milliampere steady anode current with a reactance of 50,000 ohms, *i.e.*, 10 henries inductance. Adopting a wire of larger size than 47 S.W.G., d.s.c. copper, and assuming space factors of 70 per cent. for the core, and 20 per cent. for the windings with densities at 0·5 ampere square millimetres, and 4·0 line/square centimetre equation (15) gives $A \,.\, B \,.\, D^2 = 12{\cdot}7$, and choosing $A = 0 \,.\, 5D$ and $B = 2\frac{1}{2}D$ or $1\frac{1}{4}D^4 = 12{\cdot}7$, then $D = 1{\cdot}8$, $A = 0{\cdot}9$ and $B = 4{\cdot}5$ cms.

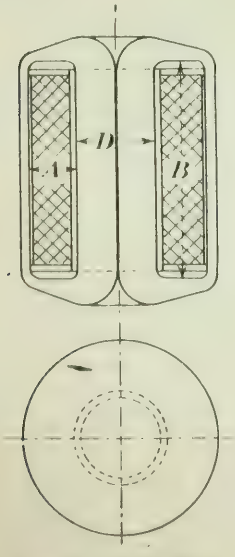

Fig. 18.—Wire Core Shell Type.

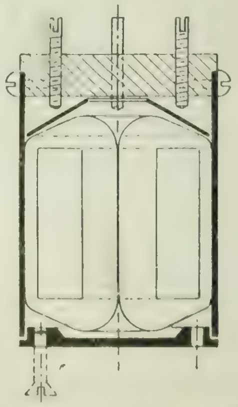

Fig. 19.—Outline, reduced to $\frac{2}{3}$ scale.

This allows an iron section of 1·8 sq. cms. with a mean magnetic path of 13 cms. If $\mu = 250$, equation (13) gives 0·43 henries per 1,000 turns, and therefore 10 henries will need

$$1{,}000 \sqrt{\frac{10}{0{\cdot}43}} = 4{,}700 \text{ turns.}$$

Specification B.—Type Fig. 17 for a three-stage valve magnifier. The primary to have an inductance of 10 henries, and the transformation ratio to be 1 to 5, using 47 S.W.S., d.s.c. copper wire. Assuming the proportions to be $A = 0{\cdot}67D$ and $B = 2{\cdot}0D$ or $A \,.\, B \,.\, D^2 = 1{\cdot}34D^4 = 6{\cdot}7$ from similar constants to those used for Specification A gives : $D = 1{\cdot}5$ cm., $A = 1{\cdot}0$ cm., and $B = 3{\cdot}0$ cms., allowing an iron section of 1·3 sq. cm. and 10 cms. mean length of iron.

For this core the inductance is 0·4 henry per 1,000 turns, and consequently the primary must be wound with 5,000 turns, and the secondary with 25,000 turns.

An outline of this transformer is shown in Fig. 19 where the coil and core is seen to be fitted inside a $1\frac{1}{2}$ in. copper barrel container as a screen. An ebonite top is shown with four terminal stalks for soldered connections ; for laboratory purposes terminals are more convenient. An earthing terminal connected to the iron core, and to the case is desirable.

AUTO-TRANSFORMERS.

When the ratio r is less than 3 or 4, it may prove advantageous to adopt an auto-transformer in place of the two-winding transformers previously described. The product $A \,.\, B \,.\, D \,.\, L$ in Fig. 16 or $A \,.\, B \,.\, D^2$ in Fig. 17 for an auto-transformer is reduced to $\left(1 - \frac{1}{r}\right)$, *i.e.*, to 50 per cent., when r is 2 or to 33 per cent. when r is 1·5, which means either a smaller transformer or a larger inductance for the given winding space.

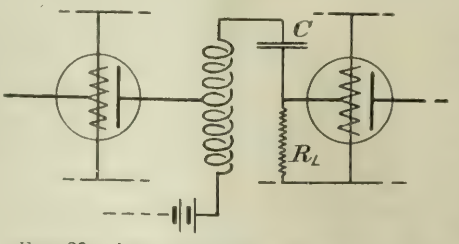

Fig. 20.—Intervalve Auto-Transformer.

The circuits for an intervalve auto-transformer are shown in Fig. 20, where C represents a blocking condenser, and R_L the grid-leak necessary to keep the grid-voltage at its correct mean value. From 0·01 to 0·05 micro-farad is generally suitable for the blocking condenser and the leak may be the usual 1 or 5 megohms. In carrying out calculations it is necessary to remember that with the grid-leak in circuit the value of R_g used is less than $1/k_{\cdot 3}$.

TELEPHONE TRANSFORMERS.

An arrangement similar to the above may be used for the final stage of a magnifier in some circumstances ; for instance if the magnifier operates telephones a step-down auto-trans-former with blocking condensers may be employed connected as shown in Fig. 21, where the last stage only is indicated.

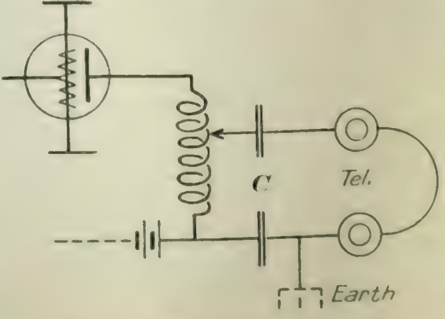

Fig. 21.—Step-Down Telephone Auto-Transformer.

If the impedance of the telephone is known, the design of the telephone transformer may be carried out by the method given for intervalve transformers ; this is, however, beyond the scope of the present article.

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* For derivation *see* "Simple Transformer Formulæ," The Electrician, Vol. lxx. p. 641 January 3rd, 1913.

Alternating-Current Track Circuiting.*

By L. H. PETER.

The apparatus forming a track circuit may be considered as comprising a transformer or other method of supply, a regulating device for adjusting the supply and a relay, in which much of the power required for operation may be supplied locally and only a small portion from the track circuit. These are known as "two-element" relays, as distinct from "single element" relays in which the whole of the power required to operate the relay is taken from the track circuit. The single-element relay has the disadvantage of heavy current consumption. It is still of great value for short track circuits, but the two-element relay has been almost universally used for medium and long track circuits.

It is also necessary to distinguish between these two-element relays designed to operate with the currents in the two elements in phase or 180 deg. out of phase with one another, and those designed to operate with the currents in the two elements in "quadrature." These relays are hereafter referred to as "in phase" and "quadrature" relays respectively.

The choice of relay, impedance bonds and method of feeding the track circuit require care. For the purpose of illustrating the good and bad combinations of relays and impedance bonds, the author presents in the original Paper a series of vector diagrams drawn with the "in phase" and "quadrature" operating values of the relays used, and the corrected values for the relays operating at the phase angles omitted. Two types of impedance bonds are also referred to: the ordinary form of bond consisting of an iron core and a two-coil winding, and the resonated impedance bond with an additional winding and condenser to increase impedance. "Distributed leak" methods are adopted in order to show the electrical state of each track circuit. Vector diagrams of tracks shunted at the transformer end of the track are drawn to show a unity power factor shunt. In the original Paper the author analyses several cases in order to justify this assumption.

Tests published by Mr. H. McCready in the United States give impedance values of 0·0011 and 0·004 respectively. With a contact resistance of 0·2 ohm and a shunt current of 3 amperes, a power-factor practically unity would result. Diagrams are constructed to show a thermal resistance between transformer, secondary and rails, so adjusted that the total current from the transformer remains constant. If for such a thermal resistance an ordinary resistance is substituted the percentage loss of the transformer voltage becomes unduly high. Alternative methods of preventing the increase in current when the track is shunted include the use of a constant current transformer, worked well below the "knee" of the saturation curve when the track is clear. Feeding the track circuit with a capacity and inductance in series has also been tried.

By increasing the relay impedance we can greatly improve the shunt values. The shunt may improve the operation of the relay by bringing the local and track circuits nearer the "in phase" condition, but it may also produce an opposite effect. Conditions which are good when one track-rail can be spared for signalling purposes, only answer less well if both rails are required for the propulsion or return current. These and other examples illustrate the importance of selecting the type of relay with reference to the form of impedance bond used. It is often desirable to place the track relay at some distance from the end of the track circuit, and in order to economise in cable a relay transformer is inserted. This further complicates the vector diagram, and may increase phase displacement between primary and secondary voltages.

Improvement in Power Factor.

Several methods have been adopted for varying the power factor of the relay in order to obtain the best operating conditions. One of these used on the quadrature relay consists in adding another winding to the iron core on which the track winding of the relay is mounted, and connecting this additional winding to a small capacity. By this means the power factor of the track winding can be brought up to "unity."

Another method of obtaining control of the phase angle on the relay is to feed the track circuit through a condenser of variable capacity, or to use a capacity and inductance in series, the two being so adjusted that the current supply to the track may be given an angle of "lag" or "lead" as desired.

Damage from presssure-rises due to any cause is protected against by the use of safety spark-gaps across the condenser terminals. By adjusting the number of primary turns in relation to the capacity, the voltage across the condenser can be maintained at a point slightly above the pressure of the mains while the track is "clear." When the track is "shunted," the short-circuit of the secondary winding of the transformer so reduces the inductance of the transformer that the pressure of the mains only is placed across the condenser terminals. This results in a decrease of the current passed by the condenser and a corresponding decrease in the current output to the track on the secondary side. This enables a higher shunt value to be obtained. Not only does a decrease in current take place, but a change in the phase angle of the current also. This still further improves the shunt value. This method of feeding is most suitable for single-rail track circuits fitted with quadrature relays.

Another method of altering the power factor of the relay track element to suit all conditions consists in introducing a capacity between the high voltage side of a relay transformer and the relay track element. This, however, does not give to the track when "shunted," the falling current output which can be obtained by feeding the track circuit through the combination of inductance and capacity. The method of Fig. 1, where a small capacity is introduced between the secondary of the relay transformer and the relay track winding, gives similar results to that of adding a condenser winding and condenser to the relay, but has the advantage that the relay need not be altered. Hence a standard design of relay can be used with or without the relay transformer, and with either the resonated or the non-resonated bond.

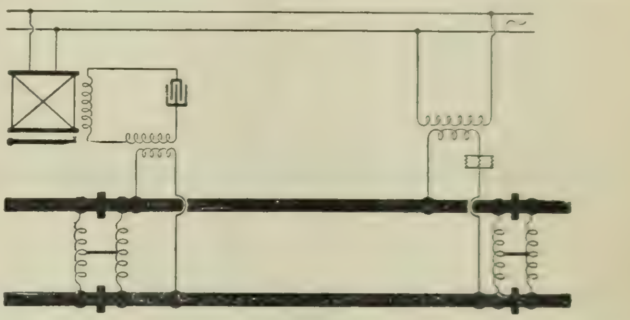

Fig. 1.—A.C. Track Circuit with Relay Transformer and Condenser in Series with Relay.

Fig. 2 shows the arrangement of the track circuit, the figures in circles denoting the points at which the following readings were taken.

	Volts.	Amperes.	Watts.	Power Factor.
1	83·9	0·54	26·5	0·586
2	0·59	1·205	0·6	0·844
3	0·58	1·105	0·4	0·624
4	15·0	0·027	0·1	0·245
5	67·3	0·44	8·4	0·284

The step-up ratio of the relay transformer in this case was 44 to 1, the capacity inserted between the relay transformer and the relay being 2 mfd. The rail impedance on even this 1,000 ft. of track accounts for a 27 deg. lag in the track current. The relay operating had a difference of 74 deg. in the phase angle between local and track currents.

Direct-current Effect.

Where alternating-current track circuits are installed on electrified roads using the running rails for the propulsion return current the alternating-current apparatus should not be affected by direct current. Where single-rail track circuits are installed, the return traction current has two paths back to the power station—*i.e.*, on the continuous return rail and a parallel path through the relay track-winding and back to the continuous return rail. The resistance of this alternative path must limit the direct current passing through the relay and transformer secondary windings to a value which will not affect the operation of the relay or transformer by saturation. This protection may also be obtained by placing small impedance coils across the transformer secondary and across the relay, these coils having relatively large impedance but low ohmic resistance. In double-rail track circuits with impedance bonds the question of saturation of transformer or relay does not arise, as the bonds are of sufficiently low resistance to prevent any appreciable difference in potential between the two rails. The bonds themselves, however, are in the direct-current return path, and their operation must not be affected by any ordinary variations of the return traction current.

As long as the return traction current is equally divided between the two rails, the effect on the iron of the bond caused by the current from one rail passing round one half of the bond winding will be neutralised by the current from the other rail passing round the other half of the winding in an opposing direction. Curves, check rails, and variations in rail section or material, all tend to cause a difference between the resistance of the two rails forming the section, resulting in more direct current traversing one half of the bond winding than the other. Thus the iron of the bond may become saturated and the impedance of the bond to the signalling current decreased. To prevent saturation, the iron circuit of the bond is cut and an air-gap of variable thickness introduced. This reduces the impedance, but, provided the air-gap is of the correct length, variations in impedance with lesser unbalancing currents will be small. This is necessary, as any variation in the bond impedance will cause variations in the alternating voltage between the two track rails.

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* Abstract of a Paper read before the Institution of Electrical Engineers.

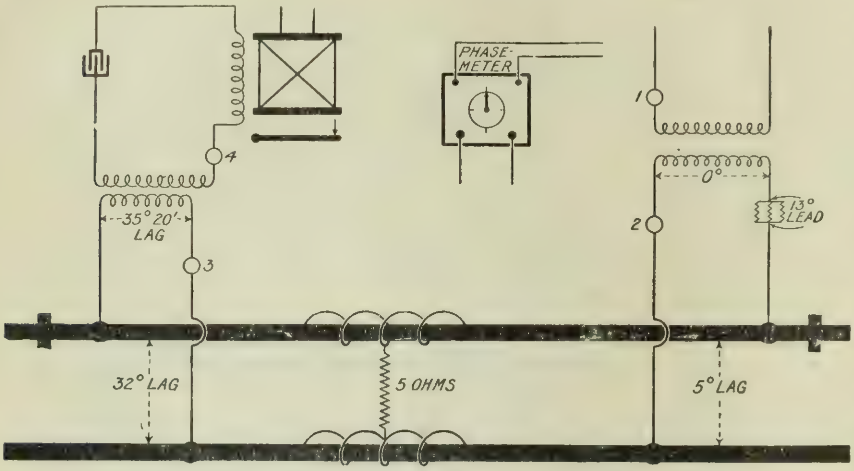

Fig. 2.—A.C. Track Circuit showing Phase Angle at Various Points.

The variation in impedance due to direct-current unbalancing of the bond is greater with the non-resonated type than with the resonated. In the non-resonated bond the impedance curves usually show a high peak, which falls rapidly as the unbalancing current increases. This peak can be flattened if the air-gap is increased, but the resulting low impedance of the bond prevents this remedy being of much use.

The impedance curves of a bond having a capacity of 750 amperes (D.C.) per rail and of the ordinary non-resonated type are shown in Fig. 3. The tests were made at 50 cycles. With the 0·06 in. air-gap the impedance only rises slightly over a wide range of track voltage. The curves plotted above the impedance curves show the very low power factor of the non-resonated bond. The same bond was used to obtain the tests shown in Fig. 4, the condenser coil now being connected up and the number of turns in circuit in the coil being adjusted to give the bond nearly unity power factor. The air-gap was kept at 0·06 in. throughout. To facilitate a comparison, the impedance curve of the non resonated bond has been shown below that of the resonated bond, the air-gap, frequency and other conditions of the test being the same in each case. In both cases the D.C. propulsion return current in the two rails is assumed equal. This is not always the case, and the bond impedance varies as the D.C. unbalancing current changes. The variation in impedance for different values of the D.C. unbalancing current is shown in Fig. 5, taken from the same resonated bond as that shown in Fig. 4. The alternating-current signalling supply was at 50 cycles, and the bond air-gap 0·06 in. A steady track voltage of 2·0 was maintained across the bond terminals. The power factor of the bond varies with the D.C. unbalancing current. If the bond is situated at a point on the line where there is always a certain amount of unbalancing current present, the drop in impedance can be overcome by altering the tapping of the condenser coil, thus making the bond have a leading power factor when no unbalancing exists, and the power factor then becoming unity when the pre-determined unbalancing current is present. The variation in impedance of the bond is less at lower frequencies, and at 25 ∾ it is possible to build a resonated bond having less than 10 per cent. variation in impedance between 0 and 200 amperes (D.C.) unbalancing current over a range of track voltages from 0·25 to 6 volts. Fig. 6 shows the impedance curves of such a bond, the solid line indicating the impedance without D.C. unbalancing current, and the dotted line the impedance with the maximum unbalancing current.

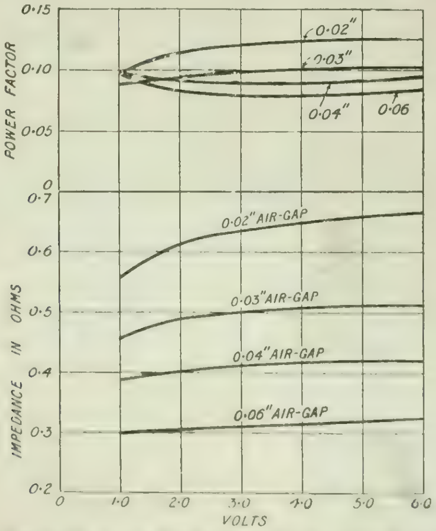

Fig. 3.—Curves showing Impedance and Power Factor of Resonated Bond with Various Air-gaps. Capacity of Bond 750 D.C. Amperes per Rail.

This variation in impedance, which gets greater as the frequency of the signalling current supply is increased, appears to be due to the increase in the watt loss in the laminated core of the bond. It is not advisable to reduce the volume of the iron in the bond core. Apart from the lower impedance of a bond with a small core, the watt loss which occurs if any attempt is made to increase the flux density in the core makes the bond inefficient; also the variation in impedance, particularly in bonds for the higher frequencies, gets greater as the core is made smaller. The normal working flux-density of these bonds is very small, being about 500 to 600 lines per square inch. It is only by working at such low densities that the bond losses on the alternating-current side can be kept small. The total alternating-current losses for a bond of the resonated type shown in Fig. 5 would be near 0·364 watt at 1·0 volt, rising to 1·4 watts at 2·0 volts across the track.

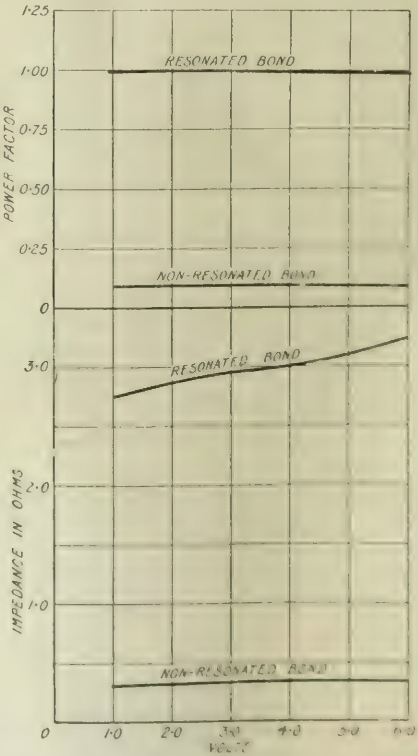

Fig. 4.—Curves showing Comparison of Impedance and Power Factor of Resonated and Non-resonated Bonds. 750 D.C. Amperes per Rail. 0·06 in. Air-gap. 50 Cycles.

The keeping of these alternating-current losses low is of great importance, particularly in the resonated bond, as an increase in losses means a decrease in the impedance of the bond and an increase in the magnetising current. Also, if the magnetising current is increased, the condenser must be either of larger capacity, or worked with a higher voltage across its terminals. It is desirable to limit the ratio between the number of turns in the condenser coil and the main coils of the bond, so that in the event of the full track-transformer secondary voltage being impressed on the bond, the alternating pressure across the condenser terminals does not rise above a predetermined figure, and spark-gaps are connected across the condenser to protect against any momentary surges due to any cause.

The necessity for using a large quantity of iron in the bond only applies in the case of D.C. electrified roads where the heavy return traction current necessitates the bond having an air-gap to avoid saturation.

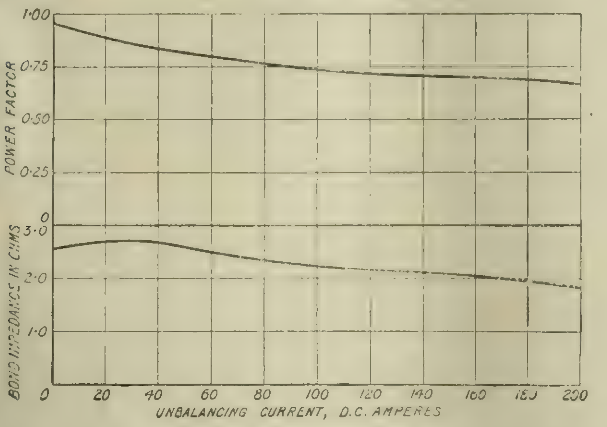

Fig. 5.—Curves showing Effect of D.C. Unbalancing Current on Resonated Bond, Impedance and Power Factor at 50 Cycles. Capacity of Bond 750 D.C. Amperes per Rail. Air-gap—0·06 in. A.C. Track Volatge = 2 Volts.

For steam-roads the bonds may be dispensed with entirely. Where A.C. is used for traction the current in the return rails is usually small and, even if one rail cannot be given up entirely for signalling purposes, bonds of much smaller capacity than those necessary to carry the return currents usually found on direct-current roads can be used. In some cases the air-gap can be omitted and a closed iron circuit used. This results in a smaller and less costly bond. Wherever possible, bonds are placed between the track rails and short flexible copper leads are run from the bond terminals to the track rails. If the bonds cannot be placed centrally between the track rails they should be placed one on each side of the centre line, so that the resistance of the copper leads may be the same for each half.

The utilisation of the resonated bond as a means of improving the phase angle between the current in the track relay local and track windings is importamt. This method consists in varying the number of turns in circuit in the condenser coil of the bond until a tapping is found which gives the desired result on the relay. This variation of the condenser circuit varies the bond power-factor, and in some cases is futile. If, however, it is found possible to vary the condenser in such a way that both the voltage across the relay track winding and the phase angle between the relay local and track currents are improved, then the adjustment is a good one, and improved shunting of the track and possibly a reduction in the track feed current will result. To obtain the best results from any double-rail track circuit with impedance bonds, it is necessary to make adjustments when the track circuit is installed, and under the normal working conditions of ballast resistance and unbalancing current, both the voltage across the relay and the phase angle being checked while the adjustment is being made.

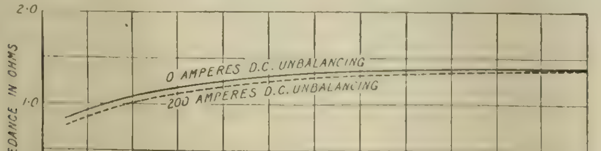

Fig. 6.—Curves showing Impedance with Zero and with 200 Amperes Unbalanced Direct-Current. 25 Cycles. Resonated Bond.

We may now consider the effect of D.C. on the relay. Relays of the galvanometer, vane or induction-motor type are all immune from operation by D.C., and the only effects are those which will cause the relay to drop—a "safe" failure, but one which must be guarded against to prevent traffic delays. If the relay is of the "in phase" galvanometer type containing no iron, the D.C. effect is not marked and only adversely affects the relay as far as heating is concerned. Excess of current through the relay track winding may damage flexible connections to the moving armature, but otherwise this relay may be considered to be non-affected by direct current. "Quadrature" relays contain iron in some part or another, and, if used for single-rail track circuits on direct-current electrified roads, must be protected against saturation from direct current passing through the parallel path. In practice the relay is protected in a similar way to the track transformer by keeping the resistance up as much as possible, and it may also have an air-gap in its iron circuit which will assist in this protection.

Direct current has the same effect on this type of relay as on the impedance bond; that is, it decreases the impedance. Fig. 7 shows the fall in impedance when D.C. is superimposed on a two-element vane relay working on A.C. The centre curve shows the D.C. ampere-turns, and the dotted curves represent the A.C. ampere-turns added and deducted from the D.C. curve. The steady fall in impedance illustrates the necessity of protecting the relay against such direct-current interference. The A.C. difference in potential across the relay track winding to give sufficient D.C. ampere-turns to put the relay out of action would be 0·55 volt. When installing this relay on a single-rail track circuit it would be necessary to adjust the resistance of the parallel path formed by the transformer secondary, section rail and relay, so that this voltage would not be reached. The alternative method of protecting relays on single-rail track circuits by placing an impedance coil as a shunt across the relay has the disadvantage that it introduces an additional piece of apparatus into the track circuit. This piece of apparatus having a different power factor from that of the relay may adversely affect the desired phase relationship.

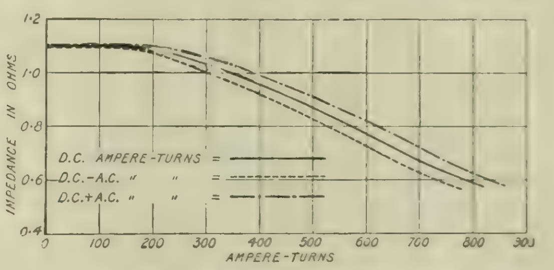

Fig. 7.—Variation in A.C. Relay Impedance with Superimposed Direct Current.

No mention has been made in this Paper of the relays adopted for track-circuiting roads on which A.C. traction current is returned to the power house through both running rails. In such cases it is customary to adopt a higher frequency for the signalling current and to use a relay which is definitely selective and is not operated by the lower-frequency traction current. Such relays, if of the two-element type, come under the same classification as that applied to all other two-element relays, and are treated in the same way when constructing the track-circuit vector diagrams.

In conclusion, the author would again emphasise the necessity of considering the apparatus forming an alternating-current track circuit as a whole and its operation under the varying conditions of ballast resistance, traction current and other factors which differ on every road. The large number of alternating-current track circuits installed in this country in recent years show great improvements over the earlier ones. There is little doubt that this progress will continue, and that the very satisfactory results already obtained in operation will be more than maintained.

Books Received.

[Copies of the undermentioned works can be had from The Electrician Office on receipt of published price, plus postage.]

"The Electricity (Supply) Act, 1919, with Notes," by W. S. Kennedy, Ll.B. (London: Electrical Review, Ltd.) Pp. 96. 3s. 6d. net.

"Automobile Starting Lighting and Ignition," by V. W. Page. (London: Hodder & Stoughton). 6th Edition. Pp. 815. 21s. net.

"Electric Welding: Its Theory, Practice, Application and Economics," by H. S. Marquand. (London: Benn Brothers, Ltd.) Pp. 204. 12s. 6d. net.

The Woman in the Progress Department.

By W. J. HISCOX.

Much has been written of the adaptability of the woman in business, and her war record, in the engineering factory at all events, certainly bears out all that has been said in this connection Some writers have, however, gone far beyond the quality of adaptability, and have openly declared that the woman was at least the man's equal in any branch of industry in which she took sufficient interest. That such an assertion is ridiculous may be stated without in the least casting any reflection upon the capabilities of woman, for the duties she performed in the engineering factory could not by any stretch of imagination be classed as grade 1. Moreover, during the period in which her industrial activities were manifest, the demand for production was so great, and the insistence on speedy delivery so intense, that many otherwise potent factors were but lightly regarded, and as a consequence the standard of workmanship was not too closely criticised.

Woman's Limitations.

In the workshop the woman was taught a specific job, which, when learned entailed no personal initiative, and which exacted no responsibility, so far as the operator was concerned. She worked under male instructors and under male supervision, and though she quickly learned her job, and afterwards performed her duties quickly and with precision, it cannot be said that such an achievement must of necessity give her the right to dub herself "engineer" or even "mechanic." In the office, too, she has "carried on," and that is as far as she has got, for certain it is that the organisation has not advanced as a direct result of the woman's effort.

It is obvious that the inexperienced woman cannot make headway any more than can the inexperienced man, and yet there are those who assert that women have become proficient in a few weeks in duties which could not be mastered by men in as many years. They say that woman has revolutionised the engineering industry, but a greater fallacy has never been exposed, for in this industry the woman, on her own initiative, has achieved nothing. Her adaptability, exploited by experienced man, has to a great extent changed the outlook of the industry, and as time goes on the experience she gains will undoubtedly enable her to compete against the man with some degree of success.

Assuming that the girl has the same opportunity as the boy, there is no reason to fear that, solely on account of sex, she will fail, even in the engineering world. Except in certain instances, where great physical strength is required (and here it may be observed that every man is not competent to qualify) the girl stands as good a chance as the boy of becoming a competent mechanic. It is, however, with the woman's aspirations to the higher administrative posts that this article is concerned, and, bearing in mind the important position the progress department enjoys in the modern factory organisation, it may perhaps be of interest to consider the chances of the woman in a department where initiative is essential, where individuality counts, and where variable circumstances and fluctuating conditions must be catered for.

The Woman's Present Place.

The woman already has her place in the progress department, but the position she occupies is not dissimilar to the position occupied by her sister in any commercial office. She is there in a subordinate capacity, engaged exclusively in matters appertaining to routine, taking charge of the filing, keeping card records, marking up charts, and the like. True, these matters are of some importance, seeing that they are regarded as essential, and neatness and accuracy are factors which cannot be dispensed with. The woman here is (when experienced) quite competent, and being usually more painstaking than the man (who is apt to consider the work as beneath his dignity) she may be regarded as the man's superior upon this particular class of work, and is as a consequence greatly to be preferred.

This does not, however, take us very far, for it speedily becomes apparent that the man, considering this work unworthy of his attention, is prepared to give the woman a clear field whilst *he* aims for something higher. Thus it is that the woman, although unquestionably the victor, must nevertheless remain in a subordinate position, acting as an assistant to the lordly male, who dominates the organisation. 'Tis said, however, that experience teaches wisdom, and, assuming that experience is supplemented by ambition and confidence, there is no reason to doubt that the woman will aspire to the higher position, and, in course of time, by merit alone, succeed in displacing one of the "superior sex," and take his place in the seat of authority, in so far as the clerical side is concerned.

The progress organisation, however, is not entirely clerical; indeed, the clerical side is subservient to the technical side, and so the woman will find that, although she has succeeded in establishing her right to a higher position, she is still under the direction of the real progress man. He is the ruling spirit of the organisation He directs and controls, and the clerical side must bow to his wishes. The records and the charts and the graphs are compiled under his direction, for his own use, and although a certain amount of responsibility must be borne by the one supervising the clerical work, that person is responsible only to the progress man concerned, and this certainly does not mark the position as one of the highest importance.

The Woman as Section Leader.

It will be seen, therefore, that the position to aspire to is that of the progress section leader, and the question which arises is whether it is possible for the woman to be successful in this direction. It may be said that she does not understand the true meaning of progress, nor grasp the significance of the duties involved, but the writer's experience is that many men (ostensibly progress section leaders) are equally ignorant, so that in this connection the woman is not handicapped as heavily as one might think. It is taken for granted that the woman would not be offered the post until she had had experience and had proved her worth, and, this being so, the method of gaining experience to ensure the necessary qualifications, must be considered.

Progress Work a Profession.

The writer has ever been of the opinion that progress work is a distinct profession, and that to qualify as a progress man (*i.e.*, a section leader) the subject must perforce devote himself to the profession and serve an apprenticeship, just in the same way as he would had he adopted any other trade or profession. For the progress man to become proficient in his calling he must of necessity enter the profession whilst still young, and become familiar with the elementary principles before endeavouring to control. This means years of hard work and constant endeavour—of patience and tact—of initiative and enterprise. He must experience failure, and turn it into success—combat disappointment with perseverance—and bearing these things in mind, one is constrained to ask "Could a woman succeed?"

That she succeeded to a certain measure during war time may be ascribed to some extent to novelty, but nowadays novelty is nonexistent. During the war she was privileged—she was accorded civility where the man was greeted with abuse. She asked questions (silly questions) and she received answers, not invariably correct, but near enough for her purpose. The woman "progress-man" has existed—does still exist—but she flourishes only under abnormal conditions, and if she is to become a permanency she must "be born again."

Despite all assertions to the contrary, the progress chaser (that much abused individual) is (and will be) an absolute necessity in the majority of engineering factories, and the most efficient progress section leader is the individual who made a success as a "chaser." The apprenticeship period should cover four years, the course being as follows:—One year in the progress office in a junior capacity; two years in the shops as progress chaser; and one year as recognised assistant to a section leader. The girl would doubtless complete the first year without a deal of effort, the duties being mainly clerical, but the chasing period is an entirely different proposition.

Even assuming that in the shops the female element is fairly strong—that is to say, a fair proportion of the operators are women—the position of the female "chaser" is wellnigh impossible. Her presence is resented, particularly by the foreman, and although he must perforce give certain information, he does so in such a way as to render its value almost negligible. He swears at the male chaser, but is conscious of his value, and information desired is usually obtained. He does not swear at the woman, but he makes her feel she is not wanted, and as a consequence she accepts the information given at its face value.

It must be remembered that at this time she is but a girl, and she cannot be expected to understand and appreciate the moods of a foreman. Her position would no doubt be more tenable were the head of the department a woman, but then she would not qualify as a section leader, seeing that the latter must handle work in many departments controlled by men. The whole position is absurd, and in the factory, where practically the whole of the operators are men, the female progress chaser has no place at all.

Once in a way an exceptionally adaptable girl may achieve a certain measure of success as a chaser, but even here the success is by no means complete. There are many flies in the ointment—much heart-burning and grumbling beneath the surface. The trouble is like a cancer—can be felt but not seen—and every day it grows worse, until at last it threatens the whole organisation.

Efficiency is impossible, for co-operation is entirely lacking. The "lady chaser" is made the scapegoat, though it is not upon her that the vials of wrath are poured. The head of the department suffers for her delinquencies, both real and imaginary, for they are used by the unscrupulous as a weapon against the organisation, with a view to bringing discredit upon it.

An Impenetrable Barrier.

Two years chasing forms an impenetrable barrier against the aspirations of the woman, for without that experience she cannot hope to achieve success as a section leader. Given equal opportunity, there is no reason to doubt that the woman can become as successful an organiser as the man, but that opportunity in progress work is denied her. The force of circumstances is too strong, seeing that the opportunity of gaining the most necessary experience is denied her.

The woman can achieve much, when her presence is regarded in the light of a novelty, but when the novelty has worn off, and she is forced to compete with the man on level terms, she is at a disadvantage. Whatever may have been the composition of the war-time progress department, it is certain that from now on the woman will play but a small part in the organisation. As a progress clerk, engaged exclusively on clerical work, she will hold her own, and her importance will vary in accordance with the methods in vogue in the different factories. It may be that, in a certain factory, the progress department is merely a records department, and here the woman will undoubtedly succeed. But in the factory where the progress department is a force to be reckoned with—where the principles of progress are thoroughly appreciated and understood, and where the progress department is in the best sense a productive department—planning, regulating and controlling—here the work is essentially a man's job, for which the woman is absolutely unsuited.

In making this statement the ability of the woman is not disparaged to the slightest extent. That as a sex her brain power is in no sense inferior to that of the man is accepted by the writer without reserve. But in the case in point conditions are against her. She is man's superior in innumerable instances, even upon work which for years was looked upon as being essentially masculine. In the electrical factory it has been demonstrated that winding can be done more expeditiously by the woman, and that being so, she has earned her place. But we are not likely to hear of the woman blacksmith or boiler maker, the reason being that the work is entirely out of her range, and for the same reason therefore the woman will never make a successful progress section leader.

The Electrification of Railways.

The Committee appointed by the Minister of Transport to inquire into certain questions connected with the electrification of railways have issued an unanimous report, of which we give the substance below. The Committee* have had before them representatives of the London & North-Western Railway, the South Eastern & Chatham Railway, the Metropolitan Railway, the London Electric Railways, the Lancashire & Yorkshire Railway, the North Eastern Railway, the London, Brighton & South Coast Railway, the Midland Railway, and the London & South-Western Railway; Mr. Ivan Ofverholm, Chief Electrical Engineer to the Swedish State Railways, and Col. Huber-Stockar, Consulting Engineer to the Federal State Railways of Switzerland; while on the side of the electrical contractors they had representatives of the British Thomson-Houston Company, the English Electric Company and the Metropolitan-Vickers Company, and a written communication from the Oerlikon Company. The Committee sent out in April, to all the chief railway companies, a *questionnaire* relating to the matters covered by their terms of reference and from the replies to this, together with those sent in to the *questionnaire* issued in January by the Ministry of Transport, as well as from the information given by the witnesses, full statistical tables were prepared, and were considered in detail by the Committee.

The Need of Regulations.

In reference to the question whether any regulations should be made for the purpose of ensuring that the future electrification of railways in this country is carried out to the best advantage in regard to interchange of electric locomotives and rolling stock, uniformity of equipment and other matters, the Committee consider that it is desirable that certain general regulations should be made for electrification of railways. These regulations should ensure standardisation of those methods and appliances which are likely to prove the most satisfactory under British conditions. Such regulations should put no avoidable difficulties in the way of the adoption in future of any improvements in methods or appliances which may from time to time become available with increasing knowledge and experience.

The Standard System.

They also recommend that regulations should be issued in accordance with the following conditions:—

(i.) That in the case of those railways which have not as yet electrified any lines, their electrification should be carried out on the direct-current system.

(ii.) That the standard pressure at the sub-station bus bars should be 1,500 volts, subject to (*a*) the continuance of any existing 600-volt and/or 1,200-volt installations; (*b*) the adoption of half the standard voltage—750 volts—in those cases where it can be shown that advantage would arise from the use of this lower pressure; (*c*) the adoption of higher pressures—limited to a multiple of the standard pressure—where it can be shown that sufficient advantage would accrue.

(iii.) That both overhead and rail conductor collection should be permitted, as long as the position and general design of the conductors and structures are in accordance with recommendations which will be made in a subsequent report. In that report the Committee will also suggest the regulations required to ensure that locomotives and/or motor coaches shall be able, wherever it may be necessary to run at two different voltages—*e.g.*, 600/750 and 1,500 volts, and/or with either rail or overhead collection.

(iv.) That the generation of current for direct current lines should be alternating three-phase at such voltage as may be desirable in each case.

(v.) That in the case of existing generating stations supplying at any frequency between 25 and 50 cycles it is unnecessary to make any change in frequency, but that it is desirable that where any one such frequency is in general use in a particular electricity district, any new power station put down in that district for supplying a railway should adopt the frequency which has been approved by the Electricity Commissioners or is in general use in that district.

The Committee have come to the conclusion that alternating current supplied to the sub-stations at a frequency of 50 cycles can be used for railway purposes without any detriment to railway working.

The Brighton Line.

The London, Brighton & South Coast Railway Company adopted the single-phase alternating-current system for its suburban lines, as this system at that time appeared the only one admitting of extension from London to Brighton when this extension became feasible. This extension is now not only feasible, but urgently desirable. The Committee is bound to recognise that if the railway is allowed to electrify its main line to Brighton on its present system interchangeability will be interfered with. They recognise, on the other hand, that to change the existing suburban equipment of the Brighton railway to a direct-current system would involve a large financial expenditure which would be difficult to justify at the present time. Having all these considerations in mind the Committee recommend (i.) that the electrical system of working at present in use on the Brighton line need not be changed; (ii.) that in view of the recent proposals of the Government as to grouping of railway companies, the question of the system on which the L.B. & S. Coast Railway Company's proposed extensions to the coast should be carried out is now one for special consideration from the point of view of the requirements of through working and interchangeability of traffic with the other systems forming part of the proposed southern group. Subject to these matters receiving the fullest consideration and provided the completion of the proposed extension on the present system shows a substantial financial advantage, the Committee are of opinion that it should be allowed.

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* The Committee was constituted as follows: Sir Alex. Kennedy, F.R.S. (*Chairman*), Sir John A. F. Aspinall (Consulting Mechanical Engineer, Ministry of Transport), Mr. A. R. Cooper (representing the London Electric Railways), Sir P. Dawson, Sir Alex. Gibb, G.B.E. (Director-General of Civil Engineering, Ministry of Transport), Mr. C. H. Merz, Sir Philip Nash, K.C.M.G., C.B. (Director-General of Traffic, Ministry of Transport), Mr. Lightly Simpson, C.B.E., D.S.O. (Chief Mechanical Engineer, Ministry of Transport), Mr. Roger T. Smith, Sir John Snell, Sir Henry Thornton, K.B.E. (General Manager, Great Eastern Railway, representing the Railway Companies), and Mr. S. G. Redman (*Secretary*).

Reviews.

The Principles Underlying Radio Communications. Radio Pamphlet No. 40. Signal Corps, U.S. Army. (Washington: Government Printing Office.) Pp. 355. 55 cents.

The extraordinarily sudden growth, during the latter part of the war, of wireless as an important means of communication by land and air created an overwhelming demand for operators with the necessary modicum of technical education to manipulate and adjust the apparatus issued to them. Provision of suitable instruction for such operators was no easy task, partly on account of sheer numbers and shortness of time available; but largely on account of the very qualities of the men and the subject of instruction. It is possible that for the mere operation of the simplest field apparatus—and in the British army, at any rate, simplicity was pushed very far, perhaps too far—the best course would be to take men without any previous notions of electricity whatever, and to give them an absolutely *ad hoc* training in the manipulation of their particular apparatus; but, above this very low level, some general electrical instruction seems necessary, and the form this general instruction should take, and the manner of approach from it to the high-frequency technique, are questions worth close consideration.

This little book was prepared at the Bureau of Standards, Washington, for the use of the United States Signal Corps in the rapid training of "radio electricians." It was issued shortly after the Armistice—like various other military wireless developments, just too late (let us still hope) ever to be put to the test of war emergency; but it has great intrinsic merit, and provides in war or peace a quite exceptionally excellent course of instruction in "the basic facts and principles of electromagnetism and their application to radio communication." The treatment is very elementary, and could not be less mathematical without the omission of algebraic symbolism altogether, but throughout it bears the mark of scientific authorship, and, as is proper, was doubtless hard to write, because it is easy to read.

The reader who has never studied electricity may begin here. He will be led in well-arranged steps through half the book before he comes to much specifically wireless matter; but the authors have borne the end in view, and have not loaded the preliminary chapters with more than is required for an adequate understanding of their sequel.

Although the book is elementary in the sense that the teaching is suited to the uninitiated, in scope it is remarkably comprehensive. Witness such sections as "48, Energy relations in inductive circuits"; "57, Circuit containing capacity inductance and resistance"; "75, Polyphase alternator"; and in the later chapters: "131, Magnetic field produced by moving lines of electric displacement"; "Transmission formulæ"; and "202, Voice modulation of radio currents by vacuum tubes." In its quality and surprising comprehensiveness, as well, perhaps, as in its small size and low price, the book is reminiscent of the classic "Elementary Lessons in Electricity and Magnetism" of S. P. Thompsen.

The wireless matter is well up to date; and although it is not without a few minor errors of theory (*e.g.*, the curves in Figs. 185 and 252), the teaching is on the whole very sound. There are several practical mistakes or inaccuracies. Thus, it is not generally true that the harmonic frequencies of the antenna are 3*f*, 5*f*, 7*f* . . . , or that an antenna severed at the bottom has the half wave-length exactly; it is obviously better to connect the transformer across the spark-gap than across the condenser as is always shown in the diagrams; quite a wrong idea of the relative sensitiveness of crystal detector and vacuum tube is conveyed by the statement that the former is suitable for 100 microamperes and the latter for 1 microampere of oscillatory current; and one cannot help suspecting that if "an amplifier consisting of two type VT 1 tubes in cascade is said to give an amplification of 10,000 times," it must have been wrongly said, and should not be repeated; a typical amplification of 7 per tube is previously given.

There are several misprints, in the numbers of the figures referred to in the text, and otherwise; but the book is generally very well arranged and printed, with an abundance of diagrams, and with photographs numerous and clear enough to give an idea of the appearance of the apparatus described. Numerical examples are used to illustrate the theory, and references are given to works which may be consulted for further information. There is no alphabetic index, although the book is complete enough to justify one; but a very full Table of Contents is provided.

Altogether, this is the most satisfactory elementary text-book on wireless telegraphy we have come across for years. It can be heartily recommended to the beginner, and even to advanced students. L. B. Turner.

The Realities of Modern Science. By John Mills. (London: Macmillan & Co.). Pp. x.+327. 10s. 6d. net.

The "Realities" referred to in the title prove to be Energy and Matter, and the latter is taken as consisting entirely of electricity in the form of positive and negative electrons. The author states in his preface that his book is intended for the general reader, interested in modern science, who finds few clues to recent advances in his memories of the formal instruction of school or college days. This purpose it fulfils admirably, for the writer shows a thoroughly competent knowledge, theoretical and practical, of the extensive field which he covers; and he writes clearly and interestingly, and possesses a very happy knack of illustrating comparatively recondite phenomena by means of thoroughly legitimate analogies derived from more familiar or more easily apprehensible sources.

The three excellent chapters on Some Uses of Mathematics, Rates, and Force, a space rate of energy, may be specially commended to schoolmasters, who should find in them potent sources of suggestions for inspiring interest on the part of pupils laboriously learning to make their earlier steps in the elements of mathematics.

The last ten chapters do not present such easy going as those which precede, but the reader who has thoroughly mastered these earlier ones will find no difficulty, beyond that of application, in the later ones, which may be said to constitute the advanced section of the book. The subjects they deal with are: Molecular motions and temperature; Motions of electrons; Interactions of moving electrons; Continuity and correspondence of molecular states; Molecular mixtures; Electrolytic dissociation; Equilibria and their displacement; Molecular magnitude; Molecular energy; Electronic magnitudes. Noteworthy in this section are the use of the Le Chatelier and Braun extension of Lenz's law to lead to the second law of thermodynamics, and the account of the Brownian movements and what is to be learned from them.

The volume is provided with a good index, is well printed and illustrated, and remarkably free from misprints, but a bad one on p. 143 is *oblate sphere* for oblate spheroid. In the footnote to p. 140, the statement about comets is incorrect in the case of the periodic comets, which have elongated elliptic orbits. On p. 53, the definition given of magnetic declination is over simplified into no definition. Marconi was not, as stated on p. 125, the first (in 1896) to show how electro-magnetic waves could be utilised for telegraphy. Popoff's system, successful up to distances of about a kilometre was described in 1895. Hughes had succeeded in 1879, long before Hertz began his investigations, in obtaining transmission up to nearly 500 yards, and showed his results to Stokes and other physicists, but abstained from publishing them until he should be able to convince Stokes, who attributed them to ordinary electro-magnetic induction. G. W. de T.

The Elements of Vector Algebra. By L. Silberstein, Ph.D. (London: Longmans, Green & Company.) Pp. 42. 5s. net.

Those who have read Dr. Silberstein's papers in the "Philosophical Magazine," and his works on projective vector algebra, relativity, electro-magnetic theory, &c., will realise what an enormously powerful weapon vector algebra is in his hands. Indeed, we may say that a familiarity with this subject is essential for the complete study of most of the modern work in mathematical physics. Happily, we have nothing here so abstruse as the theory of relativity. This small book is published primarily to enable one to become familiar with Dr. Silberstein's methods of investigating the properties of optical systems. The essential part of the book is very similar to the vector algebra developed by Heaviside, and the student who is taking up the subject for the first time will have no difficulty in understanding the definition of vectors, their sum and their difference.

When he comes to products, however, the first difficulty arises. He sees the product of two vectors defined in two ways: (1) a scalar, (2) a vector product, and both will seem to him equally arbitrary. He will surely wonder why (1) is defined as the product of the tensors of the two vectors and the cosine of the angle between them, and (2) is defined by a vector whose tensor is equal to the product of the tensors of the original vectors and the sine of the angle between them, and which is perpendicular to the plane of the pair. He will only learn from experience that these two definitions are the only ones that are of any great service to the development of the subject. We think Dr. Silberstein might have given at this point, as an illustration of both products, the case in which one of the vectors is a force and the other a displacement.

Having grasped the idea of these two products, the student will find the greater part of the rest of the work fairly plain sailing. There is a rather stiff portion, introducing several new terms, on the linear vector operator, and a few hints on the differentiation of vectors. The subject is one which can only become familiar after much earnest effort, and this little book will repay reading not once but many times. H. C. K.

Continuous Current Machines. By S. P. Smith, D.Sc. (London: Benn Brothers, Ltd.). 2nd Edition. Pp. iv.+60. 5s. net.

This is an extremely useful collection of design notes by one of the leading designers of the day, who is in close touch with the needs of the student. As mentioned in the preface it is not intended as a treatise on the subject, and on this account there is a refreshing absence of padding, and the usual photographic illustrations of out-of-date machinery which often disfigure books of this nature.

The first few notes deal with the calculations of E.M.F., and the conditions for symmetrical windings are very clearly discussed.

The author rather mixes up the terms "principles" and "laws" on page 1, in speaking of the conversion of mechanical into electrical energy. After stating what the underlying principles are, he says that "the relation, if any, between these two fundamental laws is of interest chiefly to the physicist. The laws are given elsewhere. This little gibe at the physicist cannot be passed unnoticed. Progress in design can only be obtained by the closest linking up of pure and applied science.

Commutation is dealt with in a simple manner, and where gaps occur in the theory of the subject, the author shows how these gaps are bridged by the practical designer.

The second part of the book gives an example of how a design could be carried out. A slow speed continuous current generator is dealt with.

As the author justly remarks: "There is no common method in use for designing machines," but, if the student of these notes follows the design carefully, he will receive many useful hints. This little book should be in the hands of all designers and students of design.

H. F. Haworth.

Shorter Notices.

Examples in Electrical Engineering. By J. F. Gill, M.Sc., B.Eng., A.M.I.M.E., and F. J. Teago, M.Sc., A.M.I.E.E. (London: Edward Arnold). Pp. 173. 7s. 6d. net.

This book is primarily intended for the use of students in a problem class following a lecture. It consists of two sections, the second more advanced than the first, each containing 13 papers of six questions each.

The first thing that one notices is that there is no index. Although not a serious disadvantage in a book of this type, an index would be helpful, as the problems are of a very varied type. For example, questions on potentiometers, electric cranes, power transmission and iron testing will be found in one paper.

The problems set in section 1 are intended to test the students' knowledge of fundamental principles and the relationships existing between the various units used in electrical engineering.

Section 2 deals more with machine problems.

At the end of each section the problems are worked out. This, while adding greatly to the value of the book to the student not attending lectures, is rather putting temptation in the way of the student who prefers to obtain his results easily. The object of a problem class should be to enable a student to apply what he has learned in lecture, or otherwise, to a concrete case, and to teach him to think. In the hands of a conscientious student the book should prove very valuable, as the problems are good practical examples, with clearly worked out solutions. H. F. H.

Calculation of Electric Conductors. By William T. Taylor, M.Inst.C.E., M.I.Mech.E., M.I.E.E., &c. (London: Constable & Co., Ltd.). Pp. 34. 10s. 6d. net.

This book, with the aid of an attached logarithmic chart, gives a quick graphical solution of the following problems:—Given any three of the four following items, what is the fourth? Length of cable, cross-section of cable, permissable voltage drop, maximum safe current. The above quantities are plotted to logarithmic bases on the four sides of a square chart, the resultant resistance lines being a series of parallel straight lines passing across the chart at an angle of 45°.

The operation of the chart is explained in Part 1 with the aid of numerous examples; and in Part 2 some practical examples of power transmission are worked out. Part 3 gives a number of useful conversion tables, which should be a considerable help in shortening calculations.

The cable chart limits are as follows:—Maximum length of cable circuit 12 miles, cross-section 0·005 to 1·0 sq. in., range of voltage drop 5 to 1,000 volts, current range 5 to 1,000 amperes.

There are a number of misprints in the book, and the numerator of the formula for the load distribution between two stations, given at the bottom of page 18, is quite wrong.

The symbols I and C are sometimes both used for current in the same formula; there does not appear to be any reason for this digression from standard practice.

A short description of the method of constructing the logarithmic chart, would probably be of interest to the reader.

H. F. H.

Electricity in Factories and Workshops.

The Annual Report of the Chief Inspector of Factories and Workshops (Mr. R. E. Graves) for the year 1919 has been issued and contains a record of the administrative work of the department, including reports by the Superintending Inspectors and Senior Lady Inspectors, the Medical and Electrical Inspectors, and the Inspector for Dangerous Trades, &c. The standard of safety and sanitation declined during the war, but a considerable step forward was made in the course of the year in recovering lost ground. The number of factories has increased by 12,396 since 1914, but the number of workshops has decreased by 8,060. There appears to be a gradual closing down of country workshop industries and an extensive conversion of town workshops into factories, mainly by the introduction of electric power. There were 1,385 fatal accidents, compared with 1,287 in 1914, but the non-fatal accidents fell from 158,585 to 124,632. The works (other than docks, &c.) under Regulations have increased from 67,650 to 77,957, the Electrical Regulations alone accounting for 58,268.

Electrical Inspector's Report.

In his report on the past year, Mr. G. Scott Ram states that the most important fact to chronicle is the expansion in the use of electrical energy for all kinds of purposes, which received such an impetus during the war and continues unabated now that the driving power of war emergency has been replaced by purely industrial activity. The demand for supplies for power purposes is far in excess of the present capacity of the public supply stations in many districts. This is partly attributable to the high price of coal and uncertainty as to its delivery. Many factory occupiers, particularly mill owners in the woollen and cotton districts, who before the war could not be persuaded to adopt electrical driving, are now clamouring for it, and appear aggrieved that they cannot obtain supplies of electrical energy all at once. The effect on the supply undertakings is that many are overloaded and working without any reserve of plant. The difficulties are increased in many instances owing to the inferior quality of the coal obtainable, resulting in diminished steam raising capacity. In some districts relief has been sought, by electrically linking up different supply undertakings. This has no doubt permitted of a larger combined output, but the margin having been rapidly overtaken, the situation as regards overload and shortage of plant remains uneased thereby. Numerous extensions of generating stations are in progress, and schemes for new "super-stations" are under consideration. Two new public supply generating stations of large capacity and on the most modern lines have been completed during the year, and are about to be put into operation.

Accidents.

The number of accidents reported was 390 (against 450 in 1914), of which 28 were fatal, against 20. The reduction in the total is satisfactory in view of the enormously wider use of electrical energy compared with that in the earlier years. The fatalities were, with one exception, all from alternating current. Most of them (20 out of 28) were at low pressure, *i.e.*, not exceeding about 250 volts. With two or three doubtful exceptions, the shock was in all cases from one phase to earth. As most of the systems had the neutral point earthed, the shock could not, therefore, have exceeded low pressure. In seven of them the shock was received from lighting circuits connected between phase and neutral. This once more emphasises the fact that a shock from alternating current at low pressures is vastly more dangerous than with direct current, and the matter needs bearing in mind at present when there is so much talk about cheaper methods of wiring. The process of cheapening often begins by eliminating safeguards. Whether for factory or any other premises, where alternating current is used, the cheapening process should not be allowed to introduce any unnecessary risk of shock.

Eight of the fatalities were from contact with the necessarily bare wires of overhead cranes or other travelling machines. Two were from hand lamps, one being the old type of hand lamp wherein the wire cage is attached to the lampholder. The other was an ordinary metal lampholder attached to flexible wires; this arrangement is so readily rigged up that it is often used, even where safety types of hand lamps are provided, but are perhaps not at hand at the moment. Two were due to current being switched on while persons were working on the circuit, the switches not being locked off nor any warning notice attached to them. Three (including two at high pressure) were in the testing departments of electrical manufacturing works. One of these was due to a mistake in switching. The other was due to a quite unnecessary and dangerous practice sometimes adopted in cable works. It appears that inspectors on behalf of purchasers when attending high-pressure tests of the cables, are not prepared to accept the cable maker's assurance that the pressure is actually being applied to the cable, and require an ocular demonstration of this by means of a flash. The flash is produced by short-circuiting the cable core to the lead sheathing. In this case a man entered the fenced-off danger zone to make the flash with a pair of insulated tongs and came into contact with the high-pressure connecting wires. Such demonstrations are not really necessary at all, but if required, they could be quite well arranged without anyone having to enter the danger zone. In one fatality (not included in the table in the report) the man had used a metal lamp-holder as a portable lamp on a 240-volt d.c. circuit. The holder became alive, and he received a prolonged shock and was severely burned in the hand. He died 16 months later from paralysis, attributable by a doctor to the injuries received.

Amongst the non-fatal accidents, several occurred on extra-high-tension systems. Five occurred to skilled persons, due to their own mistakes. In two cases they had forgotten to pull out the isolating switches protecting the oil switches on which they intended to work. In two others, where it was intended to earth dead conductors before working on them, live conductors were put to earth. Isolating switches were also operated in error whilst current was flowing. In five cases, unskilled persons were put to clean switchgear without proper supervision. Having completed the work they were instructed to do on dead portions of the switchgear, they proceeded without instructions to clean other parts which were live. One accident in which two men were severely burned was due to the faulty arrangement of an isolating switch, whereby it was able to fall into contact after being switched off. Another accident was due to the use of a spanner on a high-pressure switchboard close to unscreened conductors, and several others were caused by similar foolhardiness of persons when working on medium-pressure switchboards. Totally ignorant persons are always liable to be a source of danger to themselves and others when employed in electrical stations, unless under strict supervision. Three accidents were due to the explosion of oil switches, causing injuries from burns from the ignited oil.

Bad Workmanship.

Mr. Ram states that in his inspections he found, as usual, many examples of bad and dangerous work. These were by no means confined to factories where the occupier might have no technical knowledge, but they occured also in electric generating and sub-stations of public undertakings; *e.g.*, exposure of high-tension conductors within reach, not only in switchboard passage ways, but also in other parts of the premises accessible to anyone; potential transformers connected direct to the main bus-bars, without any isolating switches; open-type alternating medium-pressure switchboards with working platforms of iron plates without insulating mats. In some of the older stations which have been extended with good modern plant, old switchboards entirely unfitted for the present greatly increased power are retained in use. Occupiers of factories are often entirely dependent upon the contractors for putting in good plant in a proper manner. Even where good apparatus is supplied, dangers are often introduced through ignorance. Thus, a number of cases were found where interlocked switch and fuse boxes were provided, the intention being that the fuse boxes could only be opened for renewal of the fuses when dead, but, in fact, they were connected the wrong way round so that the fuses would be always live and the interlock of no use.

Heating and Cooking Notes.

Komet Electric Irons and Kettles.

The **Electric Heating & Hardware Company, Ltd.**, of Crown Works, Birmingham, have recently placed on the market a series of electric irons and kettles. The particular feature of the "Komet" iron is the design of the base. The front end tapers to a sharper point than usual, thus enabling the iron to be used for fine work as well as for ordinary articles. The iron is made of mild steel, and the element is carried to within a quarter of an inch of the point, thus giving, it is claimed, adequate "point" heat. The connector allows the flex to be arranged so that strain at the terminal connections is obviated, and the contact pins are surrounded by a metal housing. A metal device is fitted on the back of the iron to act as a stand when the iron is stood on end. An illustration of the "Komet" iron is shown in Fig. 1. The "Komet" kettle has a capacity of 2½ pints, and is particularly neat in design. It is supplied finished in nickel plate, and the same type of terminals and connector are used as on the iron. Considering the present-day costs of labour and material the prices asked for "Komet" appliances appear very reasonable.

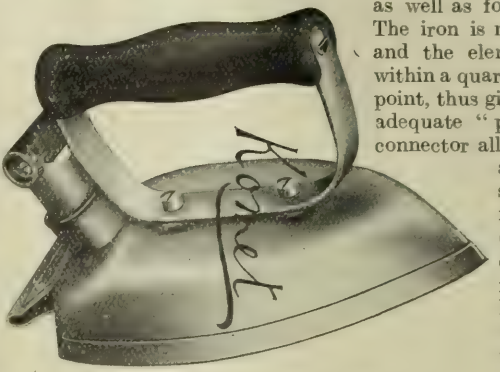

Fig. 1.—"Komet" Iron.

An American Heater.

Information has come to hand of an American patent for an electric heater which is distinctly novel, to say the least of it. In this apparatus a radiant element wound on a fireclay tube is fixed in front of a parabolic reflector. The back of the reflector is heat-insulated with a vacuum chamber to prevent heat radiation through the back. In addition, the reflector automatically oscillates like an oscillating fan, so that the heat is reflected over a wide area, instead of being confined to a definite part of the room only. If required, the oscillating mechanism can be disconnected. An automatic device disconnects the element if the heater base is moved from the normal vertical position, so that danger of a fire due to the heater falling or being knocked over is obviated.

Cooking and Food Exhibition.

The Cooking and Food Exhibition, which was held last week at the Royal Horticultural Hall, Westminster, was the twenty-fifth of its kind. It was well supported by the public, and favourably reviewed in the daily press. It is therefore to be regretted that such an excellent opportunity of bringing forward the claims of electrical apparatus should have been so poorly supported by the electrical industry. Our gas friends were largely in evidence, but electrical exhibits were confined to two displays, one by the **Carron Company** and the other by the **Ediswan Company**.

The **Carron Company** displayed a number of electric ranges suitable for domestic use, and also electric fires and the smaller cooking accessories. The cooking demonstrations carried out on a Carron Cooker attracted a good deal of attention, and results adequately bore testimony to the merits of electric cooking.

Ediswan were exhibiting a range of self-contained cooking utensils, such as milk boilers, saucepans, &c., together with hotplates and electric fires.

We hope that when the next exhibition takes place there will be a more representative display from the electrical industry, because actual demonstration of the apparatus is the most effective way of educating the public to the advantages of electrical heating and cooking. We realise that it would be burdensome for every manufacturer to show at every exhibition, but could not a comprehensive exhibit be arranged on a co-operative plan?

Electrically Heated Hay Box.

According to "Das Echo und Deutsche Export Revue," Mr. R. Reinhold has evolved a new system of low temperature cooking, in which a box surrounded with non-conducting material is maintained at a constant temperature of 212°F. by means of electrically heated coils. It is possible for food to continue cooking for three hours after the elements have been in circuit during 40 minutes only. The main switch is operated by clockwork, which can be adjusted to disconnect the supply of current at any desired time, say, after one, two, or three hours.

The Electrical Industry in Russia During the Last Five Years.*

By N. O. LIFSCHITZ.

Before the war, although the electrical industry was in a highly-developed condition, it was hardly in an independent condition, and depended largely on German firms, nearly all of whom were represented in some way in Russia. Other nations competed only to a small extent; practically the whole of the import trade was in German hands. When the war broke out this naturally came to an end, and there was at once a great deficiency in many directions, seeing that up to that time very little electrical material had been manufactured in the country. Machines and apparatus of complicated construction, as well as fuses and instruments of all kinds, had been obtained almost entirely from abroad. At first the Russians tried to buy from friendly or neutral countries; but soon there was again a deficiency owing to the immense demands arising out of the war. Sweden and Denmark were soon very short of goods, and gradually a curious phenomenon was seen in the shape of the import of German goods into Russia through intermediaries in the shape of neutrals, the goods being first exported from Germany to a neutral country, and then imported into Russia. This, indeed, took place on a large scale; but as the Germans ran short of copper, which they replaced by iron, and as transport was slow and uncertain, this source of supply soon became unavailable, as before. The Danish and Swedish firms prospered under these conditions, and soon manufactured for the Russian market on their own account, gradually improving the quality of their output. The Russians took what they could get quite thankfully, as there was no alternative source of supply, though some of the imported articles were of good quality, and came from well-known firms of long standing and experience.

But Sweden, Holland and Denmark were unable to supply all that was wanted. Japan supplied some of the deficiency, but much of this material was of poor quality. They supplied, however, 25 per cent. of the total number of imported lamps, and these were quite good. Japan also supplied cables and materials for installations of indifferent quality. France supplied some precision instruments and a few special machines. Switzerland provided meters, turbines, and a few generators, some of which took two years for delivery. It was soon evident that America was the only possible source of supply, as England was unable to do much in the way of export. Relations were entered into with the General Electric Company of America, with the Westinghouse Company and with Siemens Brothers. There was still a decided tendency to prefer machines of the German type, to which the Russian market was accustomed.

In the middle of 1915 it became evident that the war would last more than a few months, and that it was a mistake to suppose that business would soon return to the old course. Up to this time immediate delivery had been regarded as essential, but now orders were placed for large machinery with delivery in 12 or 18 months. The first considerable consignment from England and America arrived about the end of 1916, and about this time a good deal of business was done with these countries. Immense deliveries were made at Archangel, Vladivostock and Alexandrovsk. The railways were quite unable to deal with these dumps, a large fraction of which is still there, and no attempt has been made to deliver the goods. Up to the declaration of the blockade, not more than 20 or 30 per cent. of these imported machines had been delivered, and a still smaller fraction had been put to work; but it was soon found that the quality of English and American goods was first class, and that the construction was thoroughly good. The prices were higher than for German goods, and the cost of transport was also greater. It may be noted that very little business was done in this direction by small firms in England and America, the vast majority of the orders being placed with big firms. The property of the German firms in Russia was sequestrated in 1915-1916, though it was not very thoroughly done. The future for these firms depends largely on the political aspect of things.

One of the largest factories in Russia was the A.E.G. Company in Riga, and there was a risk of its falling into German hands in 1915. There was also a great need to develop the Russian factories, in view of the difficulties of import. It was, therefore, decided to remove the Riga factory to Charkow, in the interior of Russia, where immense works were erected for the supply of first-class material. This factory employs thousands of workmen, and will probably play an important part in the future. A large number of other semi-German factories were also transplanted from the Baltic provinces, and these included the Volta-Gesellschaft, the Siemens & Halske Russian firm and a number of others. The Allmänna Svenska also erected works, and there were consequently several new factories of considerable size, besides a number of smaller ones. A number of lamp factories were also built, but they were only partially successful. There were only two which in the year 1917/18 produced 500,000 lamps, and these factories laboured under many difficulties, especially in the supply of raw material. They had no effective selling organisation, and it is probable that in the course of time they will disappear. The production of lamps on a small scale is always likely to be difficult, partly because such factories have no sufficient supply of technical experts. It is, however, expected that one of the large companies, already existing in Russia, will start a lamp factory as soon as the conditions are more favourable.

The outcome of the present political situation seems very uncertain; but, in any case, it seems very unlikely that any of the principal countries of the world will be able to supply the Russian market during the next 10 years or more, owing to the needs of their own markets. It must, however, be remembered that all machinery in Russia is either destroyed or worn out; there is no reserve on which to draw. In the towns there are no lamps, tramcars or any kind of electrical material, and the whole country is practically destitute of the necessaries of life. In view of difficulties of getting raw materials, it is hardly likely that the needs of the Russian market will be supplied within a reasonable time. But, besides raw material, it will be equally important to supply engineers and technical experts of all kinds. The German experts were expelled at the beginning of the war, and large numbers of Russian engineers have either been killed, starved or otherwise put out of action. There were a number of English and American engineers in the country during the war, and they did excellent work; but they left about two years ago. There is a difficulty about the language, but the business world in Russia and the principal officials and workmen are accustomed to speak German, which thus gives Germany an advantage over its competitors.

The conditions of the electrical industry under the Soviet Government are similar to those of all other industries, all of which have been nationalised. There is a Commission at Moscow which presides over electrical affairs, and this is largely manned by committees, which have grown up during the war. The various factories are partly in the hands of the old directors, but are mainly under the control of men who have been elected by the workers and officials. The financial arrangements for any factory are drawn up several months ahead, and, if approved by the Moscow Commission, necessary arrangements are made with the bankers. There is no question of working at a profit, seeing that wages and salaries make this quite impossible; the various firms exist at the expense of the State Bank. It is a fortunate circumstance that none of the leaders of the electrical industry in Russia have been killed, though some have been imprisoned. Their lot has not been a happy one, and they have suffered in many ways; but owing to some cause, or perhaps to chance, they have all of them escaped death.

The Soviet system, according to which everything belongs to the community, naturally excludes the idea of competition. Everybody works in the capacity of State official, on a schedule laid down by the Commission. It is undeniable that this has reduced the efficiency of the worker; but the removal of competition and the many phases of activity bound up with it, may not perhaps be altogether disadvantageous. It is well known that Russian engineers were always more interested in theoretical investigations than in their subsequent practical application—or, at any rate, they carried their theories beyond practical necessities. They drew up specifications, which demanded unnecessary details, for which the buyer had to pay without any counterbalancing advantages. The German firms to some extent may be said to have encouraged this practice. It is likely that this habit will now disappear under the new system of standardisation which is being laid down by the Commission. Part of the new system is that there shall be no differences between the types of machinery made by the various factories, but that everything shall be made on one model.

Work has suffered seriously during the Russian Revolution and the transplantation of various factories, such as the A.E.G. (now called the Russian General Electric Company), has also hindered progress. Some of these factories have been moved several times, and the result is that for the last two years it has in some cases been impossible to do any work in them. The blockade has shut out raw material, and this has been another cause of stoppage. Naturally the state of confusion which exists everywhere has intensified the disorder. It is impossible to give any statistics as to production but it is perfectly certain that it is wholly unable to meet the demand Naturally no central stations or electric railways have been constructed during the war, but this has not prevented the Russians from preparing a large number of schemes on paper, the cost of which would be millions of pounds. It is very uncertain whether any of these projects will materialise in the immediate future.

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* Abstract from the "Elektrotechnische Zeitschrift," No. 20, 1920.

Low and Medium Tension Switchgear.

The General Electric Company, Ltd., have issued the fifth reprint of the 12th edition of their X. & Y. Section Catalogue (low and medium-tension switchgear). Considerable alterations and additions have been made; the section is even more comprehensive than hitherto, thereby adding to its value as a well arranged compendium of switches, cut-outs and accessories for circuits up to 600 volts. The usual features are retained, and being divided into two main parts, open type gear and ironclad gear, with each part again subdivided into groups for easy reference, the catalogue will prove invaluable to engineers, contractors and all connected with the installation and upkeep of electrical plant lighting systems and apparatus.

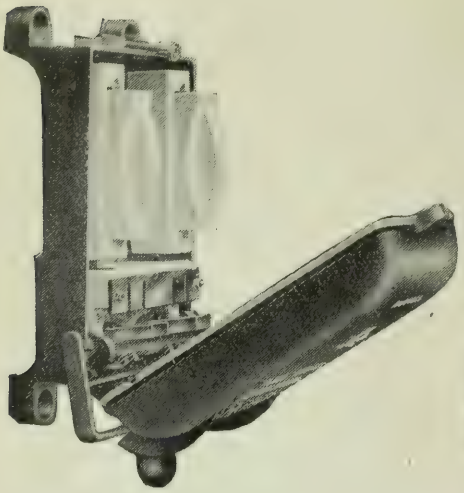

Fig. 1.—Double Break Switch.

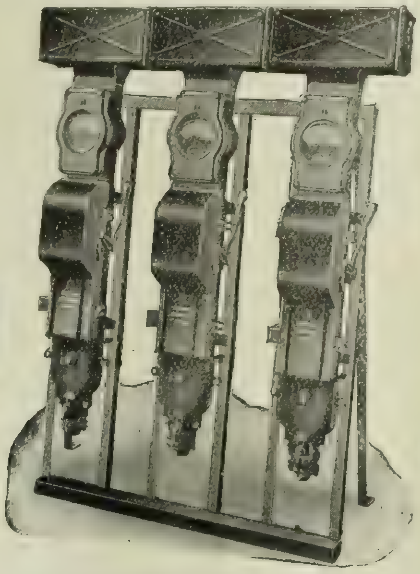

Fig. 2.—Unit Type Switchboard.

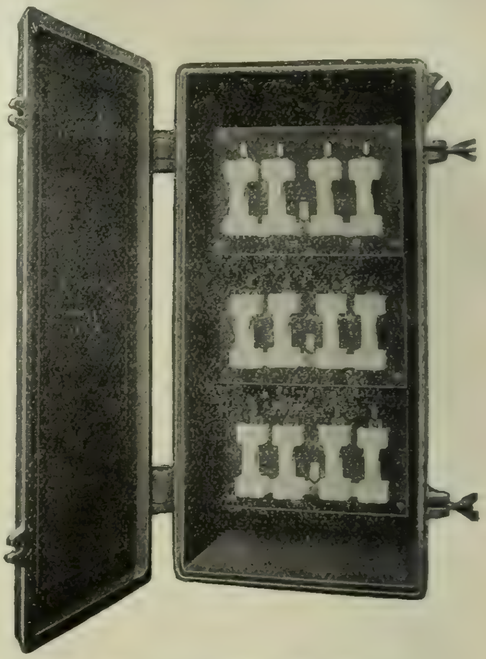

Fig. 3.—Stepped Fuse Board

"Peel," "Witton," "Adelphi" and "Leader" main switches are listed as hitherto and additional sizes and designs included. Besides battery switches, main and shunt resistance switches, field-breaking switches, volt and ammeter switches of the more usual types, a new design of three-phase ammeter switch makes its appearance. The pages following are devoted to main cutouts—"Bobbin," "Handguard," "Wedge" and "Open" types—and cable connectors, sweating sockets, &c. In the ironclad gear section a number of new sizes has been added to the range of "Salford" main switches, including 75, 150, 300 and 400 ampere switches and switches with fuses. The "Twin-break" switches are now listed also in triple pole, with and without fuses. The newest designs of "D.B." switches and switches with fuses are shown, thestirrup handle arrangement affording a most effective interlocking device.

Following a useful range of explosion-proof switches, for use in fiery mines and other situations where an explosive atmosphere may be present, we come to crane limit switches and switches with interlocked plugs for factory and dockyard use. For the first time space is devoted to the "Unit" system of "Salford" switches, a system which has proved so advantageous in factories and workshops for the control of motors, power and lighting circuits, &c., on account of its compactness, neatness and ease of effecting extensions. In brief, the system enables a complete dust and damp proof unit to be built up from suitable standard attachments with great economy in wiring, space and labour of erection.

The distribution fuse boards shown command attention, each board consisting of one, two or three enamelled slate slabs, according to the number of poles, with insulating barriers between. The fuses are of the G.E.C. hand-guard pattern, and to comply with the factory regulations insulating shields are provided, which make it impossible for an operator accidentally to come in contact with any live metal on the front of the fuse panels. Bus bars and branch terminals are fitted with the necessary sweating sockets. The enclosing case is of cast-iron, with solid or glazed front and is rendered weather-proof by means of a tallowed-hemp gasket, fitted into a groove all round the joints between the lid and the box. Standard boards are supplied with plain holes, which, to facilitate wiring, are drilled as nearly as possible directly opposite the sweating sockets and are fitted with wood bushes, but special drilling can be arranged to suit customers' requirements, and water-tight and special glands for armoured cable can be supplied. For three-phase distribution the "Stepped" type of fuse board possesses great advantages. These boards are similarly equipped to the distribution boards just described, but to meet the difficulty in connecting up, especially if there are many ways on one board, each phase is arranged on a different level, *i.e.*, at different distances from the back of the case, arranged at the top of the board, in the most convenient positions for the inlet and outlet cables. Special drilling can be arranged to suit customers' requirements. Water-tight and special glands for armoured cable can also be supplied. The final section is devoted to house service cutouts, sealing troughs, fuses for house service cutouts, switch and cutout sets of the G.E.C. tried and proved designs, and to explosion-proof cutouts. Nine pages of dimension drawings complete this excellent and useful publication.

The Swedish Power Station at Västeras.*

This station completes the scheme of the Swedish Government for the supply of electric power. Two other stations have already been built, and are supplied with water power; one of these is at Trollhättan, and supplies the midland districts, while the other is in the south at Älfkarleby. The former contains 10 turbines, giving in all 85,000 kw., while the latter has five turbines with a maximum output of 50,000 kw. The Trollhattan works get their power from the Gota river at a fairly uniform rate; but the power at the disposal of the other station from water sources is very variable. In the winter months it is only half the amount available in the summer months, owing to the fact that in the latter period of the year the melting of the snow causes a great increase in the rate of flow of the water.

It was, therefore, decided that a steam-power station was needed to smooth out these differences, and the site chosen was at Västeras, on the north side of the Mälar Lake, about 110 km. from Älfkarleby, and 290 km. from Trollhättan. There has been a great shortage of coal in Sweden during the war, and this together with other causes has led to heavy demands on the water-power stations. The extreme points of supply of the two hydraulic stations are only 100 km. apart, and the steam-power station will, therefore, be a useful auxiliary to both of them; in fact, it is now proposed to unite the two distributing networks. Still, the new station is specially intended to assist the southern power station at times when it suffers from a deficiency in the supply of water, and at present it is only proposed to use it when this lack of sufficient water arises at Älfkarleby. The conditions are, however, very irregular, and depend on the accidents of rainfall and temperature. It is expected that the Västeras Station will have to be operated for a short time in the early spring, and for a longer period during the winter; under unfavourable conditions it might have to work throughout the winter into the spring. When the snow begins to melt in May, the steam station will be completely closed for two or three months; or rather, its output will be suspended, as there also remains the possibility that it may be needed in case of a serious breakdown at one or other of the hydraulic stations. These considerations rather complicated the design; it was impossible to design the station on the lines of highest efficiency for a steady output without taking into account the fact that it may be necessary to put the station into operation with the least possible delay with very few attendants. This part of the problem, in so far as it relates to the attendants, has been solved by building in the immediate neighbourhood large workshops, in which all the repairs which arise out of the Älfkarleby station are done. There are thus always sufficient men on the spot to manage boilers and engines, and men are always available from the peat bogs of the district, these bogs being exploited for combustible for the boilers; work on the peat bogs is most conveniently done in the summer, and this harmonises with the general scheme.

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* Abstract from the "Elektrotechnische Zeitschrift," No. 6, 1920, and "Teknisk Tidskrift."

The new steam station is 1 km. to the east of the town of Västeras at a short distance from the Mälar Lake, with which it has been connected by a canal; it is also connected with the railway. Diagrams are given showing the general lay-out of the works. The engine-room is at present large enough for four units; corresponding to this the boiler-house contains 10 boilers. The output is to be 40,000 kw. At the moment, there are two turbine sets, each of 5,000 kw. with a power-factor of 0·7; with a maximum output of 7,000 kw. at a power-factor of unity. Power is generated at a pressure varying from 6,300 to 7,000 volts at 3,000 revs. per min. These outputs can be obtained with any steam pressure between 14 and 19 atmospheres; the superheat is about 375°C. In consequence of the high velocity of the steam, which amounts to 70 meters per second, great care had to be exercised in the design and arrangement of the steam piping. A third turbine, giving 10,000 kw. to 14,000 kw., is on order; they have all been made in Sweden. There is space for the installation of a fourth turbine of the larger size.

Tests were carried out on the 5,000 kw. turbines. With steam at 325°C., and condenser water at 5°C., the following results were obtained: At 2,500 kw., the Laval turbine took 6·05 kg. per kilowatt-hour, while the Stal turbine took 5·12 kg.; at 5,000 kw., the Laval turbine took 5·55 kg., and the Stal took 4·72 kg.; at 7,000 kw., the corresponding figures were 5·7 and 5·08. These figures are slightly better than the guarantees. If we take the steam consumption of the Stal turbine at 5,000 kw. as the basis, then with coal of a calorific capacity of 6,200 heat units, and an efficiency of 83 per cent. at the boilers, we consume 0·7 kg. of coal per kilowatt-hour, allowing for a loss of 3 per cent. in the steam piping and auxiliary machinery. The thermal efficiency of the whole is 19·8 per cent. The Stal turbine rests on its condenser and required no special foundations, while the Laval turbine is built on six concrete pillars, which are completely separated from the building. When the machine was first set in motion, very dangerous vibration of the building was caused, but this was rectified by completely isolating the foundations from the rest of the engine room. The condenser water is obtained from the canal, each turbine requiring 600 litres per second. A turbine-pump is also available for the Laval set in case of need. Cooling air for ventilating the generators is supplied through conduits, and up to the present there has been found to be no need to filter the air.

Voltage-regulation is controlled by resistances in the fields of the exciters. The travelling crane has a capacity of 37·5 tons. All motors and all the lighting of the station is done with low-tension polyphase current, supplied through two transformers of 500 kw. capacity. The generators are connected to the switchboard through two three-core cables with sectional areas of 240 sq. mm. A double system of 'bus-bars is used. An induction regulator which can vary the voltage by 10 per cent. on either side of the mean value is used for supplying power and light to the neighbouring town of Västeras; this is necessary on account of the considerable variations of voltage which arise out of the long-distance transmission to Älfkarleby. The two main transformers give 5,000 k.v.a., and have two high-tension windings for 20,000 and 70,000 volts. They weigh 40 tons when filled with oil. In the further extension of the station it is likely that higher pressures will be used, seeing that it is proposed to connect it with Trollhättan, and it may be used for supplying power in some of the northern districts of Sweden. The article contains a diagram, showing the general connections on the switchboard; also another showing the general arrangement of boiler house, engine room, transformer room, workshop, &c., and a third showing the position of the power house with respect to the lake and railway, and the methods of unloading coal.

The PRESTON TELEPHONIC district has been incorporated in that which will be governed from Blackburn, in pursuance of the general policy to extend the areas under the control of one head official, in the interests of administrative efficiency and economy. On the 1st inst. Mr. John Ashton, district telephone manager, of the Rochdale, Oldham, Huddersfield and Halifax area, retired after 39 years' service.

Commercial Topics.

Australian Electricity Supply Developments.

There are many interesting electric supply and traction projects at present under consideration, and one of the most interesting of these is the scheme for providing an adequate supply of electric current in greater Sydney in order to meet the rapidly increasing demands in the district. Sydney City Council will probably purchase a coal mine, erect a power house in the vicinity, and construct electric transmission lines to Sydney, a scheme involving a capital outlay of between two and three million pounds sterling. H.M. Commissioner reports that the City Council has resolved to acquire a coal property, principally to supply fuel for its power house, and the general manager of the Electricity Department (Mr. H. R. Forbes-Mackay) has reported to the Council of Sydney that it should have in operation an entirely new power house on a different site from that of its existing generating station, ready to meet the ever-increasing demand for electricity early in 1925 at latest. If the new power house is established in or near the City the first portion of the plant will consist of three turbo-alternators, each of not less than 12,000 kw. and not more than about 18,000 kw. Boiler-house plant, coal handling, ash handling, and pumping plant would also be required and switchgear for the control of the three alternators and probably from 10 to 20 feeders. If, however, the new power house is established adjoining the coal mine it would probably be equipped with larger generating units. A transmission line of not less than 60 miles would be required and also step-up and step-down transformers. Mr. Forbes-Mackay will be pleased to have from British manufacturers any information about their plant, particularly about devices for burning coal economically, handling coal from railway trucks into overhead bunkers, handling ashes from automatic stokers, &c.

* * * *

Hydro-Electric Development in Sweden.

The scarcity and high cost of coal have led to a rapid development of Swedish water power, to a great expansion of electric traction on the railways and of electric power for mining and industrial purposes. Fortunately the vast waterways of the country offer almost unlimited resources of power. According to "The Time's Trades Supplement the existing hydro-electric works are producing 1,150,000 turbine horse-power, while further works under construction will soon add another 250,000 h.p. Ten of the principal rivers in Sweden furnish the original driving power, while the electricity produced is carried for hundreds of miles across country. The generating plant (turbines, electric generators, transmission line, &c.), is largely of Swedish manufacture, but some of the distributing networks, motors, &c., have been imported. Four large stations belong to the State, and 32 (of more than 5,000 h.p. capacity) to private companies. The railway line from Kiruna to the Norwegian frontier was electrified some years ago, and the Kiruna-Lulea, Stockholm-Gothenburg, and Nordmark-Klaralfoen lines are now being electrified. Several private lines have also been converted. At present 19,000 kilometres of electric transmission line are owned by private enterprises. It is estimated that 280,000 acres of land are under cultivation where electric energy is used for both agricultural purposes and lighting. Including the farms where it is only used for lighting, this area covers 480,000 acres. Adding that of towns where electric power is used in local industries as well as for lighting and traction, the area served by electric energy amounts to a million and a half acres. The Government is empowered to grant loans to private companies for carrying out hydro-electric enterprises, while 14 million kronor have been voted for completing the work of introducing electric traction on the State railways.

* * * *

The Tasmanian Spelter Industry.

Important developments are taking place in connection with the scheme for establishing the spelter industry on a sound commercial basis in Tasmania. Last year the Government secured Parliamentary sanction to expend £500,000 in utilising the water power of Lake Rolleston in order to supply the Mount Read-Rosebery Mines, Ltd., with power for producing 50 tons of spelter per day from the group of mines on the west coast of Tasmania. This scheme has now been dropped, but the Electrolytic Zinc Company (Proprietary), Ltd., which has been producing zinc at Risdon, near Hobart, from New South Wales ores, has taken over the mines of the Mount Read Company, as well as the latter Company's option to purchase from the Government the Zeehan smelter site for establishing there a plant for the reduction, smelting and concentration of West Coast zinc and lead ores. The zinc concentrates produced at Zeehan will be taken over the Strahan-Zeehan railway to Strahan and shipped to Hobart, where the zinc concentrates will be treated. The Government is to purchase from the Mount Lyell Copper Mining Company a supply of electrical energy to be delivered at that company's power station at Lake Margaret, and erect a transmission line from there to Zeehan. It will have available about 1,500 H.P. for mining and other purposes in Zeehan for the Electrolytic Zinc Company. It was found uneconomical to establish a second zinc decomposition plant in Tasmania, and consequently an amalgamation of interests was arranged in order to meet competition with strong companies in other countries. Over 90 per cent. of the anticipated production has to be exported. The Electrolytic Zinc Company, which will increase its capital from £1,000,000 to £2,500,000, is now producing 15 tons daily of the highest grade zinc, assaying over 99.95 per cent. The construction of the plant to produce 100 tons per day of electrolytic zinc is steadily proceeding.

Electricity Supply.

Wimbledon Corporation have applied for consent to put in a 3,000 kw. turbo-alternator.

Epsom Finance Committee has been authorised to purchase an electric syren for £235.

Belfast Corporation have increased the charges for electric lighting and power by 20 per cent.

Leyton Urban council have received sanction to loans of £5,000 for mains, and £2,000 for services.

Gellygear Urban Council have applied for a loan of £2,000 to form a working balance for the electric light undertaking.

Bodmin Council have accepted the offer of the local electric light company for public lighting for ten years at £278 per annum.

Exeter Corporation has applied for permission to borrow £30,426 for additional plant, including a 1,500 kw. turbo-generator.

The price of electricity for private lighting has been increased from 8d. to 10d. a unit in Llandudno, and for power from 2½d. to 4½d.

Leeds Electric Committee has agreed to give a supply of electricity in bulk to Morley Corporation, subject to the consent of the Electricity Commissioners.

Hastings Corporation has adopted a scheme for improving the street lighting, including 31 front line arcs and 63 street arc lamps to be lit from sunset to sunrise.

Penzance Housing Committee have instructed their architect to ascertain the relative cost of electric and gas lighting in the houses to be erected on the Lescudjack site.

Portsmouth Corporation have sanctioned a scheme for extensions of the generating plant at a cost of about £75,000, including a 4,000 kw. turbo-alternator, water tube boilers, &c.

Stirling Corporation has made a further increase of ½d. a unit (from 7½d. to 8d.) in the charge for electric lighting. The power and public lighting charges have been increased by five per cent.

On Wednesday Liverpool City Council agreed to apply to the Electricity Commissioners for sanction to borrow £115,000 for additional generating plant at the Lister-drive electric power station.

Ilford Urban Council proposes to expend £10,000 on a new feeder and house services in the Cranbrook-road district, and to supply the new houses on Townswood Hill by means of an overhead line.

Hammersmith (London) Council has received the sanction of the Electricity Commissioners to a loan of £11,000 for the linking-up of the Battersea, Fulham and Hammersmith electric generating stations.

King's Lynn Corporation is investigating the probable demand of electricity in the villages of Terrington and Clenchwarren, and if there should be sufficient support supply will be given by overhead cables.

In view of the proposals for the reorganisation of electricity supply in North Wales the Urban Council of Prestatyn has appointed a committee to report on the question of introducing electricity supply in the Council's area.

Stepney (London) Council has adopted the Electricity Supply Committee's estimate of £6,000, the cost of reactances required at the Limehouse station in connection with the substitution of a 10,000 kw. for a 5,000 kw. set.

The Peterborough Corporation has asked the soke of Peterborough County Council to authorise the extension of the electric supply mains to the parishes of Thorpe, Glinton, Walton, Castor, &c., outside the borough boundary.

At a meeting last week of representatives of electric supply undertakings in the Lancashire and Cheshire districts the National Joint Board's new scale of salaries for technical members of electricity sraffs was rejected, and it was decided to frame a scale of their own instead.

It is announced that the dispute between Worcester Corporation and the E.P.E.A. has been settled by the Corporation agreeing to adopt the schedule of salaries, subject to the decision of the District Joint Board upon outstanding matters.

Pontefract Rural Council have consented to the use of overhead lines by the Yorkshire Power Company for the supply of electricity to Glass Houghton and Ferrybridge, and have asked the Company to arrange the lines so as to connect with the houses to be erected at Airedale.

The Ayrshire Dockyard Company propose to erect a power station at the East End of Irvine Harbour, which will be capable of supplying current for power and lighting requirements and also for the operation of pneumatic tools used in ship repair work.

Pending the formation of District Joint Boards for No. 5 and No. 7 Area (Midland Undertakings), informal meetings between representatives of the undertakings and representatives of the E.P.E.A. are being arranged to deal with the schedule of salaries for the technical staff. In No. 7 area a meeting was held on the 7th inst., at Nottingham.

Bingley Urban Council has notified Keighley Corporation that it proposes to refer to arbitration the question as to the means of preventing the repeated interruptions of the bulk supply of electricity by the Corporation to the Council, as provided by the agreement between them. Mr. T. Roles, of Bradford, is suggested as arbitrator.

Caerphilly Urban District Council has given notice of intention to apply for a Special Order to authorise the provision and distribution of electrical energy in the portion of the Council's area set out in the Caerphilly Order of 1913; to empower the purchase of the undertaking of the Caerphilly Electric Supply Company and to make a connection with the mains of the South Wales Electrical Power Distribution Company.

At a recent conference of local authorities in Falkirk, steps were taken to form a joint electricity authority. There were representatives present from the burghs of Stirling, Falkirk, Grangemouth, Denny, Alloa, Bo'ness, Bathgate and Armadale. A committee was appointed to ascertain the possible requirements over the whole area for the next five years, with a view to placing a scheme before the Electricity Commissioners.

Guildford Town Council have decided to purchase the undertaking of the Guildford Electricity Company, Ltd., for £55,000, and in order to defray the cost and to finance future developments they are asking for sanction to a loan of £80,000. The company was registered in 1892 and has a paid-up capital of £34,150 with £25,000 debentures and £15,000 loans. The total plant capacity is 1,200 kw., and there are about 1,300 consumers. No dividend has been paid since 1915. The shareholders have authorised the directors to sell at the figure stated.

The "South Wales Daily News" calls attention to the fact that the scrapping of the national shipyard at Beachley will leave the Chepstow district a distinct asset in the large power house on the Gloucestershire bank of the Wye, which is equipped with three turbo-alternators (two of 3,000 and one of 1,000 k.v.a.), and is running on a 24-hour load. There are three sub-stations connected with the system. The station superintendent is Mr. A. G. Greenfield, and he is optimistic regarding the future of the power house, which could be easily adapted to the needs of a super-generating station.

The Finance Committee of Manchester Corporation has withdrawn its opposition to the proposal to furnish the Lancashire Electric Power Company with about 20,000 kw. from the Barton power station, necessitating the erection of additional generating plant, at £700,000. By spending this money, the committee points out, Manchester would be anticipating its own requirements, and would also be keeping its place as the chief authority in the Electricity Commissioners' scheme for South-east Lancashire. The charges to the company would be on a higher scale than to Manchester consumers, the main addition to the charges being 7½ per cent. as "commercial profit."

The Birmingham Electric Supply Department announce that they have had to restrict the use of electric power, more particularly between 8 a.m. to 10 a.m., and from 2 p.m. to 4 p.m. daily, and otherwise where special agreements exist. In other cases the consumers have been requested substantially to economise in their use of power. The department, which asks for the co-operation of the public, points out that difficulty is being experienced in maintaining full supplies of current, and state that some measure of restriction is essential during the winter months with the heavy demands on the machinery. The new generating station at Nechells should have been in use by this time, but unavoidable delays were encountered in its erection and equipment, and the station is not likely to be ready for use for a considerable time.

Some attention is being paid to the development of Scottish water power, and an interesting meeting of representatives of public bodies in Invernessshire has been held in Edinburgh in order to consider the subject of the development of water power in the Highlands. Sir John Stirling Maxwell, Bart., presided, and Mr. W. Murray Morrison explained in detail the proposals of the British Aluminium Company for the development of the water power in the Spen Valley. The Company would promote a bill or Provisional Order for carrying out the scheme. The power to be developed would be about 60,000 h.p. and the energy would be used mainly for the production of aluminium, but a part of the power would be reserved for local industries. The meeting was of opinion that, in view of the necessity for providing employment and of the resettlement of men in the Highlands, the scheme should receive the support of the Government.

Another interesting scheme is the proposal of the Hydro-Electric Development Company, Ltd., to apply for a Provisional Order to authorise the utilisation of the water-power in North Perthshire in generating electricity. The scheme is receiving substantial support in Dundee.

The accounts of Sheffield Electric Supply Department for the year ended March 25 show revenue £786,493 (compared with £735,145 in previous year), working expenses £569,578 (£504,255), leaving gross profit £216,915 (£230,890). Interest and sinking fund required £184,992 (£161,596), and the net profit was £31,923 (£69,294), which has been placed to renewals and special expenditure fund. Average price obtained was 1·27d. (0·99d.) per unit, and cost per unit sold was 0·90d. (0·65d.) exclusive, and 1·23d. (0·89d.) inclusive, of capital charges. Maximum load was 60,593 (59,546) k.v.a. Units generated (including traction) were 158,248,710 (192,019,666) and sold 132,178,750 (161,839,041). Total connections are equal to 164,262 kw. (149,802 kw.), and motors connected aggregate 124,063 (113,548) h.p. There are 9,902 consumers (increase 1,938). Average cost of coal was 28s. 1d. per ton, compared with 22s. 6d. in previous year, and 13s. in 1916. The revenue of the installation and motor department (included in the above figures) was £82,462 (£63,878), and the working expenses were £76,938 (£60,854).

Ald. Styring, who submitted the accounts at a recent meeting of the Council, said the Committee were sorry they could not contribute anything to the relief of rates this year. The renewals and special expenditure fund was much depleted, and it was necessary to increase it. The expenditure out of that fund would be £83,500 for renewing certain generating plant and the renewal of four boilers, the cost of which was over £70,000. By the use of the new plant their position would be strengthened. During the current year the output of energy would exceed that of the last of the war years

Electric Traction.

The Hull Tramways Committee has acquired for £10,000 a site in George-street to serve as central tramway offices.

The short electric tramway route of the Edinburgh Corporation, on which there was a loss of about £2,800 a year, has been closed down, and a limited motor omnibus service has been substituted.

Hyde Corporation, which recently acquired the undertaking of the Oldham, Ashton & Hyde Electric Tramway, Ltd., is carrying out various improvements and extensions of the system. A large shed has been erected on land adjoining the depot in Mossley-road, over a dozen new tramcars have been purchased, and a new tramways office will be built. It is also proposed to lay a double tram track between Ashton and Oldham, and to inaugurate a through service of cars between the two towns.

The Extra-London Councils who own tramways have passed a resolution regretting that the L.C.C. should have approached the Ministry of Transport for the purpose of taking joint action with the companies dealing with omnibus traffic in the London area without first consulting the Metropolitan Tramways Council. They have also expressed the opinion that no co-ordination of traffic between the tramways and other surface traffic can be satisfactorily obtained unless such co-ordination is made to include the tramway and other traffic of the outer London area.

Owing to the high cost of laying down concrete foundations for tram rails Bradford Tramways Committee proposes to construct certain projected extensions with special tracks on sleepers, with a ballast foundation. Between Harehills and Oakwood, the Corporation have bought a strip of land which will be utilised for tramways. The rails will be laid on sleepers above ground, after the style of a light railway, and as there will be no ordinary traffic the tramcars will develop a much higher speed than normally. Another track of the same character is to be laid down between Hunslet and the new "garden city" of Middleton, and as existing lines fall due for renewal on the various outskirts the tramways manager will consider how far it is possible to resort to this cheaper method of construction.

London County Council, who are inviting tenders for 125 tramcars and equipments, are further offering a prize of £1,000 for the best design for a new type of electric tramcar. The assessors will be the General Manager of the L.C.C. tramways, Mr. A. L. C. Fell, and an engineer to be appointed by the President of the Institution of Civil Engineers.

The Ministry of Transport has consented to the use of the overhead trolley system of traction on the L.C.C. tramways in Grove-road, Burdett-road and West India Dock-road. The work will shortly be commenced. Owing to a dispute between Stepney Borough Council and the L.C.C. as to the system to be adopted, there has been no tramway service in this part of London since the horse cars were abolished many years ago.

As the result of a recent inspection of the Newcastle-on-Tyne Corporation Tramways, Major G. L. Hall, R. E., of the Ministry of Transport, reports that there is serious overcrowding on the Scotwood and Walker routes, and he makes the following suggestions: (*a*) The regulation by the police of passengers at times of big loads into queues, and the erection of barriers similar to those used in London; (*b*) the exhibition of a conspicuous notice, "Car full," and the provision of a barrier, which, for the present at any rate, may have to be more substantial than a chain across the entrance, the removal of which will be under the conductor's control; (*c*) the co-operation of the police and of the tramways management in ensuring that the load on cars is kept within a reasonable limit, more particularly in respect of regulating queues.

After the inspection of the Pinkston power station on the 29th ult by members of the Glasgow Tramways Committee and officials of the department, the party was entertained to luncheon. The convener of the Committee (Councillor Kelly) made an important statement on the financial position. He said the revenue from the increase in fares had exceeded expectations, and it was well that that was so, because expenses were still on the up grade. It had been said that the Committee could meet the demands which were at present being made by the employees and still leave £250,000 to the common good. He wished to disabuse the minds of the public that any such huge surplus would accrue at the end of the year. From June 1 to Aug. 31 the revenue amounted to £559,770, and the expenditure was £444,585 (traffic, £241,881; general, £72,381; repairs, £85,368; power, £44,367; and Clydebank bridge, &c., £588), leaving a gross balance of £115,185; but after deducting £46,560 for depreciation and renewals, £18,000 for income tax and other items, the quarter's surplus was only £45,615. From this there had still to be deducted a quarter of last year's deficit (£27,000) and an additional sum to renewal fund of £14,700, or a total of £41,700. The actual surplus was thus only £3,915 at the end of the first quarter and the department had not yet seen the top of the working expenses. They had a demand at present for an increase of 10s. per week to the uniformed staff and to skilled and semi-skilled workers. That would require about £150,000, but if all the demands were to be met they would require no less than £250,000. While the Corporation were willing to give their employees the highest wages and the best conditions, he thought there was a limit to which they could go. If the expenditure of the department was to be increased by anything like the figures indicated in the claims to which he had referred, the tramway fares must be again increased in order to balance the accounts.

Imperial and Foreign Notes.

A sum of $1,000,000 is to be spent by the Manitoban Government developing hydro-electric supply in the rural districts.

Portage la Prairie is now being supplied with electrical energy from the Winnipeg hydro-electric plant, the transmission line being over 56 miles in length.

An engineer from an American electric firm has been sent to British Guiana in order to make a preliminary investigation into the hydro-electric possibilities of the Colony, provided that the approval of the Colonial Government can be obtained.

Preliminary work is being carried out in connection with the hydro-electric works, which it is proposed to establish at Lillooet, on the Bridge river, British Columbia. The estimated capital expenditure on the undertaking is six million pounds. Plans for a tunnel a mile and a half long, under Mission Mountain, are being prepared. The fall will be 1,400 feet, and it is expected to develop 4,000 h.p.

The "Industrial Australian" states that Accumulators, Ltd., a Sydney company, of which Mr. W. N. Caton is managing director, has increased its capital to £25,000, and that the company has reached the manufacturing stage. Mr. Caton stated that the company will be largely dependent on the tariff being passed by the Federal Parliament which gives a protection of 27½ per cent. against English batteries and 40 per cent. against American batteries.

Mr. J. H. Butters, general manager of the Tasmanian hydro-electric department, has set out on a visit to Canada, the United States and England, in order to study the latesr development in hydro-electric generation and transmission work and to select machinery for the big construction works now in progress in Tasmania. Mr. Butters will be absent seven or eight months. When the present Great Lake scheme is completed the department will be generating 78,000 h.p., and other hydro-electric projects will then be undertaken. A water-power survey of Tasmania is in progress.

A Victorian syndicate has been formed for the distillation of brown coal on a large scale. Options have been secured over large deposits at Altona, near Melbourne, and at Lal Lal, in the Western district of the State. It is also possible that the syndicate will secure concessons from the Government for certain areas at Morwell, where the State is erecting a power house to supply Melbourne with cheap electric power. The syndicate has sent a representative to England to test samples of the coal, and if the result is satisfactory the representative will take back with him plant and machinery for a large distillation works.

It is stated that the Postal authorities of Uruguay have again invited tenders for the construction of an underground telephone system.

Christiania municipality is about to issue a loan of 50 million krone for the purpose of completing several electric generating plants for lighting the town, supplying power at the harbour buildings, &c.

The work of electrifying the Mont Cenis railway is now complete and the first electric train was recently run through the tunnel between Turin and Bussoleno. The line is worked on the three-phase system at 3,000 volts.

The British Consul at Oruro (Bolivia) states that British manufacturers have given little attention to that district's requirements of electrical plant and mining machinery, and important orders have gone to countries which have travellers touring over the large mining centres

It is reported that the South Manchuria Railway Company proposes to spend during the next five years 426,180,000 yen on improving the tracks, new rolling stock, &c.. It is proposed to spend nearly 6,000,000 yen on the extension of the electricity works in Dairen, Mukden, Changchun and Antung.

The Chamber of Commerce of La Rochelle (France) has been authorised to raise a loan of 2,100,000 francs for improvements at the port of La Pallice, including the erection of eight electric cranes and the construction of electric tracks for the same, the enlargement of the electricity sub-station, the lengthening of sheds, &c.

A project has been prepared by the Argentine Direction of National Sanitation Works Board with regard to works for the provision of running water for the City of La Banda (Santiago del Estero), the estimated cost of which, including the installation of plant for electric lighting amounts to $357,308 (paper), and a Decree has been published approving the project.

In connection with the scheme for the conversion of Belgian railways to electric traction, it is announced that direct current third-rail system at 1,500 volts will be adopted as in France. The use of electricity for domestic and farm purposes is extending rapidly, especially in the industrial areas. In North Hainault farms and small communities are served with both electric light and electric power, and the small as well as the large factories use the electric drive.

The total Production of Electrical Energy in the United States in 1919, according to statistics prepared by the U.S. Geological Survey, was 38,900,000,000 units, of which 37·9 per cent. were produced by water-power and 62·1 per cent. by steam power. New York State produced more hydro-electric energy than any other State (about 250,000,000 units per month), and also took the lead in regard to generation of energy by steam power (about 225,000,000 units per month).

It is reported from Washington that the tests of the Radio Control Installation on the "Iowa," carried out by the U.S.A. Navy Department off the Virginia Capes, have fulfilled the highest expectations of experts. The 12,000-ton battleship was navigated with accuracy, solely by means of radio waves emanating from a control station on the battleship "Ohio." The control is said to have been thoroughly efficient up to a maximum distance of 10 or 12 miles.

A brief outline is given in the "Financial News" of a big scheme prepared by Herr Hugo Stinnes for the development of electricity supply in Rhenish Westphalia. Electric power is used in local industries to a greater extent than probably in any other part of the world. Herr Stinnes is largely used in coal mines and the by-products of coal, and he has purchased a soft coal mine which he proposes to hand over to the Rhenish-Westphalian Electric Company, thus enabling it to expand its sphere so as to cover the entire Ruhr district. The shareholders of the purchased mine are guaranteed a regular dividend of 24 per cent. The great industrial leaders of the entire Rhine district will subscribe all the capital needed for the scheme which Herr Stinnes considers will solve the coal problem for German industrials.

A somewhat unusual demand for the extension of an electric service cable recently came before the Massachusetts Department of public Utilities. A wealthy resident of Newton (Mass.) made a demand upon the Edison Electric Illuminating Company to spend about £450 in extending a three-phase feeder by about a half mile in order to supply a single electric elevator. The district is served by single-phase circuits, and the petitioners contended that the company should rearrange its lines to enable the operation of a three-phase elevator in a new residence, bearing all the expense. The company offered to build the line on a basis by which its cost would be deducted from the bills of the resident from year to year until paid for. This was not considered satisfactory, and an appeal was made to the Public Utilities Commission who found that the demand was unreasonable as no other customers required that type of service and the cost would be borne by the small users if the company had to carry out the extension.

Personal and Appointments.

Mr. Mainstone, M.Sc., of Bristol, has been appointed Lecturer in Physics at the University College of North Wales, Bangor.

Glasgow University Court have appointed Mr. James G. Gray, D.Sc., to the Gargill Chair of Applied Physics, established at Gilmore Hill. Dr. Gray is the second son of Prof. A. Gray, F.R.S., Professor of Natural Philosophy in the University, and for some years he has been performing the duties of a Prpfessor of Applied Physics, conducting the classes in Physics in the University for engineering students, &c.

Stepney (London) Borough Council has appointed Lieut.-Col. G. G. Ewer, D.S.O., sales engineer in the Electricity Supply Department, at £600 per annum, rising by one annual increment to the rate scheduled for grade 3 (class F) in the schedule of salaries for technical engineers issued by the National Joint Board. The inclusive salary of Mr. A. J. Squire, deputy (commercial) manager, has been increased as from June 1, 1920, to the same figure as that paid to Mr. Young, resident deputy electrical engineer.

The engagement is announced of Captain Wedgwood Benn, D.S.O., D. F. C., M.P. (son of Sir John Benn, Bart.), and Miss Margaret Holmes, daughter of Mr. D. T. Holmes, ex-M.P., and Mrs. Holmes, and a granddaughter of Provost Eadie, of Paisley. Capt. Benn represents Leith in Parliament, and was member for St. George's in the East from 1906 to 1918. He served with the Yeomanry in Gallipoli in 1915, after which he entered upon his career in the air, first as an observer with the R.N.A.S. His gallantry on the occasion of the sinking of the "Ben My Chree" by the Turks gained him the D.S.O., and his good work on the many fronts has been recognised by a continuous award of decorations, notably the D.F.C., the Legion of Honour, the Croix de Guerre, the Italian Medal for Valour and the Italian War Cross.

Business Items, &c.

Messrs. Joseph A. Mackle, Ltd., 168, Regent-street, S.W.1, are agents in this country for the Milburn electric battery passenger car.

Joseph Wm. Carrack and Wm. Hy. Cass, electrical engineers and contractors, 6, Park-place, Leeds, have dissolved partnership. Debts by Mr. Carrack, who continues the business.

The partnership between Geo. A. Imlay, Wm. Imlay and Edward Bland (trading as Imlay & Bland), electrical and general engineers, &c., London-road, Oadby, Leics., has been dissolved. Debts by Messrs. G. A. Imlay and Wm. Bland.

Messrs. Hollings & Guest, Ltd., Birmingham, notify that they are still supplying their tyre presses in large numbers, having during the last few months completed numerous export orders, in addition to satisfying the requirements of many home garages.

Mr. N. C. Joseph, 500, Moseley-road, Birmingham, has recently designed and patented a new electric kettle, which will be in aluminium, one size only, and supplied as a standard proprietary article. Its method of construction enables it to be supplied to the public at a considerably lower price than those already in vogue.

The partnership between James Edmund Sayers and James Caldwell, consulting engineers and electricians, carried on at 190, West George-street, Glasgow, and Parliament Mansions, Victoria-street, London, S.W. 1, under the style of James E. Sayers & Caldwell, has been dissolved as from Aug. 20, 1920. Mr. Sayers will carry on business at 190, W. George-street, Glasgow, and will discharge the whole obligations of the firm, and will collect all debts due to the firm. Mr. Caldwell will carry on business in his own name at Parliament Mansions, Victoria-street, London, S.W.

Miscellaneous.

A nine-hole golf course illuminated electrically has been provided at Detroit (Mich.) for the convenience of golfers who cannot find time to play by daylight.

Premises for the erection of a new London telephone exchange have been acquired in South Audley-street. The exchange will probably be known as the Berkeley and will relieve the congestion at the Mayfair exchange.

A 1,300 ton floating crane, with a lifting power of 200 tons and operated by ten electric motors, had been acquired by the Mersey Docks and Harbour Board, and is now in Brunswick Dock. It is said to be the largest crane ever seen on the Mersey, and was built in Holland and originally intended to be sent to Russia.

At Lancaster on Monday an inquest was held on Thos. Stackhous as the result of the recent tramcar accident. When a car was descending a hill it got out of control, jumped the track and crashed into a garden wall, striking deceased. A verdict of misadventure was returned, and a rider was added that there should be stricter supervision of tramcars in regard to repairs.

Another step towards the amalgamation of the Industrial League and Council and the National Alliance of Employers and Employed was taken on the 29th ult., when it was decided at a joint meeting of the Executive Committees of the two organisations to recommend the early amalgamation of the two bodies. A sub-committee was appointed to arrange details with regard to organisation, administration, finance, &c.

An interesting exhibition of domestic electric appliances, which is being promoted by the Greenock Corporation electricity department, will be held at the Town Hall, Greenock, from the 12th until the 19th inst. There will be a good display of heating and cooking apparatus, vacuum cleaners, fans, motors, electric lamps, &c., and no doubt the electricity department will, in due course, reap the reward of their enterprise by an increased demand for electrical energy for domestic purposes.

The annual report of the Poplar (London) medical officer of health (Dr. F. W. Alexander) for 1919 gives particulars of the Electrolytic Disinfecting Fluid produced and distributed during 1919, the quantity manufactured being 33,285 gallons, and the quantity distributed, after being broken down, 66,570 gallons. The cost of the materials was £216 11s. 9d., and of running the electric motor for stirring 13s. 8d., while bottles, &c., cost £14 0s. 6d. The materials consist of chloride of magnesium, salt, caustic soda and water.

A licence has now been issued by the Board of Trade, under Sec. 20 of the Companies (Consolidation) Act, 1908, to the British Electrical and Allied Industries Research Association which has been approved by the Scientific and Industrial Research Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The director of the Association is Mr. E. B. Wedmore, care of Electrical Development Association, Hampden House, 64, Kingsway, W.C.2.

Messrs. Tangyes, Ltd., Cornwall Works, Birmingham, inform us that they have available for loan to engineering lecturers and technical instructors, a large and varied selection of lantern slides of their current specialities, comprising gas engines and suction producers, oil engines, steam and power pumps, machine tools, &c.; also an assortment of slides of historical interest dealing with these subjects. A printed list of such slides will be sent free to applicants, and typewritten copies of papers dealing with Tangye's machinery are also available for loan.

The Amalgamated Engineering Union and the Engineering and National Employers' Federations have agreed upon the draft of an arrangement covering overtime and night-shift rates. Hitherto these have varied according to local conditions, but the new agreement will substitute a single national arrangement applicable to all areas equally. For overtime, a minimum rate of time and a half has been granted up to midnight, and double time thereafter, with additional special allowances for men who have to remain at work after midnight. Except in special cases, such as repairs, breakdowns, and completion of contracts to time, overtime is to be limited to a maximum of 30 hours per month, and all systematic overtime is to be discouraged. Night-shift rates and conditions are also placed for the first time on a national basis. The night-shift working week is to consist of five nights, totalling 47 hours, with breaks for meals. The ordinary rate for night-shift work is to be time and a third, and for overtime on night-shift time and two-thirds. Work done between Saturday midnight and Sunday midnight is to be paid for at double time rates, and other work on Saturday and Sunday nights at the rate of time and two-thirds.

Scientific lighting has caught on. The ordinary man is beginning to pay attention to the quality of his artificial illumination and is no longer content to know that his lamps are of sufficient power; he also wants the light to be well distributed and he appreciates the evil of glare. The popularity of scientific lighting methods has not, of course, just happened. It is, in a large degree, the result of nearly 10 years of educational work by the British Thomson-Houston Company, whose illuminating engineers have, during that period, been engaged in the invention and development of new appliances, and in ceaseless propaganda on behalf of better lighting in homes, factories, shops and public buildings. This state of affairs is naturally very satisfactory to all concerned in the good lighting campaign. The only disadvantage is that, owing to war and post-war handicaps, it has been difficult, and sometimes impossible, to cope with the enormous demand for scientifically designed fittings. In addition, it may be confessed that the demand has increased at a greater rate than was expected. On account of the rapid growth of their lighting business, the British Thomson-Houston Company decided some months ago to extend their Rugby fittings factory. The new workshops are now nearing completion, the most efficient and up-to-date machinery is being installed, and it is hoped to be able to manufacture and deliver fittings and reflectors in vastly greater quantities. One of the staple products of the factory is the Mazdalux metal reflector for industrial lighting, and it is expected that the extended facilities, which will soon be available, will enable the company to treble or quadruple their Mazdalux output. In the case of "Eye-rest" indirect fittings, semi-indirect fittings and other lighting equipment made in the B.T.-H. factory, the production will also be considerably increased.

Imports.—The following are official values of electrical machinery, material and apparatus imported into this country (*a*) during August, 1920, and (*b*) the aggregate figures from Jan. 1 to Aug. 31, with increase or decrease compared with corresponding periods of 1919:—

Electrical machinery, (*a*) £136,728 (increase £88,901), (*b*) £730,998 (increase £304,399); telegraph and telephone cables other than submarine, (*a*) nil, (*b*) £50 (increase £50); telegraph and telephone apparatus, (*a*) £13,216 (increase £4,077), (*b*) £99,033 (decrease £80,945); other electrical wires and cables, rubber insulated, (*a*) £8,814 (increase £7,913), (*b*) £20,218 (increase £15,793); with other insulations, (*a*) £8,837 (increase £8,422), (*b*) £71,566 (increase £60,724); carbons, (*a*) £16,094 (increase £14,127), (*b*) £85,366 (increase £66,202); glow lamps, (*a*) £4,615 (increase £2,997), (*b*) £29,215 (decrease £184,295); arc lamps and electric searchlights, (*a*) £79 (increase £76), (*b*) £3,760 (increase £3,729); parts of arc lamps and searchlights (other than carbons), (*a*) £2,473 (decrease £5,853), (*b*) £9,452 (decrease £43,545); batteries, (*a*) £8,171 (increase £5,535), (*b*) £49,658 (increase £19,372); meters and measuring instruments, (*a*) £2,809 (decrease £556), (*b*) £49,450 (increase £23,551); switchboards, (*a*) £40 (decrease £88), (*b*) £1,133 (decrease £9); electrical goods and apparatus unenumerated, (*a*) £79,177 (increase £35,285), (*b*) £457,972 (increase £165,865). Total of electrical goods, machinery, material and apparatus (*a*) £284,572 (increase £164,335), (*b*) £1,615,568 (increase £350,123).

Exports.—The exports of electrical machinery, material, &c., (*a*) during August, 1920, and (*b*) from Jan. 1 to Aug. 31, with increase or decrease compared with corresponding periods of 1919 were as follows:—

Electrical machinery, (*a*) £197,964 (decrease £19,967), (*b*) £1,359,092 (increase £294,843); including railway and tramway motors, (*a*) £2,700 (decrease £25,477), (*b*) £24,994 (decrease £31,005); other generators and motors, (*a*) £128,073 (increase £9,649), (*b*) £794,894 (increase £218,545); and electrical machinery unenumerated, (*a*) £67,191 (decrease £1,139), (*b*) £539,204 (increase £107,303); telegraph and telephone cables, submarine, (*a*) £70,393 (decrease £3,590), (*b*) £1,151,633 (increase £728,322); other than submarine, (*a*) £76,474 (increase £18,232), (*b*) £655,011 (increase £393,528); telegraph and telephone apparatus, (*a*) £10,624 (increase £56,134), (*b*) £776,486 (increase £532,135); other electrical wires and cables, rubber insulated, (*a*) £148,077 (increase £45,566), (*b*) £1,072,295 (increase £592,841); with other insulation, (*a*) £157,051 (increase £18,437), (*b*) £1,374,366 (increase £804,372); carbons, (*a*) £3,505 (increase £2,413), (*b*) £72 074 (increase £65 948); glow lamps, (*a*) £28,534 (increase £15,420), (*b*) £159,665 (increase £61,931); arc lamps and searchlights, (*a*) £1,048 (increase £905), (*b*) £13,355 (increase £6,431); parts of arc lamps and searchlights (other than carbons), (*a*) £96 (decrease £198), (*b*) £8,042 (increase £234); batteries, (*a*) £48,834 (increase £6,631), (*b*) £332,750 (increase £24,120); meters and measuring instruments, (*a*) £36,497 (increase £2,973), (*b*) £255,657 (increase £107,101); switchboards, (*a*) £10,186 (increase £4,641), (*b*) £61,897 (increase £30,138); electrical goods and apparatus unenumerated, (*a*) £196,711 (increase £65,748), (*b*) £1,165,765 (increase £410,441). Total of electrical machinery, material and apparatus (*a*) £1,085,994 (increase £213,345), (*b*) £8,458,088 (increase £4,052,385).

Educational.

Like all other educational institutions, the Armstrong College, Newcastle-on-Tyne, is in urgent need of money for extensions. The number of students is 1,058, nearly 100 per cent. over the figure for 1914. The increase is greatest in the applied science sections.

Letters continue to appear in the Press on the subject of the most suitable site for a new home for the University of London. Though the Foundling Hospital area has now been offered, the majority favour the Bloomsbury site as being the most suitable and advantageous one available, and it is probable that this will ultimately be accepted by the Senate.

The Senate of the Queen's University, Belfast, has decided to found, in conjunction with the Belfast Municipal Technical Institute, new Faculty of Applied Science and Technology, to deal with such subjects as mathematics, pure and applied physics, mechanical and electrical engineering, naval architecture, applied chemistry, architecture, textile industries, &c.

The new session of the University of Birmingham commenced on Monday last. Additional laboratories for physics and chemistry are being provided. Other alterations have been made, including the provision of more laboratory accommodation in the metallurgy department. A memorial tablet to the graduates of the civil engineering department who fell in the war was unveiled on Saturday last by the Principal, Mr. Grant Robertson.

Catalogues, Price Lists, &c.

Messrs. Higgs Bros., Birmingham, have issued their October list of stock motors.

Bulletins 28S and 29S, issued by Messrs. Watson & Sons (Electro-Medical), Ltd., relate to estimates for X-ray installations and to Diathermy Apparatus respectively.

A very striking showcard, well printed in colours, which is being issued by Messrs. Siemens Brothers & Company, Ltd., forms an excellent advertisement of the Company's "Xcel" Lamps. The card, which measures 19½ in. by 12½ in., is eyeletted and corded ready for hanging, is being distributed to houses in the electrical trade throughout the British Isles, and will be supplied free of charge to factors, dealers and retailers on application. The Company have also issued a neat folder giving particulars and prices of these metal filament lamps. Quantities will be supplied to those in the trade with the names and addresses of firms overprinted.

The Hart Accumulator Company, Ltd., have recently placed on the market a portable unspillable accumulator inspection lamp which is suitable for close range inspection work, and particularly for electricity and gas meter readers, inspectors, railway officials, &c. From a descriptive leaflet we learn that the lamp fitting is designed to hook on to a coat button, leaving both hands free, at the same time giving a strong, steady light in any desired direction. The accumulator plates are contained in a strong celluloid box fitted with an unspillable device and the battery is enclosed in a waxed wood case, firmly clamped down to a rubber ring joint. Further particulars will be supplied by the company, 36, Victoria-street, S.W.1, and Marshgate-lane, Stratford, E.15.

Messrs. Mavor & Coulson, Mile End, Glasgow, have issued their revised interim Catalogue of Switchgear, which gives illustrated particulars of their manufactures. All ordinary industrial requirements are catered for and the present edition shows some additional examples of the firm's specialities. Various types of ironclad switches and fuses, switchgear, switchboards, flame-proof switch and fuse boxes, distribution boxes and pillars, d.c. and a.c. starting panels, tramway type controllers, &c., are listed and described. Owing to the present conditions and the unsettled price of raw materials no prices are given, but the firm claim that with their organisation and manufacturing facilities they are able to quote competitive prices. They will supply copies of the new catalogue to readers who use this class of gear.

In these days of high prices and difficulties with domestics, everything which tends to economy of time and labour should be investigated. In this connection we would direct attention to the illustrated leaflet of the General Electric Company, Ltd., which gives very clear and illustrated particulars of the construction and advantages of their Time Saver Electric Washer. The machine, which washes and wrings clothes, is simple in construction, runs quietly, and it is claimed that it outlives all other washers. The tub is of Cypress wood and the wringer is fitted with fine rubber rollers which cannot injure the most delicate lace or fabrics. The washer is portable, takes up little space, and it is stated that the initial outlay will be repaid in one year. The Company have many other electric labour-saving devices, such as vacuum cleaners, small motors, "Freezor" fans, "Magnet" heating and cooking apparatus, &c., which are all worthy of investigation.

Institution Notes.

The Standardisation of Portland Cement was first undertaken in 1903 on the initiation of Sir William Matthews, and a British standard specification on the subject was issued in 1904. This specification has been revised from time to time, and the latest edition, which supersedes that published in 1915, has just come to hand. This modifies in certain important particulars the rules laid down in the previous edition. The specification is obtainable from the office of the British Engineering Standards Association or from Messrs. Crosby Lockwood & Son.

The Faraday Society, the Institution of Mechanical Engineers, the Institute of Metals, and probably also the Iron & Steel Institute contemplate holding early in 1921 a joint general discussion on "The Failure of Metals under Internal or Prolonged Stress." While various aspects of the subject have already been discussed, some new matter will be placed at the disposal of the co-operating societies later in the year, and it is considered that this will afford an opportunity for a more comprehensive consideration of the subject than has yet been given to it. The scope of the discussion would permit of contributions relating to the properties and behaviour of materials other than metals which might throw light on the phenomena covered by the title. Anyone desirous of contributing to this discussion is asked to communicate with the Secretary of the Joint Committee, Mr. F. S. Spiers, 10, Essex-street, London, W.C.2.

Bankruptcies and Liquidations.

The British & Overseas Engineering Syndicate, Ltd., is being wound up voluntarily, and Mr. J. Findlay, 4, Old Burlington-street, London, W. 1, has been appointed liquidator.

A meeting of creditors of the Electric Supply Company of Western Australia, Ltd., will be held at the offices of the British Insulated & Helsby Cables, Ltd., Lennox House, Norfolk-street, London, W.C. 2, on Oct. 13.

A first and final dividend of 2s. 5d. is payable at the Official Receiver' Office, 14, edford-row, London, W.C. 1, to the creditors of Walter Hy. Mellan (lately trading as H. B. Wallis & Company), electrical engineer, 43, Turnham Green-terrace, Chiswick.

Tenders Invited and Accepted.

The date for the receipt of tenders by the Victorian Government Railways Dept. for a 5-ton electric portal crane, with luffing jib (contract 29090) is extended from Oct. 27 to Dec. 1.

Denny & Dunipace Corporation require tenders by Oct. 18 for the electric wiring of houses on the Anderson-street site (No. 2), Denny. Schedules from Mr. Jas. Straing, Architect, Falkirk.

Glasgow Parish Council require tenders by Oct. 23 for 12 months supply of electric lamps and fittings, ironmongery, &c. Forms of tender from the Inspector and Clerk, 266, George-street, Glasgow.

The Secretary of State for India invites tenders for h.d. copper wire for telegraphs. Conditions of contract from the Director-General of Stores, India Office, Whitehall, S.W.1, where tenders are to be delivered by 2 p.m. Oct. 12.

Bradford Corporation require tenders by 10 a.m. Oct. 28 for two natural-draught, chimney-type cooling towers, pipe-work, troughing, valves, &c. (Contract R. 160). Specifications, forms of tender, &c., from Mr. Thomas Roles, Electricity Offices, Town Hall, Bradford.

Sheffield Electric Supply Committee require tenders (by Oct. 12) for the supply of two 10,000 kw. steam turbines, condensing plant, pipe work, &c., alternators and exciters. Specifications from the general manager and engineer, Mr. S. E. Fedden, Commercial-street, Sheffield.

The Deputy Postmaster-General, Melbourne, will receive tenders until 3 p.m. Nov. 23, for the supply of telephones and telephone and switchboard parts (Contract No. 1650) for the Australian Commonwealth Postmaster-General's Department. Specifications from the High Commissioner, Australia House, Strand, London, W.C.2.

London County Council require tenders by 4 p.m., Oct. 25, for the supply and maintenance of 125 bodies for electric tramcars, 125 maximum traction bogie trucks, and 125 electrical car equipments, with assembly of bodies, trucks, electrical equipments, &c., into complete tramcars. Specifications, &c., from the Clerk of the Council, Spring Gardens, S.W.1.

The New South Wales Department of Public Works require tenders by 2 p.m. Dec. 6, for the supply and erection of (1) switchgear and transformers and turbines and generators for the Nymboida hydro-electric development, and (2) switchgear and transformers for the Barren Jack hydro-electric scheme. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.1, or 73, Basinghall-street, E.C.2, London.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the Australian Commonwealth Postmaster-General's Department: telegraph and telephone instruments (schedules 546 and 549) (Oct. 20), and telephone instruments (schedule 548) (Nov. 3) for S. Australia; also New South Wales: Telegraph and telephone instruments and switchboard parts, schedule 753 (Nov. 25). South Australia: Telephone instruments, schedule 547 (Nov. 10). Queensland: Protectors, schedule 505 (Nov. 30); iron poles, schedule 506 (Nov. 24); and protected cable terminals and cable distributing boxes, schedule 507 (Nov. 24). Tender forms, &c., can be obtained at the office of the High Commissioner for Australia, Room 406, Australia House, Strand, London, W.C. 2.

Edinburgh Electric Lighting Committee recommend the acceptance of the tender of Messrs. Bruce Peebles & Company for the supply of the greater part of the converting plant required for the Portobello power station, amounting to over £80,000. The Committee also recommend that other contracts should go to the Metropolitan-Vickers Electrical Company at £46,000, and to the Brush Company at £7,000.

The following tenders were received by Stepney (London) Electricity Committee for 2 miles 1 sq. in., ½ mile 0·5 sq. in., and 1 mile 0·007 sq. in. lead-covered cable: W. T. Henley's Telegraph Works Company (*accepted*), £6,625; British Insulated & Helsby Cables, £6,720; and Callender's Cable & Construction Company, £6,983. The Committee has also accepted the following tenders: W. T. Henley's Telegraph Works Company, ¼ mile 0·1 sq, in. cable (£279), 440 yds. 0·1 sq, in. (£289), ¼ mile 0·2 sq. in. (£465); Sutton & Company, 1 mile 3 in. earthenware pipes, £359 and ½ mile, £177; for 1 mile troughs and covers, £327; 2 miles £567, 3 miles £901. 2s. 2d.; Albion Clay Company, for ½ mile 4 in. conduits, £544; Aron Electricity Meter, Ltd., five combined meters and demand indicators and two time switches, £163; Reavell & Company, air compressor, £205; Bertram Thomas, four circuit breakers, £399; Electrical Installations, Ltd., 30-line telephone intercommunication system at Osborn-street sub-station, £357; Reason Mfg. Company, for 2½ to 20 ampere meters; Ferranti Ltd., 50 and 100 ampere meters, and Aron Electricity Meter, Ltd., for meters of 200 amperes and upwards for period ending June 30, 1921.

Particulars are given in the 15th annual report of the Meteorological Committee of the Treasury of the transfer of the Meteorological Office to the Air Ministry. With regard to the international exchange of meteorological information by wireless telegraphy, it is stated that only from two or three countries have synoptic data been picked up with sufficient regularity in London to compare at all favourably in practical utility with transmission by cable. British data for use in foreign countries are dispatched thrice daily from Croydon and twice from Carnarvon and Aberdeen. The system of weather reports by wireless from Atlantic liners, which was instituted in 1909 and collapsed during the war, has now, after a brief temporary revival by the Air Ministry ast year, ceased to exist.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1917.

147,955. British Thomson-Houston Co. (General Electric Co.). Apparatus for forming filaments for electric lamps. May 9, 1917.

1918.

149,018 Eccles & Jordan. Method of generating electric oscillations. March 20, 1918.

1919.

132,777 Paemelaire. Dynamo-electric machines. September 19, 1918.

133,018 Delille. Electrically-heated smoothing irons. September 25, 1918.

135,386 Domestic Engineering Co. Regulating means for electric generating sets. April 6, 1918.

138,588 Marconi Wireless Telegraph Co. Radio signalling apparatus. (7/2/19.)

Relates to a method of reducing static interference in radio communication, which consists in receiving static and signal waves in unlike antenna system portions, one of which portions is unaffected by the direction of signal approach and the other of which portions is affected by reversal of signal direction, and geometrically combining the currents due to all of said waves to reduce static interference and retain certain signals.

139,448 Piquerez. Resistance for electric furnaces. (26/2/19.)

139,748 Dushman. Vacuum-discharge apparatus. (4/3/19.)

146,558 Roberts. Form of light-intensifier for metal filament electric lamps. (4/3/19.)

146,561 Rodriquez. X-ray apparatus. (11/3/19.)

146,562 Western Electric Co. (Western Electric Co.) Wireless and other signalling systems using high frequency currents. (11/3/19.)

146,573 Holslag. Electrode for perforating metal plates. (1/4/19.)

146,586 Eckersley. Switchgear for electro-magnetic wave transmission and reception systems. (4/4/19.)

146,589 Murray. Station sets for intercommunication telephones. (5/4/19.)

146,590 Murray. Station telephone sets for intercommunication telephone systems. (5/4/19.)

146,591 Murray. Driving-mechanism for the selector arm of automatic selector switches. (5/4/19.)

146,610 Eckersley. Electro-magnetic wave transmission systems. (10/4/19.)

146,615 Oldham & Oldham. Miners' safety lamps and other electric hand lamps. (10/4/19.)

146,618 Wade. (National Carbon Co.) Apparatus for forming electric battery elements. (10/4/19.)

146,624 Siemens Bros. Dynamo Works & Janzten. Dynamo-electric machines. (11/4/19.)

146,626 Harland & Wolff & Bentley. Electrical gear for operating bulkhead doors. (11/4/19.)

146,694 Fairless. Electric lamp fittings. (2/6/19.)

146,700 Crochat. Electric motor and like controllers. (6/6/19.)

146,708 Taggart. Vacuum tube rectifiers or generators of alternating current, especially for use in wireless telegraphy. (20/6/19.) (Cognate Application, 20,269/19.)

Relates to an electron discharge device consisting of a single filament passing through the axes of two substantially cylindrical anodes of substantially equal diameter and acting as a full-wave rectifier of alternating or oscillating current by virtue of the fact that the electron current from the filament passes to the cylindrical anodes alternately, these anodes being given potentials of opposite sign at any given moment with respect to the filament by the alternating current to be rectified.

146,722 Bazley. Electro-magnetic brake for tramway, railway and like vehicles. (9/7/19.)

146,724 Davis. Electric telegraphs. (12/7/19.)

146,731 Gunstone. High-tension apparatus for use with hot cathode X-ray tubes. (29/7/19.)

146,741 Leonard. Electric heaters. (13/8/19.)

146,746 Belfield. (Westinghouse Air Brake Co.) Automatic electric couplings. (5/9/19.)

146,747 Rahbek & Johnsen. Electrical receiving apparatus particularly for use in connection with telegraphs and telegraph relays. (6/9/19.) (Addition to 5,611/19.)

146,763 Wilson & Callenders' Cable & Construction Co. Jointing metallic sheathed electric cables. (17/10/19.)

146,786 O'Leary. Electric coils. (30/12/18.) (Divided application on 21,807/19.)

1920 Specifications.

137,522 Domestic Engineering Company. Electric power systems. April 6, 1918 (Divided application on 125,386.)

138,920 Strobel. Current distributor for magneto-electric ignition apparatus. March 2, 1918.

146,794 Harris. Brake magnets for electricity motor meters. (7/5/19.) (Divided application on 11,433/19.)

149,044 Qoain. Electric radiators. May 1, 1919.

149,049. Bibby. Transformation of polyphase currents particularly for use in electric furnaces. May 2, 1919.

149,057 Mason & Richardson. Letter combination electric switch for protection against stealing of motor-vehicles. May 3, 1913. (Cognate application 16,688/91/.)

149,066 Round & Wright. Wireless telegraphuy. May 6, 1919.

149,076 Mullard. Construction of thermionic valves. May 8, 1919.

149,139 Western Electric Company (Western Electric Co.). Electric signalling systems, especially applicable to combined telegraph and telephone systems. September 1, 1919.

149,146 Western Electric Company (Western Electric Co.). Composite electric signalling systems. October 6, 1919.

149,188. Thomas. Self-producing electric motive power combination. April 22, 1920.

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

April 6, 1920.

9,590 Hanner. Electric lamps for motor cars, &c.

9,616 Shenton & Co. & Margerison. Electrical resistance apparatus.

9,629 Dimitrievitch. Relays.

9,631 Rabjohys & Vickery. Change-over switch apparatus.

9,651 Metropolitan-Vickers Electrical Co. Treating magnetisable material (4/4/19, U.S.)

9,670 Hitchcock. Permanent magnets and permanent magnet motors.

9,673 Automatic Telephone Mfg. Co. Telephone systems. (20/8/19, U.S.)

9,679 Callaway. Fuses.

9,680 British Lighting & Ignition Co. & Turner. Dynamo-electric systems for automobiles.

9,681 Cash & Gorringe. Electric switches, sockets, &c.

9,686 Assie. Electric furnaces. (9/8/17, France.)

9,667 Wilson Welder & Metals Co. Electrical welding. (22/4/19, U.S.)

April 7, 1920.

9,707 Shillito. Direct-current dynamo electric machines.

9,708 Railing & Wilson. Step by step mechanism for electric motor starters.

9,742 Charles. Electric lighting.

9,750 CURTIS. Device for compensating for effects of temperature in electrical circuits.
9,763 MARKS. (Nagel Electric Co.) Electric measuring instrument.
9,800 AIGNER & ERBAN. Arrangements for transmission of electric currents by liquid conductors. (11/3/19, Austria.)
9,801 ERBAN. Magneto-electric couplings.

April 8, 1920.

9,822 BROADBENT. Flexible pendant electric light fittings.
9,852 PARKINSON. Brush lifting and short circuiting means for induction motors.
9,860 INDUSTRIAL RESEARCH CORPN. Electric generating systems. (8/4/19, U.S.)
9,861 INDUSTRIAL RESEARCH CORPN. Electric generating systems. (28/4/19, U.S.)
9,867 B.T.-H. CO. (G.E. Co.) Ventilating systems for electric machines.
9,884 MARTIN. Electric soldering apparatus.
9,900 SHEPHERD & WILSON. Electrical cut-outs.

April 9, 1920.

9,902 ELECTRIC VEHICLES, LTD. Tipping wagons.
9,929 SODEN.
9,963 BARR & STROUD & FRENCH. Electric moters of unwound armature type.
9,974 B.T.-H. CO. & WHITAKER. Dynamo-electric machines.
9,997 MOORE. Electric furnaces.

April 10, 1920.

10,061 ORLING. Telegraph circuits.
10,062 PUNGA. Alternating-current motors. (26/3/19, Germany.)
10,068 HAMILTON, PILE & SMITH. Electrical measuring instruments of moving coil type.
10,105 HARTMANN. Electrical switching apparatus.

April 12, 1920.

10,118 METRODES, LTD., & DAVENPORT. Apparatus for manufacture of electrodes.
10,168 WESTERN ELECTRIC CO. Telephone systems. (11/4/19, U.S.)
10,181 MACKENZIE. Production of high-tension unidirectional currents or impulses.
10,184 POTTER. Thermo-electric systems for production of electrical energy.
10,204 MELLERSH-JACKSON. (Taylor.) Radio-telegraphy signalling systems.
10,216 TURCAT. Telephonic apparatus permitting of automatic calling and connecting up. (6/3/19, France.)
10,217 TURCAT. Automatic telephony. (10/4/19, France.)

April 13, 1920.

10,232 BOLTON. Circuit breakers, &c.
10,241 GOODMAN. Continuous-current voltage reducing cells.
10,248 GRIFFIN. Terminal connections for flexible electric conduits.
10,253 ACCLES, STEVENTON & SHELVOKE. Rotary transformers and converters.
10,258 LAMBOT. Automatic telephone, &c., systems.
10,263 EWTILL MFG. CO., EWER & TILLINGHAST. Electric changing colour sign.
10,293 CORNELIUS. Electric rotating furnaces.
10,299 AUTOMATIC & ELECTRIC FURNACES, LTD., BARFIELD & WILD. Electric muffle furnaces.
10,300 REID. Electric clocks.
10,319 IGRANIC ELECTRIC CO. (Cutler Hammer Mfg. Co.) Controlling resistances.

April 14, 1920.

10,363 BARTER. Electric machines.
10,373 AUTOMATIC TELEPHONE MFG. CO. & SAVIN. Distributing arrangements for telephone, &c., systems.
10,374 AUTOMATIC TELEPHONE MFG. CO. & SMITH. Call indicators for telephone, &c., systems.
10,402 REID & SCOTT-TAGGART. Wireless telegraphy.
10,404 WESTERN ELECTRIC CO. Multiplex high-frequency electric signalling systems.
10,405 PORTCH Electric burglar alarm systems.

April 15, 1920.

10,466 TAYLOR. Transmission and distribution with alternating currents.
10,477 FEATHER. Mounting electric motors on machines.
10,512 REES. Telephones.
10,534 B.T.-H. CO. & SHUTTLEWORTH. (G.E. Co.) Motor control.
10,539 CAMBRIDGE & PAUL INSTRUMENT CO. & RAWCLIFFE. Thermo-electric measurement of temperature.
10,542 DELIN. Electric gas ignition devices.
10,549 WESTERN ELECTRIC CO. High-frequency electric signalling. (21/8/15, U.S.)
10,550 TAYLOR. Wireless telephone transmitters.
10,552 TAYLOR. Induction or reactance coils.
10,553 GRANVILLE & SMITH. Electric cables.
10,5 6 WATTS. Overhead conductors, &c.

April 16, 1920.

10,620 NEWTON. Electric gongs and hammers.
10,644 B.T.-H. CO. High-frequency dynamo electric machines. (22/6/15. U.S.)
10,646 BULLIMORE. Electric lamps.
10,661 DIMITRIEVITCH. Relays.
10,664 TELEGRAPH CONSTRUCTION & MAINTENANCE CO. Lighting of buoys, &c.
10,666 BEATTIE. Protecting telephone, &c., instruments against lightning, &c.
10,669 BILEY & KEARTON. Telephones.

April 17, 1920.

10,691 ADDISON. Locking device for switches of direct-current motors.
10,707 ECCLES. Electrical means of indicating relative movements of members of apparatus.
10,709 ECCLES. Relays.
10,718 SCHROEDER. Winding for electrical apparatus.
10,719 SCHROEDER. Insulated electric conductor.
10,748 AKT. GES. BROWN, BOVERI ET CIE. Preventing injurious earthing currents electrical nets. (17/4/19, Switzerland.)
10,756 B.T.-H. CO. (G.E. Co.) Tungsten alloy.
10,763 EAST ANGLIAN ENGINEERING CO. & WATERS. Bench gear for dynamos.
10,772 COX. Insulators.

Companies' Reports, &c.

The directors of the RUSHDEN & DISTRICT ELECTRIC SUPPLY COMPANY, LTD., have declared an interim dividend of 5 per cent. for the half-year.

The directors of the AUCKLAND ELECTRIC TRAMWAYS COMPANY, LTD., have declared a dividend of 6½ per cent. (1s. [illegible]d. per share) on the ordinary shares for the past year, carrying £9,610 forward.

The directors of the CUBA SUBMARINE TELEGRAPH COMPANY, LTD., have declared an interim dividend for the six months ended June 30 at the rate of 5 per cent. per annum, tax free, on the ordinary shares.

Sir Edward Goulding has been elected a director of the ANGLO-ARGENTINE TRAMWAYS COMPANY in succession to Sir Philip Lloyd-Greame, who retired from the board on accepting office as Parliamentary Secretary to the Board of Trade. A further year's arrears of dividend of the 5½ per cent. cumulative first preference shares is being paid.

The shareholders of the SWANSEA IMPROVEMENTS & TRAMWAYS COMPANY have been informed that in view of the decreased profits owing to the strike from April 23 last to May 29, and to the increased cost of materials since the commencement of the present year, the board is unable to declare a dividend upon the ordinary shares for the six months ended June 30.

In a communication to the Press, Mr. H. Hirst, chairman and managing director of the GENERAL ELECTRIC COMPANY, LTD., protests against the practice of calling the Allgemeine Elektricitäts Gesellschaft the "General Electric Company," as it implies an association of the General Electric Company with that German concern which does not exist. Mr. Hirst points out the Allgemeine Elektricitäts Gesellschaft (or A.E.G.), should it be essential to translate the title, would be "General Electricity Company."

The gross earnings of the ELECTRIC SUPPLY CORPORATION, LTD., for the year 1919 were £60,085, an increase of £8,707 over 1918. The sum taken into net revenue account amounts to £13,519, against £13,161. After paying interest upon debenture stock and cost of repairs and renewals, and taking into account the balance brought forward, the surplus is £3,621. It is proposed to place £3,000 to reserve and to carry forward £621. The Hendon Electric Supply Company distributed a dividend and bonus of 15 per cent. for 1919, and the Dumbarton Burgh & County Tramways Company a dividend of 5 per cent. on the ordinary shares.

The report of Messrs. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LTD., for the four years ended December, 1919, has been issued and shows that the net profits for the whole period, after making provision for taxation, depreciation and writing down of capital expenditure, was £4,053,605. From this is deducted £1,000,000 for further writing down of capital expenditure and £2,465,093 dividends paid for the four years, including the final distribution for 1919, leaving £588,512, which, with the balance of £461,387 from 1915, makes £1,049,899 to be carried forward. Owing to the extent and complexity of the work undertaken during the war it has been impossible to separate the accounts, and the four years are submitted as one period. It is stated that the Siddeley-Deasy Motor Car Company has been acquired and a controlling interest taken in Pearson & Knowles Coal & Iron Company, Armstrongs & Main & Crompton & Company. The reorganisation of the works for peace industries is complete and much commercial work has been undertaken.

During the past year the SOUTHERN BRAZIL ELECTRIC COMPANY, LTD., made a profit of £1,500, compared with a loss of £7,000 for the preceding year. The improvement is, according to the chairman (Mr. E. H. Tootal), satisfactory, who states that the revenue has continued to increase in a gratifying manner since the accounts were made up. In the districts with which they were concerned the prospects were decidedly favourable, and demands for installations for supplying power to the plantations were coming in freely. The services of their various undertakings had been carried out without any hitch, and owing to the improvement in the conditions of labour in Brazil they had been exempt from any strike troubles. The progress in the development of the company's undertaking was decidedly reassuring, and it only required a renewal of the former activity of the export trade of Brazil to make the progress more rapid and increasingly remunerative.

The Marquess of Winchester, who presided over the meeting of the VICTORIA FALLS & TRANSVAAL POWER COMPANY, LTD., on Friday, stated that notwithstanding the continued increase in cost in all classes of material and in wages, &c., and in spite of the heavy taxation, the trading for 1919 enabled the company to maintain the same dividends as last year, and without reducing the carry forward. The revenue was £829,470, the net result (after providing for interest, premium and expenses of debentures, depreciation and British taxation) being a profit of £175,624, out of which (with £93,693 brought forward) dividends at the rate of 10 per cent. on the preference shares and 5 per cent. on the ordinary shares had been paid, leaving a balance of £94,3[illegible]0, which had been carried forward. Nothing had been added to the reserve fund, which stood at £250,000. The company was still without any settlement of the relief from British income-tax in respect of Colonial taxation. He expressed the great appreciation of the board for the good work done by the management and the staff, which was evidenced by the fact that during the current year the business had so far been satisfactorily maintained, and the amount of power sold corresponded with that of the previous year.

An arrangement has been made for the union of the interests of the CONSOLIDATED SIGNAL COMPANY, LTD., and the WESTINGHOUSE BRAKE COMPANY, LTD. It is proposed to sell to the Westinghouse Company all those shares owned by the Consolidated Company in companies dealing with railway signals and safety devices, the Consolidated Company acquiring in lieu thereof shares of the Westinghouse Company. Mr. H. G. Brown, the chairman and managing director of the Consolidated Company, will act as managing director of the Westinghouse Company for 10 years. The German and Russian assets of the Westinghouse Company are not included in the arrangement which is conditional upon the adoption by the shareholders of that company of resolutions necessary to carry it into effect and for the increase of its capital to provide the new shares required to complete the purchase. The consideration to be paid to the Consolidated Signal Company is £416,112 in cash, and the Consolidated Company will subscribe at par for 416,112 shares of £1 each in the Westinghouse Company and pay for same in cash. When the transaction has been completed, the issued capital of the Westinghouse Company will be £1,015,032 in fully-paid ordinary shares of £1 each, of which the Consolidated Company will own 391,112 shares. The issued capital of the Consolidated Signal Company will remain at £364,743 in 214,195 6 per cent. cumulative preference and 150,548 ordinary shares of £1 each. In addition to Mr. H. G. Brown, Messrs. D. E. Norton, S. P. Wood and W. Wingfield, directors of the Consolidated Company, will join the board of the Westinghouse Company, the title of which will be changed to the Westinghouse Brake and Saxby Signal Company.

New Companies.

ADAPTA SIGN & TRADING COMPANY, LTD. (170,452).—Private company. Reg. Sept. 27. Capital £15,000 in £1 shares. To carry on the business of manufacturers of electrical or mechanical devices or apparatus for advertisement purposes, &c., and to adopt an agreement with J. C. Wilson and D. Figur. First directors are: D. Figur (chairman) and J. C. Wilson (managing) and N. Figur. Reg. office: Suite No. 1, Leicester House, 5, Green-street, Leicester-square, W.C.2.

ELECTRIC GRAMOPHONES, LTD. (170,391).—Private company. Reg. September 23, capital £1,500 in 1,450 preferred part ordinary shares of £1 each, and 1,000 deferred shares of 1s. each, to carry on the business of manufacturers of gramophones and talking machines, manufacturers of and dealers in motors, wires, apparatus and electrical appliances, &c. First directors are; K. O. Davis and C. J. Barnett. Reg. office: 7, The Quadrant, Winchmore Hill, N. 21.

FARNDONS POWER & GENERAL ELECTRICAL COMPANY, LTD. (170,442). Private company. Reg. Sept. 25. Capital £20,0000 in £1 shares. To carry on the business indicated by the title, and to adopt an agreement with Farndons Electric, Ltd. First directors are: F. Farndon (managing), P. Farndon, H. M. Watson, H. King and T. J. Penney. Secretary: F. G. Saw. Reg. office: 32, Romford-road, Stratford, E.15.

GILBERTS, LTD. (170,394).—Private company. Reg. Sept. 23. Capital £2,000 in £1 shares. Manufacturers of electrical fittings of all kinds, art metal work, &c. First directors are: H. Davies, A. W. Green, and W. C. McMillan. Reg. office: 15, Hillfield Park, Muswell Hill, N.10.

Arrangements for the Week.

FRIDAY, October 8th (To-day).

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At 39, Victoria-street, London, S.W. Lecturette on "The Manufacture of Wood Wool," by Mr. A. J. Simpson.

SATURDAY, October 9th.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

7 p.m. At the Grand Hotel, Colmore-row, Birmingham. Paper on "Thermo-Electric Currents as Applied to Pyrometry" by Mr. F. S. Pile, M.A., and Mr. C. E. M. Stone.

TUESDAY, October 12th.

INSTITUTION OF ELECTRICAL ENGINEERS. SOUTH MIDLAND CENTRE.

7.30 p.m. At the University, Edmund-street, Birmingham. Chairman's address by Mr. E. T. G. Donovan, and Paper on "Hydro Electric Power Schemes," by Mr. E. Gallizia.

WEDNESDAY, October 13th.

ASSOCIATION OF ENGINEERS-IN-CHARGE.

7.30 p.m. At St. Bride Institute, Bride-lane, London, E.C. Paper on "Progress in Industrial Lighting," by Mr. L. Gaster.

FRIDAY, October 15th.

ROYAL SOCIETY OF ARTS. INDIAN SECTION.

4.30 p.m. At John-street, Adelphi, London, W.C. Paper on "British Trade with India," by Mr. T. M. Ainscough.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At 39, Victoria-street, London, S.W. Lecturette on "Elementary Physics and Chemistry in Relation to Motor Cars," by Mr. R. S. Fox.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics":—"Accidents by Air and Rail"; and "The Work of Sir Charles Wakefield, Bart."

"The Cabinet Maker":—"The Decoration of Furniture: II.; Mouldings"; "Electric Lighting of Shop Windows"; and Annual Congress of the Textile Institute.

"The Chemical Age":—"Structure Symbols of Organic Compounds and Radicals," by Ingo W. D. Hackh; and Chemical Traders' Views on the New Imports Bill.

"Farm and Home":—Lincoln Tractor Trial Report; "How to Increase our Flock," by E. W. Lloyd; and "Goatlings in the Autumn," by J. T. Bird.

"The Fruit-Grower":—(First Show issue)—Arrangements for Worcester (illustrated); "Transport Ministry and Railways"; and "Tractor Trials in Lincolnshire."

"Gardening Illustrated":—"Clematises: Their Absence from Gardens"; "National Rose Society's Show"; and "Seasonal Notes on Chrysanthemums."

"The Gas World":—(Special Cooking and Heating Number)—"The Selling Side of Gas," by W. M. Mason; "A Study of the New Gas Regulation Act," by G. N. H. Humphreys; and New Features in Gas cookers, fires and water-heaters.

"Hardware Trade Journal":—"The Ironmonger's Storeroom"; "Training Ex-Service Men for the Hardware Trade"; and "The Prices of Castings."

"Ways and Means":—"Financial Instability and Free Trade," by Sir George Paish; "The German Works Council Act, 1920," by William Wallace; and "Organisation of the Woollen and Worsted Trade in the West of Scotland," by Donald Currie.

Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 9, 1880.)

THE TELEPHONE IN USE.—Messrs. Stevenson, Jacques & Company have placed their ironstone mines at Boosbeck, near Guisborough, in telephonic communication with their offices at Middlesbrough and with their smelting furnaces at Acklim, the mines and furnaces being 15 miles apart.

THE TELEPHONE IN SYDNEY.—The rooms of Mr. Cracknell, the superintendent of telegraphs, at the General Post Office, are fitted up with one of Edison's telephones. The communication is between the Post Office and the Exchange, and is said to work admirably. Attempts are being made to establish an exchange.

ROYAL EXCHANGE RESTAURANT.—It is difficult to introduce a grain of common sense into a brainless animal. It seems, however, certain that some such a creature has been "having some fun," as he would term it, with the electric light apparatus in use beneath the Royal Exchange. Fortunately the tampering was discovered in time to prevent serious injury, although not in time to prevent considerable temporary inconvenience.

RAPID TELEGRAPHY FROM AUSTRALIA TO LONDON.—On the 1st inst. a message of sixty-nine words was forwarded by the Governor of Victoria announcing the opening of the Melbourne Exhibition on that day. This message was despatched from Melbourne at 1 p.m., and reached London at 3.43 a.m. on the same day, or 9 hours 17 minutes befor the hour of its despatch. Allowing, however, for the difference of time between the two cities, it occupied only 23 minutes in transit. The route of the message was over the lines of the Victorian and South Australian colonies, the cables of the Eastern Extension, Australasia & China Telegraph Company, the lines of the Indian Government, the cables of the Eastern Telegraph Company, and the lines of the Egyptian and French Governments, and the rapidity of its transmission shows the harmony with which these various administrations work together. The total distances traversed was 13,398 miles.

TELEGRAMS TO REGIMENTS ON SERVICE.—The following letter on this subject appeared recently in *The Times*: "A short time ago I had occasion to send a telegram from England to an officer of my regiment then quartered in a station in the north of India. I knew that my regiment had been ordered to leave at once for the front, and that they might leave their station before my message reached them; I therefore requested the clerk in the telegraph office to have the telegram sent on after them, either by telegraph or post, if they had marched before its delivery, and I told him that I would pay any extra charge incurred in doing so. He replied that he could not make any such arrangement, and that he did not even know whether the telegram would be sent after them at all or not. I may add that the charge was over £2 for the message, which consisted of only three words—each word of both the sender's and addressee's name being charged for at the full rate of 4s. 9d. a word.

Prices of Metals, Chemicals, &c.

TUESDAY, Oct. 5.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£107 0 0	—	—
Electro Wirebars...	,,	£114 0 0	—	£3 0 0
H.C. wire basis......	per lb.	1s. 4⅛d.	—	5/16d.
Sheet	,,	1s. 5⅝d.	—	⅜d.
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. 9⅛d.	—	5/16d.
Brass 60/40—				
Rod, basis	,,	0s. 10½d.	—	¼d.
Sheet, basis	,,	1s. 4⅛d.	—	⅝d.
Wire, basis	,,	1s. 4¾d.	⅝d.	—
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£36 5 0	—	£0 15 0
Foreign or Colonial	,,	34 12 6	—	£0 5 0
Tin—Ingot	,,	272 0 0	£0 15 0	—
Wire, basis	per lb.	0 3 6¼	—	—

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £18 5s.

,, (Roll Brimstone).—Per ton £18 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £41.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 3d.

Sodium Chlorate.—Per lb. 5½d.

Rubber.—Para fine, 1s. 7d.; plantation 1st latex, 1s. 6½d. lb. The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Co., Ltd.

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Notes.

Electric Traction in Europe.

THE article by M. PARODI, which we publish on another page of this issue, shows that the European Continent is no nearer standardisation in electric traction than we are in this country. Each nationality seems to prefer one particular system for reasons of sentiment rather than efficiency, and clings to it with a stedfastness which is worthy of a better cause. It is interesting, moreover, to note that in Germany electric traction is in a state of stagnation, in spite of its pioneer efforts on the Dessau–Bitterfeld Railway, and that, therefore, this seems to be the one country where a standard system could be adopted without a certain amount of destruction being a necessary preliminary. Italy remains wedded to the three-phase system, though even she is not an absolutely constant lover; while, considering the fuel difficulties, we are surprised that no greater progress has been made in converting the network of lines, especially in the north, to electric traction. In France a Commission appointed by the Ministry of Public Works reported in favour of the high-tension direct-current system, and some 3,000 miles of line are to be converted to this method; but the Midi authorities propose to equip 1,863 miles of their line on the single-phase system as an extension to the 93 miles which are already thus operated. On the whole, therefore, though there may be two opinions as to the desirability and possibility of national and international standardisation in matters concerning electric traction, it will be agreed that the policy now being followed in Europe is not likely to lead to that standardisation coming about.

Electric Traction in Switzerland.

THE conversion of the railways now operated by steam locomotives to electric traction has always been closely studied by Swiss engineers. As is well known, a start was made some time ago with the Simplon tunnel, and schemes for the electrification of the whole of the system have also been prepared. The pre-eminent reasons for this were, of course, the high price of coal and the presence of abundant water power. There would now appear to be a third reason. For, owing to the high rate of currency in Switzerland compared with Germany, Austria and Italy, it is at present found cheaper to send international traffic by a circuitous route which avoids the Swiss system. One way of getting over this is by the speeding up of the introduction of electric traction so that more favourable terms can be offered, and if this plan is adopted one result should be that a large number of orders will have to be placed abroad. We are used by this time to British contracts going to Switzerland; the reverse would be a pleasant change.

Traction Frequencies and Efficiencies.

THE statement in the interim report of the Electrification of Railways Advisory Committee that no loss of efficiency is anticipated by using frequencies as high as 50 is one of those half truths which are really so much more misleading than downright incorrectness, for they tend to convey a definite impression, which, though not essentially untrue, is not shored up by the collection of facts which are so valuable a part of the structure in engineering if satisfactory financial results are to be the outcome of the scheme under consideration. If, for instance, we compare the results that are obtainable, in our present state of knowledge, by using frequencies of 25 and 50 respectively in railway working, what do we find? If the former frequency is used, it is possible to employ rotary converters with an output of 1,500 kw. But no manufacturer will guarantee satisfactory, much less safe, operation with rotaries of this output at the higher frequency. We know that machines of this size are being used with a frequency of 40 on the Shildon-Newport section of the North-Eastern Railway, but we understand they are seldom fully loaded, and, even as it is, the frequent flash-overs and other minor failures that occur are hardly such as to encourage their adoption for the supply of, say, a London suburban line. The inevitable conclusion we must reach, then, is that if the higher frequency is to be employed in connection with rotaries, the size of the sets must be cut down and a certain amount of efficiency must thereby be sacrificed.

The Financial Side.

THE other possible solution gives no better results. It is true that motor-generators can be used instead of rotary-converters, and that, by their employment, sets as large as those mentioned above may be employed, and high efficiency thereby maintained; but to do so means a great increase in capital expenditure, for, according to recent estimates, the erection of motor-generator plant instead of rotary-converters of the same output would increase the cost by no less than 100 per cent. It is therefore patent that the frequency question cannot be dismissed with the light and airy treatment it has received in the report. It is, in fact, a question which must be settled definitely, not only for reasons of cost and efficiency, but because all undertakings which are likely to be called upon to supply a railway, and even the railway companies themselves, must know how they stand without delay unless development is to be unduly retarded. For instance, is it better for a railway company serving a district where the prevailing frequency is 40 to take energy from the supply authority at the higher frequency, and sacrifice both efficiency and reliability to save money; or should it build a station of its own to secure what the local supply cannot give it, and be involved in an expenditure which may adversely affect the financial stability of the undertaking? It is questions like these which have to be answered, but what the correct answer is the Committee's report gives little clue.

Telephone Developments in the United States.

The account of his visit to the United States given by Sir William Noble to the Institution of Post Office Electrical Engineers, of which we give an account in another column of this issue, shows how great has been recent progress in telephone work in that country. This may be explained partly by the fortunate position of American manufacturing companies and the general prosperity enjoyed by the country in the early period of the war; but it is probably due still more to the remarkable facilities for research which these companies enjoy. One cannot resist the conclusion that in this respect we should do well to follow the example of the United States more than we have done in the past. Another factor making for general efficiency has doubtless been the exceptional experience acquired on the long-distance telephone systems of the States. The point of chief interest in the Paper is the account of the automatic exchanges, which seem now to be accepted as entirely satisfactory and trustworthy for dense city areas. It is interesting to learn that Sir William has arranged with the American Telephone & Telegraph Company for a 3,500 line panel system to be installed in London, forming the nucleus of a 10,000 line system. We hope that the experience thus gained will enable any leeway in this sea to be rapidly recovered.

Some Interesting Instruments.

Considering how important measurement is in the proper conduct of both the scientific and technical sides of electrical practice it is perhaps strange that not more work is published on the design of electrical instruments. It may be argued with a good deal of truth that the instruments which we have at present are sufficiently well designed for all practical purposes and that any change would be unnecessary and undesirable when so many other things remain to be done. This view receives little support in the report recently made by the Committee on Instruments and Measurements of the American Institute of Electrical Engineers. It appears that most firms engaged in this class of work reported the completion of experimental models, especially for measuring kilovolt ampere hours and demand devices for measuring kilovolt-amperes, kilowatts and power-factors, either separately or simultaneously on a single record. An automatic potentiometer and an automatic Wheatstone bridge both singly and in combination are also being developed. For electrochemical work the latter can be operated on a 60-cycle alternating-current circuit in conjunction with a special alternating-current galvanometer. The measurement of the thermal performance of cables in daily or weekly cycles and of transformers and turbo-generators is also being dealt with. These all mark real advances. Similar work we know is being done at the National Physical Laboratory, but it would be well for the authorities at that Institution and our own manufacturers to come together in consultation in order that no theoretical or practical point may be neglected, while information as to what is going on should be periodically laid before the Institution or the technical Press.

The Direct United States Cable.

The Government has acquired what may prove to be a valuable link in the "All-red" submarine cable scheme by purchasing the undertaking of the Direct United States Cable Company. In a statement issued by the directors of the company it is pointed out that the Government offer includes the purchase of the cable as laid, with the property, stock of cable and equipment, at a figure which will permit of a payment to the shareholders of £6 per £10 share. The company, which was formed in 1877, owned a cable laid in 1874 between Ballinskellings Bay, Ireland, and Halifax (Nova Scotia), and from there to Rye Beach (U.S.A.); but in 1910 a new cable was laid, and the line was diverted to Harbour Grace, Newfoundland. In 1912 the cable, as well as the cables of the Anglo-American Telegraph Company, were leased to the Western Union Telegraph Company for 99 years, thus depriving this country of all real control of the cable communication with Canada. In 1918 the cable broke down in deep water, and, owing to the Government restrictions upon the use of cable steamers, the company was unable to effect repairs within the time fixed in the lease, the result being that the Western Union Company repudiated the working agreement, and refused to pay the stipulated rent. Litigation ensued, and, as the Direct United States Company was unsuccessful the directors opened negotiations for a renewal of the lease. These efforts to arrange a working agreement have now failed, and the property will pass to the Government.

A Chance for British Control.

During the war the want of direct British submarine communication with Canada was greatly felt, and though the partial remedy was found in the deviation of one of the cables of the Deutsch Atlantische Telegraphen Gesellschaft to Halifax, it was recognised that for satisfactory communication a duplicate cable was necessary, especially as for reliable secret communication the submarine cable must continue to have a wide application. This link will now be provided by the direct cable when it has been thoroughly overhauled and repaired. One of the disadvantages under which the company has suffered in the past has been that it had only one line, and when that broke down traffic had to be transferred to its rivals. In pre-war days there were 17 North Atlantic cables—viz., Western Union eight (including the Direct line), the Commercial Cable five, the Compagnie Française des Cables Sous-Marins two, and the Deutsche Atlantische two. Of the latter two cables, one now belongs to Canada, and the other to the French Government, though their final disposition must depend to some extent upon international agreements.

Half-Watt versus Gasfilled.

There is a tendency among English speaking peoples to label things with names which on the *lucus a non lucendo* principle, describe their properties by ascribing to them qualities which they do not possess. An example of this is the so-called "half-watt" lamp. When it first appeared its most popular feature was that it had a higher "efficiency" than the vacuum type metal filament lamp. The latter lamp was supposed to have an "efficiency" of 1 watt per candle-power: and it was therefore convenient to assume that the "efficiency" of the new lamp was twice as great. The discovery that this is not the case has caused embarrassment to our friends and joy to our enemies. We are therefore glad to hear that those firms who are members of the Electric Lamp Manufacturers' Association have decided as soon as possible to discard the term "half-watt" and to refer to this type of lamp as "gasfilled," employed as an adjective and written (if the compositor will permit) as one word. A further reason for this change is that a number of lamps are now being sold as "half-watt" which are in reality vacuum lamps, with a bulb resembling a gasfilled lamp and fitted with a spiralised filament in ring formation. These lamps are being sold to the public at prices slightly lower than an Association gasfilled lamp, but at a considerably higher price than Association vacuum lamps. To describe them as "half watt" is, of course, inexact, but to describe them as gasfilled would be a perversion of the truth of a depth to which those concerned would hardly dare descend. The proposed change will be very welcome, and the only criticism necessary upon it is that it might have been made before.

The Demonstration of Electricity.

At present exhibitions of all sorts and sizes and dealing with all sorts and conditions of things, from babies to vegetable produce, are being held in every part of the country. Different as these assemblies are, both in organisation, utility and object, they all have this one point in common that electricity could be used to assist in solving the problems which face the trade or industry they are intended to exploit. To take the two instances given above, the babies would certainly fare no worse, and might fare a good deal better, while the same is in a greater degree true of their mothers, if the use of electrically-operated labour-saving devices, such as milk warmers, irons, washing machines and curling tong heaters became more usual, while the man who grows giant vegetable marrows would doubtless find that many of the processes connected with this fascinating pursuit could be facilitated by the use of electric motors, while the employment of an electric vehicle for taking his goods to the market would conduce to greater efficiency and allow a saving on railway rates to be effected.

A Travelling Exhibition.

It therefore seems a great pity that there is seldom any electrical representation at these exhibitions. On the other hand, it must be admitted that electrical manufacturers can, as units, hardly be expected to go to the trouble and expense of having a regular stand at each of these exhibitions when they are so numerous and so varied in character, and when their connection with electricity, though apparent, is more or less indirect. But both these difficulties might be overcome by the inauguration and maintenance by some central authority, such as the B.E.D.A., of a travelling "fit up" electrical exhibit, to which the necessary modifications, suggested by requirements of each particular case, could be made as occasion required. In this way there would be no exhibition without its electrical stand, an arrangement that would bring the advantages of electrical working before an entirely new public and assist in the development of an entirely new class of consumer. In order that we may take our part in this new work, we shall be pleased to receive announcements of exhibitions where such a portable stand could be usefully shown, in order that a record may be made in our columns for the "information and necessary action" of those most intimately concerned.

The Fluctuation Clause in Contracts.

It is satisfactory to learn that the iron and steel merchants have been dealing with the subject of preparing a standard clause for insertion in contracts in place of the existing fluctuating condition with regard to prices. This is a very important matter, more especially in connection with foreign contracts and orders. We have recently called attention to the volume of business which has been lost to British manufacturers and exporters through dislike of foreign buyers to the fluctuation clause and the inability on the part of our manufacturers to guarantee delivery of goods within a reasonable time. We hope that this work will be carried to a satisfactory conclusion, and that a standard clause will be evolved, not only by iron and steel masters, but by electrical manufacturers and exporters for insertion in their contracts.

The Present Proposal.

We learn that the present proposal, which has been laid before manufacturers, is that in the event of any shortening of hours, increase in wages, cost of material, or of transport charges during the currency of the contract, the price shall be increased by an amount to cover the whole of such charges; but should any such costs or charges be decreased, or the price reduced for any other reason, the contract price shall be reduced by an amount equal to such decrease. A few manufacturers have already adopted the principle of the clause, but it has been found impossible to secure uniform practice. It may be found impracticable to introduce complete uniformity of practice in any branch of industry, but it is highly desirable to have something in the nature of fixed, definite terms which can be easily understood and appreciated by foreign and colonial customers. An alternative proposal is that the existing clause should be modified by introducing a stipulation in every contract fixing a time limit for the enforcement of any advance in price to cover any increase in cost that may occur during the currency of the contract. It is thought that this restriction would have a good effect in stimulating deliveries.

Electricity in Mines.

Part I. of the Annual Report of the Chief Inspector of Mines, from which we give some extracts in another column, is compiled in the usual uninteresting official style. There are 200 pages of statistics, tables, records and official reports from divisional inspectors, but there is no index, and therefore it is not easy to find any particular matter in which the casual seeker after knowledge may be interested. We learn, however, that substantial progress has been made in the introduction of mechanical coal cutters, especially in Scotland, the Northern Division of England and South Wales. In some areas it is reported that there were difficulties in getting electrical supplies and a greater advance would have been made if plant had been available. Electric safety lamps are being used in increasing numbers, and in South Wales and in the Yorkshire and North Midlands area they are very popular with the miners. In Scotland the Inspector expresses the opinion that with the introduction of a practical electric head lamp the number of explosions of fire damp would be reduced. It is said that the Scottish miner, so long accustomed to carry a naked light lamp on his bonnet, objects very strongly to use a safety lamp of the ordinary type; but if he were given an electric lamp which he could carry on his head, his objections would be to a great extent overcome. There was a decided drop in the number of accidents, but there were nine fatalities due to the use of electrical machinery. The majority of these could, however, have been avoided by prudence and by the proper inspection and supervision of the plant. New regulations for the use of electricity on the surface of mines were introduced during the current year, and with a stricter enforcement of working rules we hope to see a better record in next year's Report.

Commercialism and Electric Vehicles.

We are glad to learn that the electric vehicle will be well represented at the Commercial Vehicle Exhibition which opened at Olympia yesterday. We hope that electrical engineers, in whatever branch of the industry they may be engaged, will take an opportunity of paying the stands a visit and of seeing whether there is not on show some lorry, delivery van or truck which would not meet their own needs for efficient transport. For as with the domestic problem, so with the electric vehicle, propaganda must begin at home. In this connection an interesting point for the cynical is to be found in the poster displayed on all the hoardings advertising the exhibition. It contains accurate and artistic representations of both the petrol and steam vehicle, but of the electric vehicle there is no sign. We hope those responsible will wake up by next year.

Electricity Supply in London.

Since their appointment the Electricity Commissioners have followed the very wise policy of considering all applications for extensions to existing generating stations not only from the point of view of the requirements of the area which that station primarily serves, but also from those of the surrounding district. In this way it has often been found that though an area could not be supplied with sufficient electrical energy from its own station without extensions being necessary, by interlinking a supply could be given from an adjacent area, where the plant installed was not fully loaded. By following this policy it has been possible in the large majority of cases to deal with the present and prospective load of the next few years without resource to the erection of comparatively small, new stations.

There have, of course, been exceptions to this rule, the most notable of which was the permission recently given to the Nottingham Corporation to erect a 240,000 kw. station. But this permission carried with it the obligation to supply, if necessary, the electrical needs of the area as well of the district, and is, therefore, not so much an exception as an extension of the principle we have just enunciated. This policy has, of course, not been universally carried out without opposition or criticism, but it has been carried out without that opposition or criticism being vocal enough to attract much public attention.

The Barking Station Again.

But last week we made a further step forward in this phase of electrical politics. For the inquiry held by the Commissioners into an application by the County of London Electric Supply Company to erect a station at Barking to meet their electrical needs recalled the battle of some fifteen years ago when County Councils, municipalities and private owners all had their nostrums for solving the problem of electricity supply in London. In addition, many of the old protagonists were present, and the site itself was familiar as a battleground.

The Company's Case.

The case of the company in support of their application is briefly as follows : The load in their area is growing so rapidly that extensions to the generating plant are vitally necessary. These are not possible at the present stations, where much of the plant is obsolescent and will require early renewal. The only economical scheme is, in their opinion, therefore, to build a new station at Barking, where 60.000 kw. can be erected as a first instalment (and 200,000 kw. ultimately), and thus provide a way out of the present difficulties. Further, it will allow the London and Romford areas of the Company to be developed in the most modern way, and the railway load which is certain to come along in the near future to be adequately dealt with. In addition, the company have the land, and but for the war would have built the station before now. Finally, as an appeal *ad misericordiam*, the load of the company is increasing so rapidly that unless permission to build this station is granted the company might just as well go out of business, or at least, would have to restrict their output.

The Opposition Case.

The opposition's case is succinct. They object to the vital question of the future electricity supply of London being considered piecemeal. They point out that they (and they means practically all those concerned with electricity supply in London, except the County Company) have now under consideration, and in six months' time will have ready for presentation to the Commissioners, a joint scheme for electricity supply in the metropolitan area. It is surely possible, they add, for the County of London Company to wait that short time, and see how the proposals then put forward will assist to relieve them of their difficulties.

Some Interesting Points.

Now it is no part of our business to adjudicate on these rival cases ; that, of course, is for the Commissioners. But without expressing any opinion on the merits of the two sets of arguments, there are one or two points to which we may call attention, as having an important bearing on this vexed question of electricity supply in London. First of all, it seems to us there is a conspicuous lack of any desire on the part of either party to sink differences in order to secure a workable joint scheme. We hope that we do them an injustice in making this statement, but that is the appearance of things. In fact, so fearful are some of the interested parties that some one else may gain some slight advantage that they are willing to inflict any injury upon themselves to prevent such a state of things coming about. Electricity supply in London has had a sad history. Its future will be equally sad if this sort of thing continues, but that does not seem to be realised.

Our ideal for the electricity supply of London would be a joint scheme put forward for the Commissioners' consideration by *all* the supply authorities in London. To formulate such a scheme should be within the bounds of possibility, and its advantages are evident over a scheme put forward by one company admittedly for its own benefit, even though there are reservations enabling the proposed station to be more widely used later on. But it is difficult to make binding agreements with a body that does not yet exist. For that reason we should be inclined to agree that it is better to wait for six months for the joint scheme than to give the County Company what they want. But there remains an uncomfortable suspicion that the joint scheme is still very much in the paper stage, and there are even rumours that suggest that if its ghostlike shadow fulfils its objects of blocking the progress which the County Company's application foreshadows that is where it is likely to remain. We know to our cost that sort of thing has been done before and will probably be done again.

The Question of Finance.

Finally, there is the question of finance. To build this station the County of London Company will obviously require to raise capital, which, as they rightly point out, cannot be done cheaply at present, though an authority with wide County Council and municipal backing would have less difficulty. But behind this simple fact there seems to be various strange deals going, such as land being sold by one company to another with a different name but the same shareholders, and an uneasy feeling that behind this desire to obtain permission to build a station there is also the idea that possession of such a site may come in useful for exploiting the public a bit later. We therefore sincerely hope Sir Harry Haward has his eyes open; for finance is going to be the controlling factor in this business. These then are some of the pretty problems with which the Commissioners have to deal, and we hope that in doing so they will take such steps that the history of electricity supply in London may be better in future than it has been in the past, and we may get a co-ordinated scheme in which everyone can play their part without friction and for mutual benefit.

The Profit and Loss of Engineering Training.

The profit and loss account of any commercial undertaking is usually examined from the point of view of those who, like its shareholders, expect to receive from it some return for the capital they have invested. But this is not the only point of view; and if the unusual course is taken of considering it from the angle of the employee or the creditor, a new light may often be thrown upon some of its features.

Taking the item of salaries and wages (which appears in every such account) as an example of what we mean, and assuming the income of the firm to be fixed, it follows the less there is expended on salaries, wages or any other item of running costs the more there will be available for division between the shareholders. The argument cannot, of course, be carried to a logical conclusion in either direction. For, except within very narrow limits, if there were no salaries there would be no profits; and, on the other hand, it is not unknown for an increase in salaries to be followed by an increase in profits owing to the greater comfort and security in which those concerned are enabled to work and live. So much so that it is becoming more and more recognised by progressive employers that the payment of adequate salaries is worth the shareholder's while.

The Training Balance Sheet.

This is all written by way of parable, a parable which is applicable to certain aspects of engineering training which are not without their importance at the present time. If our knowledge of engineering science and technology is to develop and increase we shall require a constant supply of young men well educated in the fundamentals of knowledge; and thereby enabled to carry on this great work in the right way. To employ the "profit-and-loss-account" analogy, if there is no education there will be no engineers. We do not say that this result is likely to come to pass, and imagination boggles at the state of affairs that would exist if it did. Nevertheless, even without the full consummation resulting from such a policy the tendency in the direction we have indicated is already sufficiently alarming and should be checked before it is too late. A pleasant exception is, however, to be found in the proposals recently put forward by the B.E.A.M.A. for the establishment of research studentships and scholarships in mechanical and electrical engineering. The principle of these is excellent; and though we are not in agreement with all the details of the working proposals we shall defer our criticism for a time, as we understand the scheme is of a provisional character. The great thing, however, is the recognition that some assistance is necessary in order that the best kind of ngineer may be produced and that everything must not be left to the boy's or the parent's individual effort. It is a change that is most welcome.

Lack of Attraction a Drawback.

Returning to our balance sheet once again in the development of our argument we may push our analogy a little further. For if there is no attraction to the young man in the engineering profession, if he can expect neither honour nor wealth, but only a life of indignity and drudgery as a result of all his training, he will naturally choose some other calling. It may be argued that if his bent is towards teaching he will teach whatever the remuneration may be, and that if he is keen on designing he will design, though he starve; in other words, whatever his prospects he will find his reward in his work apart from any financial return. Undoubtedly this is so. But in spite of what we are told there is a minimum below which it is not safe to go, if efficient work is to be obtained, and in any event exploitation of this kind is most deplorable. This is so far being forced upon educational authorities that matters are already improved in primary and secondary schools, and it is time universities followed suit. If they do not engineering will no longer obtain its share of the best intellects and the movement in the direction we have indicated above will have begun. Soon after the engineering profession will be within measurable reach of the state where no salaries are paid neither are any profits obtained.

Two Important Occurrences.

If we are accused of being too pessimistic in this matter we can point to two recent occurrences which give us some justification for our attitude; the closing of Finsbury Technical College and the decision of the Engineering Training Organisation to abandon its work. This is not a time when we can afford to dispense with technical colleges or with organisations which aim to interest employers in educational matters. In both cases what has occurred has occurred mainly for financial reasons. Those concerned, though perhaps unconsciously, are in fact trying to obtain profits without paying any salaries. It is a policy which is foolish and may easily be disastrous. We are therefore relieved to hear that the work of the Engineering Training Organisation is to be taken over by the Engineering Employers' Federation by arrangement with the Federation of British Industries, and we wish them every success in their important undertaking.

The Selection of Teachers.

We said just now that the lack of recognition for the engineer is as worthy of proper financial remuneration as the commercial man will force the best of our youth to neglect engineering as a profession. It will also have another result. It will prevent the best of our youth from obtaining proper engineering training. For to train that youth in the way it should go requires the best and most progressive intellects, and it is not surprising to find that those intellects are no longer satisfied with the poorly paid posts which are mainly all the teaching profession has to offer. It may be regrettable that salesmanship should be preferred to professorship, but it is not surprising. Much of the equipment is poor. Cheese-paring has of necessity to be the best policy. No good result can come of such a state of things. If we do not check this tendency the velocity of the movement towards disaster is likely to be accelerated. We, therefore, feel it to be essential that the industry should provide for its needs in this respect. The reply may be that this is the State's business, but it is the industry's business to see that the State do their business and not to wait for it to be done, and even faintly to discourage it. There is no philanthropy about the question, for money spent on this object will bring in a great return. All that is wanted to ensure it is breadth of view which regrettably it seldom receives.

The Crawling of Induction Motors.

By LAURENCE H. A. CARR, M.Sc.Tech., M.I.E.E.

It is well known that some squirrel-cage motors when started under certain loads will not run up to full speed, but will "crawl" at a much lower speed, due not to any increase in the load, but solely to some inherent characteristic of the motor itself. In machines which exhibit this phenomenon the rotor is usually of comparatively low resistance, and tests of the few cases which have come under the writer's notice have shown that if n be the number of slots per stator pole-pair, the crawling speed is $1/(n+1)$th of the true synchronous speed of the motor.

When crawling, the stator current is usually high, saturating the lips of the teeth, with leakage flux, so that the main flux can get through to the rotor very little better than if the stator had open slots; in other words, the permeance of the air-gap varies from a maximum to practically zero around the inner surface of the stator, according to some such law as $1+q\cos\theta$, where θ is an angle corresponding to 2π=stator slot pitch.

According to the ordinary rotating field theory the resultant field, where there are n slots per pole pair, can be replaced by the fundamental, a field having $(n-1)$ times as many poles, rotating backwards, and a field having $(n+1)$ times as many poles as the fundamental, rotating forwards.

This, however, cannot explain the observed effect (due to the negative torque of the $(n+1)$ the field at over-synchronism), as firstly, the crawl takes place at exactly the sub-synchronous speed, without allowing for any slip of the rotor relatively to that particular field, and secondly, the observed effect is far greater than is explained in the above way, since the maximum negative torque of the $(n+1)$th field can never be more than $1/(n+1)$ of the maximum torque of the main field, which with the higher values of n is far too small to neutralise the main torque at any point.

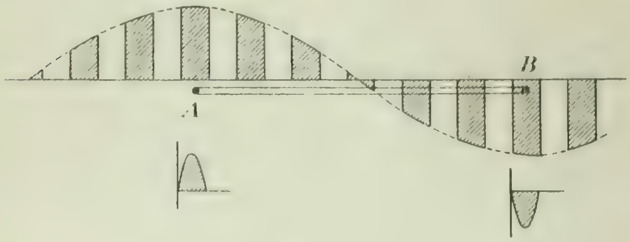

Fig. 1.

If a motor be considered in which the stator slots (owing to saturation of the lips of the teeth with leakage flux), carry no flux, the flux-space wave will be ragged, as shown in Fig. 1. Let AB in this figure represent a full-pitched rotor coil moving at crawling speed, *i.e.*, at $1/(n+1)$th of the true synchronous speed. It will be seen that conductor A is only cutting flux while the flux is positive. When the flux under that particular pole is negative, the conductor is moving in a flux-less space, and it moves under the next tooth just in time to meet the growth of the next positive wave. The cycle of E.M.F. due to motion alone is therefore a sine wave with the negative half missing, there is a positive half-wave followed by zero for the other half cycle. Similarly, conductor B will have no positive values, the curve of E.M.F. due to motion being a negative half-wave, followed by zero for half a period. Since the conductors are in series, these two E.M.F.s add up. It is clear that this E.M.F. has a direct or continuous component in addition to the alternating component (plus higher harmonics).

Meanwhile the transformer action of the stator field is producing an additional E.M.F. in the coil, but this is sinusoidal and does not destroy the direct current which flows in the conditions considered, though it is entirely overlooked in the usual rotating field theory.

Mathematical Treatment.

To investigate fully the behaviour of this current it is necessary to treat the problem mathematically, considering for simplicity's sake a two-phase stator. A further simplification is to consider values per half-turn or conductor, since as the quantities concerned vary sinusoidally, if at all, there is always an equivalent equal and opposite path for any current, save in the one case to be considered later.

List of Symbols.

B_1=Flux density due to phase I.
B_2=Flux density due to phase II.
B_m=Maximum value of either B_1 or B_2.
e_t=Instantaneous E.M.F. per conductor due to transformer action.
e_r=Instantaneous E.M.F. per conductor due to rotation.
e_s=Instantaneous E.M.F. (total) at slip $s, = e_t + e_r$.
E=Maximum value of rotor E.M.F. at standstill.
e=Instantaneous E.M.F., that is e_s, when slip is $n/(n+1)$.
f=Frequency.
l=Core-length.
n=Number of stator slots per pole pair.
p=Pole-pitch.
q=Factor in expression for permeance.
s=Slip, expressed as a fraction.
t=Time (variable).
v=Linear velocity of rotor conductor.
α=Angle between axis of coil (momentary) and axis of stator coil of phase I.
ω=$2\pi f$.
Φ_1=Flux due to phase I, linking with rotor coil.
Φ_2=Flux due to phase II, linking with rotor coil.
Φ_m=Maximum value of Φ_1 or Φ_2.
β=An angle corresponding to the position of the rotor coil with respect to the permeance curve at zero time.

For any position of a secondary coil inclined at an angle α to the axis of stator coil I (see Fig. 2), assuming sinusoidal distribution of flux both in time and space, and calling the time zero when Φ_1 is zero and increasing, the flux of phase I. linking with the coil $\Phi_1 = \Phi_m \sin\alpha \sin\omega t$,
similarly,

$$\Phi_2 = \Phi_m \cos\alpha \sin(\omega t - \pi/2) = \Phi_m \cos\alpha \cos\omega t.$$

The transformer E.M.F. per conductor

$$\begin{aligned} e_t &= \tfrac{1}{2} d\Phi/dt, \\ &= \tfrac{1}{2}\Phi_m d(\sin\alpha \sin\omega t + \cos\alpha\cos\omega t)/dt, \\ e_t &= \tfrac{1}{2}\omega\Phi_m(\sin\alpha\cos\omega t - \cos\alpha\sin\omega t), \\ &= -\tfrac{1}{2}\omega\Phi_m \sin(\omega t - \alpha). \end{aligned}$$

The flux density at the conductor and at right angles to its motion, with uniform permeance is the sum of B_1 and B_2, where

$$\begin{aligned} B_1 &= B_m \sin\omega t \cos\alpha, \\ B_2 &= B_m \sin(\omega t - \pi/2)\sin\alpha, \end{aligned}$$

$$\begin{aligned} \text{hence} \quad e_r &= (B_1 + B_2)lv, \\ &= B_m lv(\sin\omega t\cos\alpha - \cos\omega t \sin\alpha), \\ &= B_m lv \sin(\omega t - \alpha), \\ \text{but} \quad \Phi_m &= B_m lp2/\pi, \\ \text{and} \quad v &= (1-s)2pf, \\ \text{hence} \quad B_m lv &= (1-s)\Phi_m\omega/2, \\ \text{and} \quad e_r &= \tfrac{1}{2}(1-s)\omega\Phi_m \sin(\omega t - \alpha). \end{aligned}$$

For convenience the signs of e_t and e_r may be reversed, so that the total E.M.F. at slip s

$$\begin{aligned} e_s = e_t + e_r &= \tfrac{1}{2}\omega s\Phi_m \sin(\omega t - \alpha), \\ &= Es\sin(\omega t - \alpha). \end{aligned}$$

The effect of the varying permeance must now be considered, which can be done by multiplying e_r throughout by the permeance $1+q\sin n\alpha$.

Strictly speaking this gives only the first two terms of a series of harmonics, the higher values of which may be neglected.

For a square topped permeance wave q may have values above unity, up to a limit of two for a knife edged tooth, but in practice its value will probably be not much above unity. Further, q may be either positive or negative according to whether a tooth or a slot lies on the axis of stator coil I.

Then the E.M.F. per half-turn

$$e = \tfrac{1}{2}\omega\Phi_m[\sin(\omega t - \alpha) - (1-s)(1+q\sin n\alpha)\sin(\omega t - \alpha)].$$

At crawling speed, corresponding to the phenomena described earlier in the paper,

$$1-s=1/(n+1),$$

hence

$$e=Es\sin(\omega t-a)-\frac{E}{n+1}q\sin na\sin(\omega t-a),$$

but under the conditions considered,

$$\omega t=(n+1)a+\beta,$$

where β may have any value from 0 to 2π, and corresponds to the permeance at the conductor considered at the moment chosen for zero time.

Then

$$e=Es\sin(\omega t-a)-\frac{Eq}{n+1}\sin na\sin(na+\beta),$$

$$=Es\sin(\omega t-a)-\frac{Eq}{n+1}\{\cos\beta-\cos(2na+\beta)\}.$$

This means that the total E.M.F. present consists of the following three terms :—

(1) $Es\sin(\omega t-a)$, the alternating E.M.F. that would exist if there were no variation in permeance.

(2) $\frac{Eq}{n+1}\cos(2na+\beta)$, a double periodicity E.M.F.

(3) $\frac{Eq}{n+1}\cos\beta$, a direct or continuous E.M.F.

It is this last which is the cause of crawling.

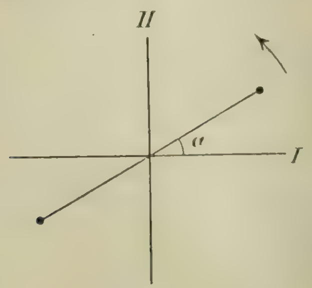

Fig. 2.

Though the pressure is small compared to the alternating pressure (since it contains the term $1/(n+1)$), yet being direct it will produce a much larger current in proportion, due to the reactance having no effect. Further, since in the crawling condition, the currents are much larger than at full load, even a small fraction of those currents will produce heavy magnetic disturbances.

The Result of the Direct Current.

The exact result of the direct current is difficult to calculate. Firstly, the M.M.F. of the rotor due to the direct current depends on the number of slots in the rotor, as on that depends the stepping of $\cos\beta$ from slot to slot, and hence the number of poles on the rotor due to the direct current.

Thus, if the rotor has one more slot than the number corresponding to $(n+1)$ per pole pair, the stepping of $\cos\beta$ will be such that the direct currents give the effect of a two-pole rotor. If two more slots, then the result is a four-pole rotor, and so on.

Further, as far as the writer is aware, there exists no method of dealing mathematically with sine waves plus constant quantities, particularly when their space wave-lengths, or pole-pitches, are not necessarily the same, and their magnitudes are mutually dependant. Certainly a great loss in torque is to be expected as the direct current must at times seriously oppose the main alternating flux of the machine. A low resistance rotor is doubly disadvantageous, since firstly, the main torque of the machine at low speeds is reduced, and secondly, the direct current, and its harmful effect, are increased.

How to Prevent Crawling.

The way to prevent crawling is, however, clearly indicated in the above equations, the solution being to give the rotor one more slot per pole-pair than the stator, when though the continuous E.M.F.s will be produced, $\cos\beta$ will be constant round the rotor, that is to say, every bar will produce exactly the same continuous E.M.F., and there will be no continuous current.

It is a noticeable fact that machines built in accordance with this rule run up from rest extremely quietly, and it appears probable that the howl emitted by so many motors when starting up, is due to passing through this crawling speed, and the probable oscillatory stages on each side of it. It also appears that any periodic variation in apparent permeance round the stator may be treated in the same way, as for example the irregularity in the flux-space wave in pole-changing motors, and the crawling tendency often observed in these cases is also due to a direct current circulating in the rotor in exactly the same way that has been described above.

Continuous Wave Multi-Stage Receiving Circuits employing Retroaction and Self-Heterodyne Principles.

By JOHN SCOTT-TAGGART.

In a recent Paper read before the Wireless Society of London' the present author drew especial attention to the value of retroactive amplification in the case of continuous wave reception. The problem no longer involves lessening the decrement of incoming wave-groups, as in the case of spark signals, but lessening the effective resistance of the aerial circuits. In other words, the positive resistance of the aerial circuit is almost completely neutralised by what is equivalent to putting a negative resistance in series with it.

Some further examples of the use of this principle are given in Figs. 1 and 2. In the former arrangement, the aerial circuit L_1C_1 is tuned exactly to the incoming continuous waves, the value of C_1 being kept at a minimum. In the anode circuit of the first valve is a retroactor coil R_1, whose coupling with respect to L_1 may be varied. The condenser C_2 will usually be omitted. The magnified potentials across R_1 are passed on to the grid G_2 of a second valve, through a blocking condenser whose purpose is to insulate G_2 from the positive side of the anode battery H. In the anode circuit of the second triode is an inductance shunted by a condenser, C_3. This circuit is tuned to a frequency slightly to one side of the incoming frequency. The magnified oscillations are now applied to the grid G_3 of the last valve, which functions as a detector. The anode circuit of this last valve contains the telephones T, shunted by a by-path condenser, and a retroactor coil, R_2, coupled to the inductance in the anode circuit of the preceding valve. The circuit is normally so arranged that the first valve acts as a retroaction amplifier, or, in other words, a means of introducing negative resistance into the aerial circuit. The coupling between R_1 and L_1 is adjusted to the point just preceding self-oscillation. The amplified oscillations are, after a second high-frequency magnification, heterodyned by the last valve, the coupling between

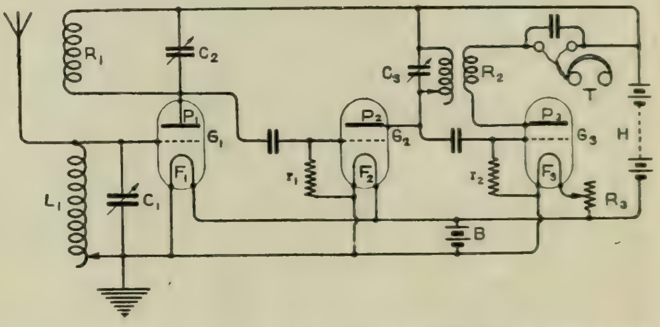

Fig. 1.—Three-valve Continuous-wave Receiver, in which the Last Vacuum Tube Acts as Detector.

R_2 and the inductance in the anode circuit of the second valve being adjusted to produce self-oscillation in the third triode. The beats produced are rectified by the last valve, whose filament current may be independently varied by means of R_3.

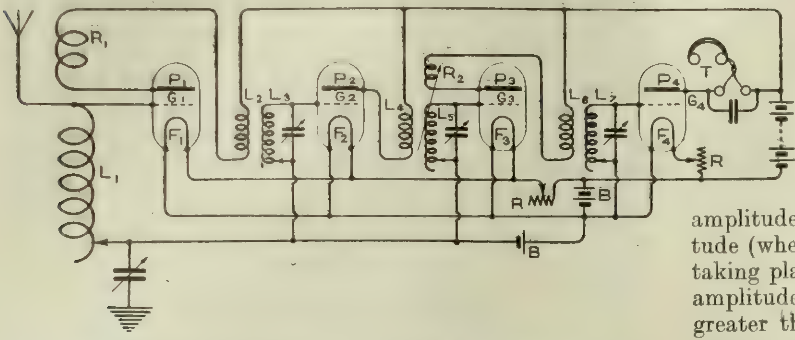

Fig. 2.—Method of Receiving Continuous Waves on a Multi-valve Amplifier. Retroaction is Employed in the First Tube.

Various modifications of this circuit are possible. For example, the condenser C_3 may be connected across R_2 if desired. Initial tuning-in to signals may be facilitated by making the first triode oscillate and adjusting C_1 and L_1 till the beat note is heard; the coupling between R_2 and the inductance in the anode circuit of the second valve is made less than that required for self-oscillation.

The second figure shows a four-valve receiver, which works on the same principle as Fig. 1. The first valve lessens the resistance of the aerial circuit and reinforces the incoming continuous waves which are amplified by the first and second valves, heterodyned by the third and rectified by the fourth. An interesting feature of this arrangement is that it acts as a limiter. The third valve produces oscillations of fixed amplitude, so that incoming signals which are of greater amplitude (when they reach the third valve) than the oscillations taking place there will not produce signals in proportion to their amplitude. When the amplitude of the local oscillations is greater than the amplitude of the incoming oscillations, the signal strength is dependent on the strength of the incoming oscillations. When, however, the local oscillations are the weaker, the signal strength is independent of the amplitude of the incoming oscillations. By taking advantage of this fact, we can use the third valve as a limiting device to prevent very strong signals from completely interfering with weaker ones.

Electric Traction in Europe and America.*

By M. PARODI.

In the *United States* about 6,214 miles of main lines have been electrified, in addition to some 49,602 miles of tramways and secondary railways, some of which, however, both from the point of view of length and traffic, represent quite important lines; but the low price of coal does not encourage electrification. The longest line electrified is that of the Chicago, Milwaukee and St. Paul Railway, in Montana, where electric locomotives are used on 621 miles of line—shortly to be increased to 870 miles.

In *Europe*, the high price of coal tends to hasten electrification, especially in France, Switzerland and in Italy.

In *France*, the Compagnie du Midi has already electrified 93 miles, and intends to electrify 1,863 miles of line. The Compagnie d'Orleans has prepared a programme for the electrification of 1,863 miles, and the Compagnie P-L-M will electrify 1,366 miles. The problems of the electrification of the French railways are being considered by a Commission appointed by the Ministry of Public Works, and it would appear, from the report of the deputation it sent to the United States in 1919, that the high-tension direct-current system will be adopted, although the Midi lines already in operation are generally equipped on the single-phase system.

In *Switzerland*, the Simplon Tunnel was electrified on the three-phase system in 1906, but only for a length of some 12 miles. In 1913, the line of the Bernese Alps was opened, using single-phase currents at 15,000 volts, and during the war the Rhaetian railways have also been electrified on the single system, but at 11,000 volts. In 1916, it was decided to adopt the 15,000-volt single-phase system for the electrification of the whole of the federal lines, starting with the Gothard lines, which will soon be in operation.

The *Italian railways* during the last 20 years have developed the three-phase system in Lombardy and Piedmont, 279 miles being electrified. Although 279 miles is but a small fraction of the total of 8,432 miles, economy in coal is of great importance in Italy, and a further 1,100 miles, out of a total of 2,690 miles projected, is to be electrified.

In *Sweden*, where one would have expected electrification to have taken place some time since, the mineral line, 75 miles long, from Kiruna to Riksgransen, is the only one electrified, but a programme provides for eight large hydro electric power stations.

In *Germany* the subject has been studied at great length, but without any important result having been reached, although the trunk line from Dessau to Bitterfeld, forming part of the main line from Magdeburg to Leipzig, was electrified in 1910.

Experience in Main Line Electrification.

Actually, the electrification of main lines is still, in all countries, fragmentary and rare, and of the total of 744,000 miles of lines in the world only 6,200 miles are electrified, these generally consisting of lines or groups of lines forming part of some much larger system.

The three systems in use are the direct current, the single-phase and the three-phase.

The Single-Phase System.

As single-phase currents are theoretically the most advantageous, this system is, in fact, the most widely used up to the present. It appears, however, that henceforth the direct current system will be more favoured.

One of the great practical inconveniences of the single-phase system originates in the disturbances set up in telegraph and telephone circuits carried alongside the track. The fact that the Swiss system is to be electrified with single-phase currents, however, shows that the Swiss railway engineers consider this effect to be no longer of importance. In France and the United States the single-phase conductors have been duplicated, special transformers being introduced into the circuits. Another method, no less irksome, consists in reducing the distance between feeding points on the overhead wire, in order to maintain as uniform a voltage as possible, by increasing the number of sub-stations.

In cases where there is no possibility of disturbing any telegraphic circuit, the installation of the single-phase system is simple. The current supplied to the transmission line at a very high voltage is transformed at sub-stations about 12 miles apart, and fed to the locomotives at a voltage of 12,000 to 15,000, and supplied to the motors at a still further reduced voltage.

A variation of the system called the single-three-phase system necessitates the installation on the locomotives of a converter receiving single-phase current from the overhead wire, and supplying three-phase currents to the three-phase induction motors driving the axles. This system is in use on the Pennsylvania and on the Norfolk and Western Railways in the United States.

The Three-Phase System.

The three-phase system has important advantages, but with the exception of a few isolated applications such as the Simplon Tunnel, the Swiss line from Bergdorf to Thun, and the Cascade Tunnel section of the Great Northern Railway of the United States, it is practically employed only in Italy.

The motors are particularly efficient and lend themselves readily to regenerative breaking. This simplicity permits of the construction of relatively light and powerful locomotives, the specific weight—61 lb. to 66 lb. per horse-power—being less than with any other form of traction. The uniform distribution of the load between two (or even three) locomotives coupled to the same train is also easily obtained by the insertion of a fixed resistance in the rotor circuit of one of the locomotives (normally that with the smallest wheels). This operation at constant speed which is characteristic of three-phase traction may appear to be inconvenient on many systems, but the Italian railway engineers consider it a great convenience in assuring the regularity of the service on their mountain lines.

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* Abstract of articles in "Le Génie Civil" and the "Revue générale des Chemins de Fer."

The great drawback to the three-phase system lies in the necessity of collecting current simultaneously from two overhead conductors at a considerable difference of potential, since each conductor represents one phase, the third phase being represented by the rails. It has, therefore, been necessary to limit the pressure between these two wires to about 3,000 volts, and even then their satisfactory insulation becomes a difficult problem in tunnels and especially in terminal stations where considerable complications arise in the overhead equipment. The cost of maintaining the line is heavy.

Current at a pressure of 3,000-4,000 volts is furnished by transformer sub-stations placed about 2-3 miles apart, and receiving the primary current at a very high voltage. On the Mont-Cenis line the sub-stations are about 6 miles apart, and it is hoped to increase this distance by using a rather higher secondary voltage. Owing to this small distance between sub-stations, disturbances caused by induction in telephone and telegraph circuits have not been too marked, although several lines alongside the Italian railways have been affected.

THE HIGH-TENSION DIRECT-CURRENT SYSTEM.

The high-tension direct-current system is simply a development of that universally employed for tramways, for metropolitan and suburban railways, the voltage having been raised, step by step, from 500 to 1,500 per motor, may be from 1,000 to 3,000 for two motors in series. It is possible to go further and to use line pressures of 3,500 or even 4,000 volts, but the necessity does not appear for the moment to arise in Europe, where the trains have not a tonnage comparable with that of the large goods trains in America.

The simple method of distribution with a single overhead conductor and the rails as the return conductor has proved perfectly satisfactory for voltages of 2,400 and 3,000 on the Butte-Anaconda and the Chicago-Milwaukee-St. Paul Railways in the United States. In Italy, the line from Turin to Lanzo is to be electrified with 4,000 volts direct current.

When the voltage exceeds 1,500 it is necessary that the locomotives should carry one or more groups of two motors connected permanently in series. If these motors are connected mechanically no difficulty arises, but if there is no mechanical connection, the skidding of a pair of wheels may give rise to an over-voltage on the motor and flashing over at the commutator. This danger may be overcome by the use of suitable safety devices, or "anti-flashes." On the new locomotives for the Chicago-Milwaukee-St. Paul Railway, the G. E. Company have installed 12 1,000-volt motors each directly driving an axle without any mechanical coupling; these motors are arranged in four groups, each of three in series. The Westinghouse type also has 12 motors, but for 750 volts, and coupled mechanically in pairs to drive one of the six axles through a common gearing; the axles are, however, quite independent of one another.

It is important that a locomotive should be equipped exclusively with motors capable of carrying momentarily the maximum voltage which they may accidentally receive in the absence of mechanical coupling; this, of course, considerably increases the difficulties of construction. Although this multiplication of the number of motors is possible on large locomotives, it is not suited to motor coaches where four motors per coach are amply sufficient. In addition, there is at present no example, either in Europe or in America, of direct current motor coaches operating regularly at 2,400 or 3,000 volts.

The reliable and very simple method of employing resistances at starting and during braking used on all tramways, is not desirable for use on railways on account of its low efficiency. A regenerative method of control on the lines of that developed by the General Electric Company for the Chicago-St. Paul locomotives is to be preferred. The solution of this delicate problem of regenerative control is of capital importance from the point of view of the development of direct-current traction, for it alone gives a complete regulation of the speed during the operation as a motor, an almost continuous variation of the speed being obtained by varying the ratio of the currents in the armature and field windings by means of a special exciter. It should be noted that regenerative braking is less certain than resistance braking, since, in the event of the line circuit being broken due to the opening of the circuit breakers, the motors run on light load and the braking effect disappears.

TRANSMISSION FOR HIGH-TENSION DIRECT-CURRENT SYSTEMS.

With the high-tension direct-current system, the primary current will be extra-high-tension three-phase, since this is the form best suited to the transmission of electrical energy in bulk. The usual frequency is 50. Three-phase current is converted to direct current at sub-stations placed at intervals along the line. In the case of the Chicago-St. Paul line, the sub-stations are about 31 miles apart, and each station contains two or three 2,000-kw. motor generator sets having an overload capacity of 50 per cent. for 2 hours, and 200 per cent. for 5 minutes. Thus, a 2,500-ton train taking 1,000 kw. (and up to 4,000 kw. on an up-grade) can be supplied from a single motor generator. On down grades this train may return up to 2,600 kw. to the line, thus helping the primary system to a considerable extent.

The locomotive park already comprises 44 units, 12 passenger, 30 goods and 2 shunting. The two first types only differ in the gear ratio employed, the maximum speed being 62 miles per hour for the passenger and 31 miles for the goods locomotives.

The disturbances set up in feeble current circuits are not important; telegraph lines work well without any particular protection, and telephone lines are readily protected by including suitable apparatus in their circuit.

Summing up, Mr. Parodi comes to the conclusion that in the actual state of the electrical industry, the direct current system appears to be the only one that can be recommended for adoption in France.

The Measurement of Electrolytic Resistance Using Alternating Currents.*

BY H. F. HAWORTH.

If an alternating current is sent through a solution, the cell acts as a capacity in series with a resistance, both varying with the frequency. These experiments sought to establish the relation between the apparent resistance of the cell, as measured between the current-carrying electrodes, and the true resistance of the electrolyte otherwise determined. Bridge measurements of electrolytic resistance giving only minimum balance are unsatisfactory, but it should be possible to measure a definite resistance with zero balance on a bridge.

Apparatus.—It is desirable to adopt a sine wave of E.M.F. so that $\sqrt{CL}=\frac{1}{2\pi f}$. The current is then in phase with the applied voltage, and has the same wave shape. Two suitable alternators, giving maximum frequencies of 250 and 1,000 cycles per second, were designed and constructed, having armatures connected directly on to the shaft of the motor driving them—an essential to constancy of supply frequency. A speed indicator is attached to each machine to give the frequency, and suitable field resistances were used to ensure speed and voltage control.

As a means of detecting P.D.s on the bridges, &c., used, a Duddell vibration galvanometer was employed, various devices being used to increase the sensibility of the instrument and otherwise improve it. Thermostatic means for keeping the temperature constant within $\pm\frac{1}{1,000}$°C. were provided The thermostat proper consists of a thin glass bulb filled with toluene, and having a connecting limb containing mercury attached. In the original Paper the author describes in detail the action of this apparatus, which proved quite satisfactory.

Cells were constructed with platinum and Jena glass, a couple having platinum electrodes each 5×2 cm., separated 1 cm. Comparison tests were made with the platinised and non-platinised electrodes.

As a general rule, either one or other of the arrangements shown in Figs. 1 and 2 was used.

The cell is denoted by a resistance R in series with a condenser C. In series with it is placed a variable self-induction L_1, and in the adjacent arm of the bridge another self-induction is introduced in order to balance the minimum self-induction of the variable one when the electrolytic cell is short-circuited. The bridge was usually an even ratio, one balance being obtained initially with the cell short-circuited. The cell is then introduced, and the bridge again balanced by the introduction of self-induction into the cell arm and resistance R into the adjacent arm. Then the *cell* resistance is R, and its capacity C is

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* Abstract of a Paper read before the Faraday Society.

$$C=\frac{1}{(L_1-L_2)w^2},$$

where $w=2\pi f.$, and L_1-L_2 is the difference between the initial and final self-inductions.

If M_0 is the mutual inductance required to balance the bridge with the cell out, and M is the mutual inductance, and R the additional resistance required with the cell in the bridge,

then cell resistance $=R$ and cell capacity $=\frac{2}{(M-M_0)w^2}$.

The alteration of R and L or M must proceed simultaneously, as no balance can be obtained until both equations are satisfied. In the following measurements the capacity of the two electrodes in series is given the capacity of either, being double this value. This only holds true if the capacity is constant during the current cycle. Otherwise the current wave will be distorted and absolute balance be impossible. But experiments suggest that we may treat this capacity as constant. Experiments were carried out with two similar cells, having electrodes 5×2 cm. placed 1 cm. apart. Both cells had unplatinised electrodes at the start. Experiments were carried out to find the resistance and capacity relationship between the cells before platinising one of them.

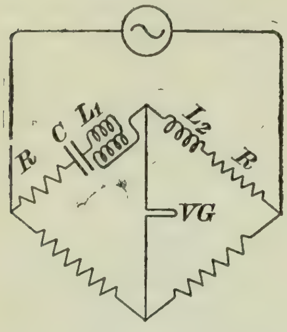

Fig. 1.

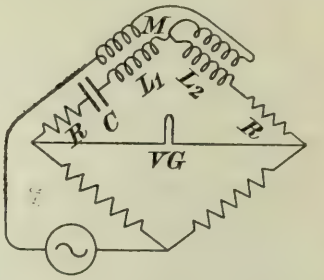

Fig. 2.

Bridge Arrangements.

In the original Paper the author gives the results of some experiments on a cell filled with a decinormal solution of KCl. With currents varying from 0·50 to 21·25 milliamperes, the resistance varied only from 8·60 to 8·55 ohms; 4 milliamperes were used in subsequent experiments on the effect of frequency. With frequencies from 100 to 260 the resistance of cell No. 1 varied from 9·64 to 8·06; of cell No. 2 from 9·88 to 8·18. This change can be expressed by exponential equations. The electrodes of cell No. 1 were now platinised. Using a decinormal solution of KCl the resistance varied from 5·684 to 5·649 with a range of frequency from 120 to 1,000—a decrease of 0·615 per cent.

Dilution tests with both platinised and unplatinised electrodes were next carried out. Starting with $\frac{1}{10}$ KCl, the solution was diluted to half strength and this was repeated eight times (thus ultimately arriving at $\frac{1}{2{,}500}$ strength). In each case measurements were made at frequencies from 100—1,000, resistance and capacity of cell being measured.

These dilution experiments gave interesting results. Even using platinised electrodes, the resistance of the cell varied with the frequency, although for strong solutions this variation is small compared with that in the cell having non-platinised electrodes. As dilution proceeds, the percentage resistance variation decreases up to a point; then it increases until with dilute solutions the resistance variation with frequency is just as bad with the cell having platinised electrodes as with the cell having non-platinised electrodes.

The resistance variations of the non-platinised cell are large with strong solutions, a 42·5 per cent. variation being noticed with the decinormal KCl; but this variation diminishes rapidly as the dilution proceeds, although the rate of resistance alteration is not inversely proportional to the dilution as might be supposed. With dilute solutions it is preferable to use non-platinised electrodes. In every case dilution means a decrease in the effective capacity of the cell.

In order to see how R was altering as the angle of lead of the current altered the angles $\theta=\tan^{-1}\frac{1}{wCR}$, where C and R are the equivalent capacity and resistance of the cell, were calculated for various values of the frequency. By a graphical construction the author derives the following equation for the true resistance of the electrolyte.

$R=R_f-\frac{\tan\propto}{2\pi fC}$ where $\propto$ is the angle made by the locus and the axis of Y. As dilution proceeds $\tan\propto$ is approximately a constant quantity. The equations connecting C and f have been worked out in several cases, and the following are the resistance equations obtained by putting in these values :—

Table I.

Solution KCl	tan ∝	Eqn. for C and f.	Resistance and f.
$\frac{1}{10}$	0·295	$C=248{\cdot}4f^{-0{\cdot}165}$	$R=Rf-177{\cdot}7f^{-0{\cdot}835}$
$\frac{1}{20}$	0·295	$C=223{\cdot}4f^{-0{\cdot}14}$	$R=Rf-250f^{-0{\cdot}86}$
$\frac{1}{40}$	0·295	$C=182{\cdot}9f^{-0{\cdot}137}$	$R=Rf-238-f^{0{\cdot}863}$
$\frac{1}{80}$	0·295		
$\frac{1}{160}$	0·295		
$\frac{1}{320}$			

The resistance of the electrolyte at infinite frequency can be calculated as follows :—

If R_1, C_1, R_2, C_2 are the apparent resistances and capacities at frequencies f_1 and f_2 $Rw=\frac{R_1w_1C_1-R_2w_2C_2}{w_1c_1-w_2c_2}$. From this expression knowing the constant of the cell, the true conductivity of the solution can be found.

The large increase of capacity noticed on platinising the electrodes is not due entirely to an increase of area; probably platinisin the electrodes brings them into closer contact with the electrolyte. Spongy platinum has a peculiar effect on gases, and the normal gas film may be largely absorbed by the platinum black, thus increasing the capacity of the electrodes to the electrolyte, reducing the voltage across this dielectric per unit current, and reducing the losses. The ratios of the capacities of the platinised to the unplatinised plates are shown in Fig. 3. The ratios are given for frequencies 1,000 and 100. This ratio is not constant, but varies both with frequency and dilution.

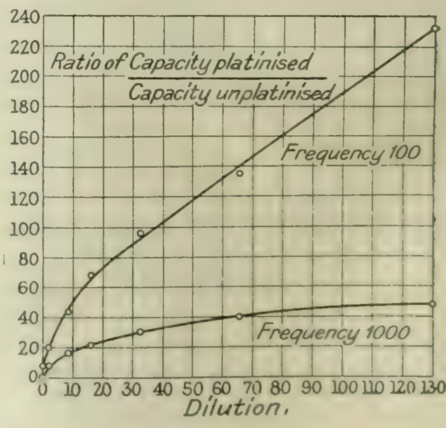

Fig. 3.

The effect of temperature alteration on a decinormal solution of KCl at two different frequencies was tried. In the case of the non-platinised cell the two resistance temperature curves are parallel straight lines, giving the same temperature coefficient at the two frequencies. The capacity effect varies only very slightly with the temperature. The resistance temperature equations are as follows:

$$R_{200}f=9{\cdot}25-0{\cdot}0813t$$
$$R_{940}f=7{\cdot}95-0{\cdot}0813t.$$

The platinised cell gave very much the same results, except that the two lines were very close together.

In the original Paper the author discusses the experiments of Smith and Moss, on cell resistance variations and presents some further experiments on KCl, using a Drysdale potentiometer, the resistance between the potential electrodes was practically constant, while that between the current electrodes varied slightly, viz., from 428·4 to 422 for a change in frequency from 188 to 880. Experiments with concentrated KCl solution yielded a more marked variation, namely, from 1·385 to 1·295 between current electrodes; the resistance between potential electrodes being still constant.

Other experiments on platinised and non-platinised electrodes are described and finally the author presents the following summary of his conclusions:—

In measuring the resistance of an electrolyte in a bridge we have, in addition to the electrolytic resistance proper, to deal with the resistance and capacity of a gas film which interposes between the electrodes and the electrolyte, and behaves like a leaky condenser. Its thickness and resistance depend on the strength of the solution employed, temperature, current flowing through cell, and frequency. Increase in temperature or current both diminish the gas film thickness. With increase of frequency the film apparently becomes thicker as the apparent capacity of the electrodes diminishes, but its losses apparently decrease. If the impedance of the cell be plotted in correct phase relationship to the current through it for a number of different frequencies, the locus of the impedance is a straight line, which cuts the current axis at the point of infinite frequency, and the intercept on the current axis is the true resistance of the electrolyte.

The effect of platinising an electrode is not simply to increase its area; if this were so the ratio of the capacity effects of the platinised cell to the unplatinised cell would remain constant for different frequencies and strength of solutions; but it does not. The percentage resistance variation with dilution diminishes to a certain point, and, as dilution proceeds, begins to increase again, with platinised electrodes; whereas with non-platinised electrodes the percentage resistance variation always diminishes as dilution proceeds. With dilute solutions the non-platinised electrode is electrically as suitable as the platinised electrode, while chemically it is superior.

The effect of platinising the electrodes is apparently to produce a deposit of spongy platinum capable of absorbing the gas film, which is accordingly reduced in thickness. As the impedance locus with respect to current of an electrolytic cell is a straight line, the condenser formed by the gas film varies with frequency according to the relation $R \times C = \frac{1}{f}$, where R is the equivalent resistance of the film.

Experiments by Smith and Moss, using high resistance cells and a voltmeter-ammeter method, have shown constancy of impedance over a wide range of frequency. The author's experiments, using strong solutions and low-resistance cells, show that the resistance of an electrolyte is independent of the frequency within the limits of frequency used, provided the potential electrodes are put out of the main current stream

Finally, accurate measurements of resistance by bridge or potentiometer methods can be made with cells having either platinised or non-platinised electrodes using any strength of solution and resistance of cell, provided that the precautions indicated in the Paper are observed.

Radio Telegraphic Station at Rome.*

By Commanders **B. MICCHIARDI** and **G. PESSION** (Royal Italian Navy) and **G. VALLAURI** (Director of the Electrotechnical and Radio Telegraphic Institute of the Royal Italian Navy).

In 1917, the Italian Government decided to construct a high-power radio telegraphic station capable of handling traffic with the Red Sea Italian colonies, and of communicating with North America. This task was undertaken by the Royal Navy, which is at present in charge of all radio communication between Italy and its colonies.

Rapid communication with the main offices of the Government was necessary. Further, the station had to be situated in readily accessible territory, on moist soil, in a region not intensely cultivated or covered with trees, and in the neighbourhood of supply stations for electricity and gas. A tract of land in the Tiber valley, immediately below the Basilica of San Paolo, in Rome, was accordingly selected.

THE SYSTEM EMPLOYED.

Communication was to be established in two almost opposite directions, the true bearing along a great circle through Rome being, for Massaua, 130·5 deg., and, for New York, 300·9 deg. The respective distances are 2,440 and 4,300 miles. The necessity for haste led to the adoption of certain existing buildings, and also dictated the choice of the system to be used. Continuous waves generated by the Poulsen arc were selected. The Royal Navy had used the arc successfully in other small stations. An antenna was provisionally chosen, having the shape of an equilateral triangle, supported by three cables (spreaders) more than 610 ft. in height, with the down leads coming from one of the sides. Later, a second set of down leads was brought from the interior of the elevated triangle. For the antenna supports wooden masts, having a triangular lattice-work structure, were adopted. Such masts had been previously employed successfully in America.

The plans of the station were rapidly worked out in May, 1917. The radio transmitting apparatus and its switchboard were furnished by the radio engineer, Mr. Cyril F. Elwell, who supervised its construction in Italy; the generators were furnished by the Marelli Company, and the principal controlling switchboard was supplied by the Magrini Company and provided with "C. G. S." measuring instruments, and at the end of October, 1917—that is, in less than five months—the station was ready.

TRANSMITTING APPARATUS.

The installation of transmitting apparatus is shown in Fig. 1. The transmitting room is divided into two parts, one for the generating machinery and the other for the arc. The generating machinery consists, at present, of a single set, but a second will be shortly added. The power supply is obtained from the Società Anglo-Romana at 8,500 volts (three-phase). There is a small 30 k.v.a. transformer stepping down to 220 volts for the lighting lines, and another 500 k.v.a. transformer providing 525 volts for the principal set and all auxiliary motors. This room is on the ground floor, and the conductors to the transmitting room consist of underground

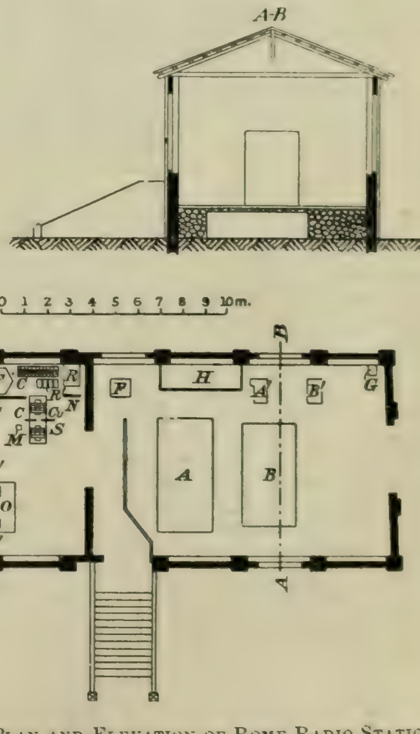

FIG. 1.—GROUND PLAN AND ELEVATION OF ROME RADIO STATION.

A	250 kw. Set.
B	200 kw. Set.
A' B'	Auxiliary 110 Volt Set.
C	Shunt Capacity across Arc.
C'	Keys.
C"	Ground Condenser.
F	Antenna Switchboard.
F	Choke Coils.
G	Illuminating Gas Aspirator.
H	Motor-generator Switchboard.
I	Antenna Inductance.
L	Arc Switchboard.
M	Motor for Rotating Cathodes.
N	Panel Board Carrying Contacts of Starting Arc Resistance.
O	Operating Table Carrying Keys.
P	Blowers for Keys.
R	Arc Starting Resistances.
R'	Resistance of Arc Shunt Circuit.
S	Poulsen Arcs.

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* Abstract of a Paper appearing in the "Proceedings" of the Institute of Radio Engineers.

cable. An overload circuit-breaker is inserted in the transformer primary.

The motor generator set consists of two direct-connected machines, running at 645 revs. per min. The motor has the following constants: 387 kw., 500 v., 530 amperes, 44 ∾, power factor 88 per cent., and full-load efficiency 93·5 per cent. The direct-current generator has two commutators which can be connected in series or parallel. It is considerably over-compounded, and is separately excited at 110 volts. At full output and with two commutators in series it yields 350 kw. 1,200 volts 291 amps., efficiency 93 per cent. The two halves of the series excitation winding can be connected in parallel or in series, giving various characteristics. The machines have been designed with generous dimensions, as overheating did not even exceed 40 deg. for any electrical part. A severe test of dielectric strength—*i.e.*, the application for a 10-minute period of an effective alternating voltage of 5,000 volts—was carried out on the dynamo windings.

A diagram of the switchboard for controlling the principal unit and the auxiliary units is given in Fig. 2. Two overload circuit-breakers were provided—namely, an oil breaker in the three-phase circuit and an air-breaker in the direct-current line. Means were provided for protecting the dynamo from radio frequency currents originating in the arc and against possible earthing of the antenna.

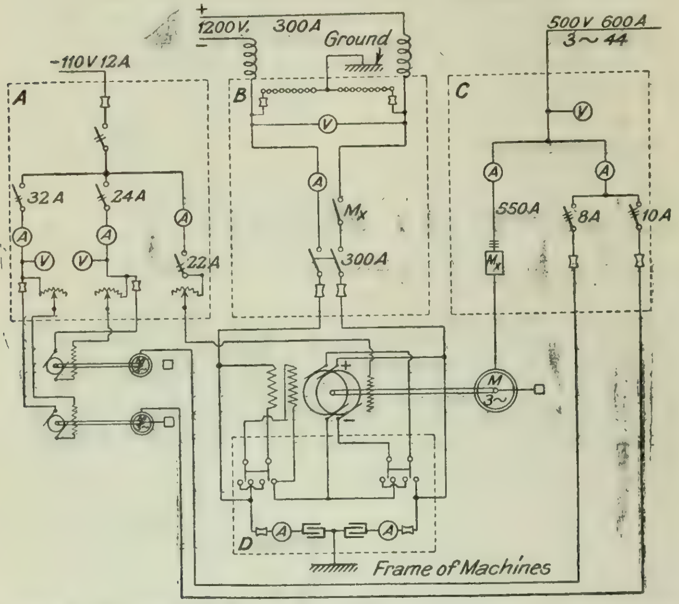

Fig. 2.—Diagram of Switchboard Controlling the Principal and Auxiliary Units.

The antenna is separated from earth by a condenser and the framework of the dynamo (and therefore that of the entire unit) is insulated from earth, the base plate of the set being supported on a framework of beechwood previously boiled in paraffin. An insulation resistance between frame and earth of several tens of megohms is thus obtained. To prevent any appreciable oscillating current from reaching the windings of the dynamo and thus giving rise to dangerous P.D.s therein (1) there are inserted in the supply line of the arc large choke coil inductances; (2) the terminals of this line are connected to each other through an ohmic resistance (shown in Fig. 2 in the upper portion of panel *B*) consisting of 20 incandescent lamps connected in series with the middle point of the series earthed; (3) the terminals of the machine are shunted by two sets of condensers, that connected to the positive pole being 0·1 mfd. and that connected to the negative pole 2 mfds., the junction point of the sets being connected to the frames of the motor generator set. This last shunt includes two ammeters, which under nornal operating conditions for the arc indicate an oscillating current of about 0·5 ampere.

Arc Equipment.

The assembly of arc equipment comprises two similar arcs, an operating switchboard, an antenna inductance, and a table on which are mounted the keys and all other transmitting accessories. The two conductors of the arc supply circuit (direct-current 1,200 volts and 300 amperes) before leaving the generator room, pass through two current-limiting inductances, each of 5 millihenrys (the reactance of which is still further increased owing to the mutual inductance).

On the arc switchboards are a commutator for changing over from one arc to the other, with two extra choke coils and, for each arc, an overload circuit-breaker, a starting resistance provided with electric remote control, an ammeter, and a voltmeter. All auxiliary control apparatus is supplied with 110-volt current and connected through an interlocking arrangement which prevents the arc circuit closing until all necessary preliminaries have been carried out. The diagram shows several of the interlocking circuits.

The Poulsen arc is provided with a rectangular magnetic circuit, the lower portion being enclosed in a masonry base. Magnetising coils, which are normally in parallel, are connected to the negative pole of the generator, and consist of 356 turns made up of two flat copper strips, each having a cross-section of 0·28 by 0·32 in. The air gap has a normal length of 3·2 in. The intensities of the magnetic field for various exciting currents and different values of air gap were determined. Within a range of 6 in. from this axis, the influence of the yoke is insufficient appreciably to distort the magnetic field, which therefore remains practically symmetrical.

Wave Length.

Normal operation of this radio telegraphic station is carried on at a wave length of 11,000 metres, with a supply current of 220 amperes, and consequently with a field intensity in the centre of the gap of 6,700 gauss. When working on a shorter wave of approximately 7,000 metres, the supply current diminishes to 150 amperes and the field intensity to 5,750 gauss. The copper anode is cooled and the water, having passed through this anode, continues on its way to cool the arc chamber. The carbon cathode is 2 in. in diameter, and is slowly turned round on its own axis. Regulation of the distance between the electrodes is carried out by hand.

The arc is struck by bringing the electrodes momentarily into contact, a suitable starting resistance being inserted and gradually cut out as the arc is lengthened. The hydrocarbon atmosphere required for operation of the arc consists of illuminating gas. The anode of the arc is directly connected with the antenna through a large inductance of a maximum value of self-inductance 3,060 microhenrys. The cathode is connected through the antenna ammeter to one terminal of the grounding condenser; the other condenser terminal is connected to earth. This condenser consists of 80 paper condensers in parallel, each having a capacity of 2 mfds.

Earthing Arrangements.

The earth connection consists of 18 plates buried at such a depth as to be in permanently moist earth and of 36 copper wires each 985 ft. long, radiating outward from the station. The antenna is supported on three latticework wooden masts, each 714 ft. high, arranged at the vertices of an equilateral triangle.

Tests and Measurements.

The construction of this antenna provided an opportunity to carry on tests and measurements of unusual technical interest. At a given wave length, the current received by a radio station at a definite distance is inversely proportional to the product of the effective height of the transmitting antenna multiplied by the current in its earth lead. In general, diminished values of effective height correspond to increased values of capacity. Indeed, to increase the capacity the number of antenna wires can be increased within certain limits, which, however, results in increased weight. Consequently, for mechanical reasons, the sag of the wires must be increased, thus diminishing the geometrical height, and, in general, also the efficiency. A similar result is obtained if the antenna is prolonged by obliquely descending leads or if the number of wires in the down lead of the antenna is increased.

At San Paolo attempts were made to obtain a maximum effective height. For this reason an antenna was constructed, made up of a network of wires stretched between three steel spreaders or cables suspended between the three masts. Considerable tension was placed on the wires to ensure that the capacity area of the antenna should be at the greatest possible distance from the ground. The shape of the antenna consequently became that of a sort of triangle with curved sides, these sides being the three steel cables mentioned below (Fig. 3). Ultimately the down leads were reduced to 13 in number, very close to each other, and were stretched between the radio station and the mid-point of the nearest side of the triangle. The total resulting capacity was 0·0099 mfds., and it was possible without trouble, to secure an antenna current of 140 amperes at a wave length of approximately 10,000 metres.

Arrangements were then made to measure the effective height of this antenna by the aid of an experimental loop antenna, consisting of a rectangle of copper wire, set up at Fiumicino in a vertical plane passing through San Paolo. This latter station was started up and the current induced in the loop antenna when tuned to resonance, was measured. From the known value of the resistance of this experimental antenna, it was possible to calculate the E.M.F. induced, and therefore the effective value of the magnetic field. Knowledge of the field intensity permits the calculation of the height of a vertical antenna with quasi-stationary current distribution equivalent to that at San Paolo—*i.e.*, the effective height of the latter antenna. The value actually found was 151·2 metres for wave lengths between 6,500 and 10,000 metres.

In a second series of trials, the antenna at San Paolo was modified in order to increase its capacity. More wires were stretched across the upper portion of the antenna, thus filling up the empty space between the catenary arcs of the steel supporting cables, and the length of the down lead was considerably increased by connecting to the triangular antenna at various points on its upper surface. Thus, the length of the down leads and their distance apart were both increased. The capacity of the new antenna was 0·0112 mfd., and its effective height 138·3 metres (422 ft.).

To obtain the same voltage as formerly secured with the first antenna by 140 amperes, it was necessary to have 158·5 amperes in the antenna. The products of the effective height in kilometres by the current in the antenna in amperes were respectively, in the two cases, 21·2 and 21·9. Thus, the second antenna was superior to the first, and was therefore retained. The total resistance of the antenna was measured by the impulse excitation method, and therefore with damped current. The results obtained are shown in Fig. 4, and agree well with expectations in both dry and rainy weather.

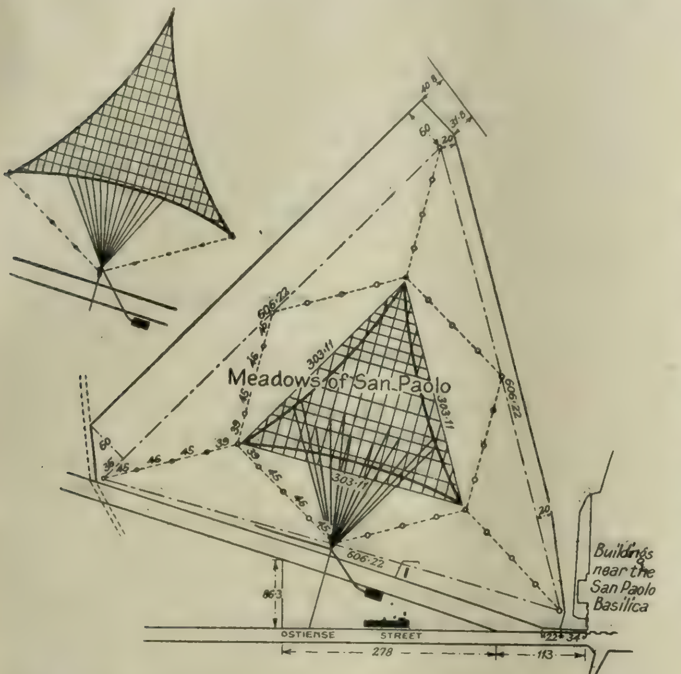

Fig. 3.—Showing Arrangement of Triangular Form of Antenna.

Working Methods.

Signalling is accomplished by short-circuiting a number of turns of the antenna inductance, thus reducing the wave length in the intervals between signals. These two waves, the "working" (sending) wave for the longer and the "stand-by" (compensation) wave for the shorter, differ by 180 metres when the transmitting wave is 11,000 metres. The existence of two waves is a disadvantage, since it increases interference with other radio stations. Investigations are in progress on methods of eliminating the compensation wave by the use of an artificial absorbing antenna during the spaces between signals. The short-circuiting of the turns of the spiral is done by a number of relay breaks with large silver contacts cooled by air currents. The relays are controlled by a hand key. In order to use a high-speed interrupter, controlled by a Wheatstone transmitter, experiments are being carried out on pneumatically operated keys. Shunted across the arc is an oscillatory circuit of short wave-length, consisting of a capacity of 0·005 mfd. and an ohmic resistance reducing the current in the shunt circuit to two-thirds that in the antenna. The addition of this shunt is advantageous as it permits an increase of 10 per cent in the effective antenna current.

A number of observations were obtained, keeping constant the supply voltage, the arc shunt circuit and the width of the air gap in the magnetic circuit of the arc. In each case the electrodes were adjusted to the best distance apart. A number of quantities were measured as functions of the wave length. In Fig. 5 some of the resulting curves are given. For the constant supply voltage of V_{cc}=800 volts, there are given, the oscillatory current in the antenna I_a, the radiated power P_i, and the "conventional range" D calculated by the Austin formula on the assumption that a received current of 15 micro-amperes and an effective height of receiving antenna of 100 metres and resistance of 25 ohms are required.

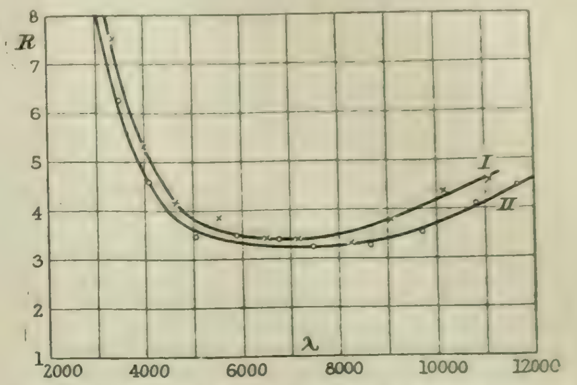

Fig. 4.—Relation between Resistance of Antenna and Wave-lengths.

Receiving Arrangements.

The radio station at San Paolo has two receiving stations. One of these is of the ordinary type, installed in a small room adjoining the transmitting station. This room is lined with metallic netting connected to earth, in order to protect the receiving apparatus against excessive induction from the transmitter. An underground wire joins the receiving room with the transmitting room in order to carry antenna current into the former. There have been installed receivers of the Royal Navy type. Other underground conductors permit control of the transmitting relays by a key situated in the receiving room.

The second receiving station, situated near Monte Rotondo, was intended to permit duplex operation in working with America. It receives from America by means of a loop antenna, the plane of which points at the American transmitting station, and is perpendicular to the line adjoining Monte Rotondo and San Paolo. Accordingly, reception is only slightly influenced by transmission at San Paolo, and thus the American station can be received at any time.

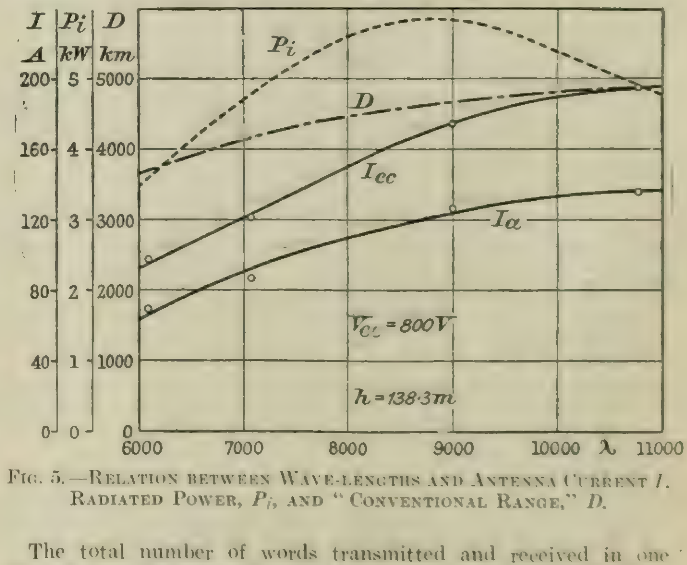

Fig. 5.—Relation between Wave-lengths and Antenna Current I, Radiated Power, P_i, and "Conventional Range," D.

The total number of words transmitted and received in one year from the San Paolo station and at Monte Rotondo (July, 1918, to June, 1919) is 728,249. The cost of this station, in round numbers is a little less than 1,000,000 Italian lire (£40,000 at pre-war exchange rate).

From June 1st to October, inclusive, reception is difficult from eight o'clock onwards. Strong atmospheric disturbances begin at about three o'clock in the morning and by eight o'clock have reached a considerable intensity, which then gradually increases.

November and December are the best months for reception, but reception from America was never interrupted, except during times of heavy storm near the receiving station.

Telegraph and Telephone Engineering in the United States.*

By Sir WILLIAM NOBLE.
(Engineer-in-Chief to the British Post Office).

This Paper contains an account of the experiences of the author, and the party accompanying him, during a recent visit to the United States, in the course of which information regarding the leading telegraph and telephone systems in the United States was collected.

Meetings had been arranged beforehand with the engineers of the American Telegraph & Telephone Company, the Western Electric Company, the Automatic Electric Company, and the Western Union Telegraph Company. The party first stayed in New York, visiting exchanges and attending conferences, &c., subsequently starting on a tour of some of the main centres of interest. After travelling via Baltimore to Washington and to Columbus, Ohio (where one of the earliest automatic telephone exchanges was inspected), the party proceeded to Lima and then went on to Chicago, where the Hawthorne factory of the Western Electric Company was visited. The factory occupies 220 acres, employs 20,000 hands, and is one of the largest manufacturing installations in America. The arrangements appear excellent and the output is enormous; in 1920-21, 127,000 lines will be reached, and this output may be doubled in 1922. An interesting feature is the complete scheme for training employees of various grades. In Chicago there is also a large concern dealing with automatic telephones, viz., the Automatic Electric Company. The 1920 output is estimated to reach 75,000 lines.

Returning to New York the conferences with the engineers of the A. T. & R. T. and Western Electric Companies were resumed, after which the party took the boat for England.

Summing up impressions of the visits, the Author remarks that the prosperity enjoyed by the United States during the early period of the war, and the opportunities for development afforded their manufacturing companies, have led to considerable progress in telephone and telegraph work. The feature which most struck the party was the abundant facilities for experiment and research. Thus the research department of the Western Electric Company is housed in a special building occupying about 400,000 sq. ft. and equipped with plant valued at about £1,000,000. It employs 2,500 men, of whom 1,500 are engineers and their assistants. The building also contains the historical museum of the American Telegraph & Telephone and Western Electric Companies.

The chief feature of American progress has been the general introduction of automatic exchanges. Opinion was almost unanimous that a full automatic system is preferable,—except that one group of experts thought that subscribers should not be trusted with the dial and that the best method was one based on auto-manual or semi-automatic principles. The auto-manual service at Lima, Ohio, was the best inspected. The Western Electric Company has designed their panel system to operate with a dial having the impulse system similar to that of the Automatic Telephone Manufacturing Company's system in this country. All the existing American exchanges are of the latter (Strowger) type. There are, however, three types of dials with different systems of impulses. Systems supplied for use in Great Britain will utilise a dial with an average speed of ten impulses per second, the break portion of each impulse being within 60 to 68 per cent. of the complete impulse. This will accord with the standard adopted in America.

Enquiry showed complete satisfaction with automatic methods for use in large city areas, and the author arranged with the American Telephone & Telegraph Company to give him an option of purchasing a 3,500-line panel type equipment for the use of authorities in Great Britain. Arrangements have been made for this to be installed in G.P.O., South London, where it will form the nucleus of a 10,000-line exchange.

In the subsequent section of his Paper the author described and illustrated various panel systems and minor improvements recently effected and gave a summary of 14 advantages claimed on behalf of this system of automatic exchange. The panel system is considered to be far in advance of other systems for large telephone areas. The estimated number of telephone stations owned by the Associated Bell Companies in America on September 30, 1919, was upwards of 7,000,000 and over 3,000,000 additional stations, owned by other companies, are connected. The total thus exceeds 12,000,000, an average of one telephone for every 10 persons.

Long distance systems have reached a high level of efficiency. New York and Chicago are over 1,000 miles apart. A letter posted in New York on Monday morning would be delivered on Wednesday morning in Chicago, but the delay in telephone calls between the two cities rarely exceeds 20 minutes. A remarkable example of long-distance transmission is that between New York and San Francisco, about 3,400 miles. Yet speech on the telephone is comparatively easy. Success in long distance service is due largely to the extensive use of loading coils, but the New York to San Francisco system has been made possible only by the development of the telephone repeater; a revolution has also been recently effected by the introduction of the three-electrode thermionic valve.

An expert visiting the United States is struck by the general absence of trees along telephone routes, which naturally aids efficiency. Poles are usually of timber, generally untreated. Neither poles nor arms are earth wired. Glass insulators are used almost exclusively, but some porcelain insulators are used for transcontinental lines. A feature is the extensive use of aerial lines, both for local and long distance service. Joint use of pole lines for telephones, electric lighting and power transmission is common. Electrolysis is a serious trouble with underground mains in America. However, in the large cities such as New York and Chicago (where the cable plant dwarfs even the present cabling of London) distribution is mainly underground, and Philadelphia and Boston are connected to New York by underground trunk routes. For the repair of aerial lines motor-truck equipments are largely used. Motor cycles are seldom employed, and linesmen are almost invariably provided with light run-about cars of the Ford make, a result, doubtless, of the comparative cheapness of motor-cars and petrol in the United States.

Correspondence.

DIRECTIONAL HYDROPHONES.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: One would gather from the report of the Kelvin Lecture, in your issue of October 1st, that the directional hydrophone was not to be attributed to anyone in particular, though some reference is made to the matter in the lecture itself.

The facts of the case are that Prof. J. T. MacGregor-Morris and I, under cover of patent, introduced the principle to the Admiralty in October 1915. In May, 1916, we made successful trial of a model in the sea at Aberdour. Nothing practical was done by the authorities until February, 1917, when the Admiralty adopted the double plate form af the instrument developed in the laboratories of the East London College, in preference to the single diaphragm type developed under the auspices of the Board of Invention. A special committee assessed the amount to be paid by the Crown as user at £12,000. Prof. W. H. Bragg and Sir Ernest Rutherford lodged a specification No. 125,446, claiming the single diaphragm construction. On publication, I took action, with the result that the Law Officer directed that the claim to the single diaphragm system as such should be removed, and further reference made to the Sykes-Morris specification.

I am writing to you because names have been associated with other inventions, and it seems only fair that the valuable work done at a London College should not be passed over.—
I am, &c., A. F. Sykes, B.Sc., A.M.I.E.E.

London, Oct. 7.

[It will be realised that as it was impossible to publish the Kelvin lecture in full, it was equally impossible to give credit in our columns to all those mentioned in Dr. Drysdale's review of what had been done in the design of marine signalling apparatus.—Ed. E.]

AUTUMN TRADE PROMOTION NUMBER.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I have read with much interest and some amusement the various articles in your Annual Trade Promotion Number, and note the various arguments for and against electricity as the solution of the present servant problem.

What strikes me most is the evident lack of experience some of your contributors show, and more especially those who deride the use of what America has proved to be the greatest help to the overworked housewife. With over eight years' experience in the use of electricity for cooking and other domestic appliances, I should like to point out that the great British public must first be educated, both in the use and abuse of most electrical appliances, for by nature we are all apt to be conservative, and do things in the same way as our mothers did before us. From the point of view of a salesman, I should like to point out that one really satisfied purchaser always brings another, and that to sell an unsatisfactory article does more to retard the development of the use of electricity than it does good, either to the shopkeeper or the supply undertaking.

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* Abstract of a Paper read before the London Centre of the Institution of Post Office Electrical Engineers.

We often find the present-day bride furnishing her home by following in her mother's footsteps, and the greatest set back she will encounter in carrying out this policy is the lack of domestic servants. One way out of this difficulty is to invest, say, one year's wages and keep of a servant, which is at least £100, in electrical appliances. I should suggest she purchases an electric vacuum cleaner, one or two fires, a cooker, or at the least, a griller and kettle; and last, but not least, an electric iron. The money thus spent will prove to be a most excellent investment both in temper and time and saving of wear and tear of furniture and carpets, all of which would probably run into hundreds of pounds. Later on, if her finances permit, she could invest in a washing machine, sewing machine and much other electrical apparatus, so that the home might easily become an electric home.

Some years ago one of our foremost pioneers of electricity, a great enthusiast and patentee, showed me an electric fire reposing in the lid of an old tin biscuit box. In spite of its sordid surroundings I predicted a great future for this fire, and I am glad to say it has proved a tremendous success, a wonderful seller, many thousands now being in use. It is a really bright fire, quite economical in running and not expensive in design, easy to repair and the life is good. I, personally, have sold many hundreds, and every fire sells always another. What better testimonial can there be?

So, to revert to my former statement, I am convinced that people, the great British public, must be educated in the use of electricity, and the big undertakings or supplies of electricity can best do the educating by running showrooms and demonstrations. But one word *re* salesmen and women! Let great care be taken in the choice of suitable people. They must understand their work, be users themselves, if possible, and never be apathetic or careless. Above all, they must never make misstatements as to the actual cost of running, but explain how fires, &c., may be switched off, point out the great residual heat in some types of hot plates, and that one-third heat or medium heat is sufficient to keep a pan boiling, and thus reduce the expense of cooking or heating.

The cost of this education must, of course, be borne by some one, and as the electricity supply undertakings will be the beneficiaires of these providers of the cheaper or off peak load, they must be prepared to do this, and each do their share. The cost of running a small, or even a larger, house electrically is *not* enormous, as one of your contributors states. It can be run for very little more than coal or gas, and can be made a matter of much or little cost, according to the person who is using it. My own household, with three in family, everything done electrically, is a proof of the cheapness of running an electric home. With two meters, one for light and another for heating and cooking, my bills have never exceeded £7 per quarter, and usually average between £5 and £6 per quarter. Not a big item in these post-war times!

If space permitted I could give many interesting items of the phenomenal increase of sales and the advancing strides that I have known during these last eight years. I have christened my maid of all work "Electric," and she always obeys my commands. Electricity is "out to win," and is making good all the time, but first of all, we must learn to walk slowly before we run. "Educate and advertise."—I am, &c.,

E. Walton.
(Manageress of Southport Corporation
Electricity Showrooms.)
Southport, Oct. 7.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Owing to holidays your issue of Sept. 24, with all its interesting information with regard to domestic heating and cooking, has only come under my notice during the last few days.

There is one point in Mr. Hardy's article which I cannot quite understand. In speaking of the application of electricity to all the possible uses in private houses, and under the heading of "Electric Fires—Economical," he gives particulars of an experiment carried out by the Glasgow Corporation on two 3-apartment houses. Would it be possible to get Mr. Hardy to give a statement of the actual apparatus installed in these houses, because the number of units used appears to me very unduly high?

I am simply comparing it with a 14-room house in which the entire cooking for a household of eight is done electrically. There are no coal fires in any of the rooms, and only wood fires are used for a short time every day in the winter in the kitchen in an open fireplace, and for two or three hours at most in the drawing-room in the evening. There is a fair-sized hall in which, in cold weather, it is necessary to keep a 2-kw. radiator going steadily from 7 o'clock in the morning until bedtime. And yet in this house the total consumption of current has never exceeded 10,000 units per annum.

In the paragraph in Mr. Hardy's article just above the one referred to, he makes some mention of an electric hot-water supply, but I imagine he is not getting any water heated except what is done on a hot-plate in these two 3-apartment houses.

My object in writing this letter is merely to clear up the point as to what apparatus is using all this current, as it appears to me that Mr. Hardy is crabbing electrical heating unintentionally by giving such a very high consumption for such very small houses.

I would say that in the house, of which I have given the annual consumption, the equipment is roughly 60-lights, cooker 6 kw., radiators 17 kw. The average consumption for cooking per week throughout the year for a party of eight is 110 units; but this is probably unduly high owing to the peculiar diet of one member of the family which calls for a good deal of extra cooking.—I am, &c.,

London, Oct. 8. M. J. E. Tilney.

THE WOMAN IN THE PROGRESS DEPARTMENT.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In his article on "Woman in the Progress Department," Mr. W. J. Hiscox has assigned the cause of woman's limitations to her own lack of initiative instead of to the action of the men's unions which has barred the way to her development. It was quite obvious that up to 1916 women were changing the outlook in engineering workshops. It was conclusively proved that intelligent, educated girls (and boys too) could learn almost any mechanical process in a few weeks, if properly taught. But the A.S.E. (as it was then) took alarm. It did not like the public to learn that its idol of so-called "skilled work" was standing on feet of clay. The illusion of highly skilled work to be acquired only by years of apprenticeship, must be kept up at all costs. Consequently Regulation L. 2 was invented with the result (anticipated) that women were prevented learning more than one or two operations because their training at full men's skilled wages was too expensive for any firm to undertake. That was a most damaging set-back to women. The more intelligent educated girl at once began to leave the shops, seeing no prospect of advancement.

With reference to the progress department, the salaries offered to women are usually too small for an educated girl to live on away from home. Consequently the choice of suitable girls is limited to those who live near the works, and the advantage of choice from a wider field is lost to the works.

Mr. Hiscox disposes very lightly of the clerical side of the profession. It is rather startling to learn that the highly imaginative brain of the mathematician and the brilliant genius of the inventor are something subservient to the technical side of the workshop and that all must bow to the "progress chaser."

A word as to the present position of the girls who have pluckily stuck to the work in which they have been trained. Scattered in small numbers in various works, their position is lonely and difficult. Not generally welcomed by men, and still looked upon as somewhat out of place, they find it a hard task to carry on. It is naturally more pleasant to be popular and to work in friendly surroundings. It needs a stout heart to carry on. But help is coming, the little factories in view are the outcome of the girls' enthusiasm, and when they are working together in their very own factories and manufacturing necessaries for us all, surely even the A.S.E. will admit that such factories have earned the right to live.—I am, &c.,

London, Oct. 11. K. Parsons.

ELECTRICITY IN FACTORIES AND WORKSHOPS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The report of Mr. Scott Ram just issued affords interesting evidence on the subject of danger from electric shock, 20 out of the total of 28 fatal cases having arisen from alternating current at pressures below 250 volts and none from direct current. At the I.M.E.A. Convention last summer I deprecated the suggestion made in one of the papers then read to increase consumers' pressures above the 220 to 240 volts now in use, and I ventured to suggest that much lower pressures on the appliances and much higher pressures on the mains should be employed. I was regarded as a dangerous, disloyal heretic, and my statement that 220 volts alternating was liable to kill people was flatly denied. In the Press also the danger has been pooh-poohed. Truth is truth and shall prevail, and no person of ordinary intelligence and honesty can doubt Mr. Ram's statements nor fail to see their bearing.

It is often said that even supposing 220 volts alternating current can be fatal there is no risk in an ordinary dwelling house with wooden floors and velvet pile carpets. I agree that the risk of getting a shock is diminished in such rooms, but it is present in an acute form in bathrooms, wine-cellars, sculleries and laundries, and most of us hope to see the largest consumption of energy for domestic purposes in places of this kind (cooking ranges, washing machines, dish washers, &c.). To minimise the risk, wholesale efficient earthing is necessary, and since the Rules must be sensibly uniform, this very precaution introduces a risk in the otherwise relatively safe rooms in the house by deliberately bringing in an earth conveniently placed for an individual to touch. Why not sweep away all risk and all irksome rules by using 50 volts alternating current for domestic supply? I have only touched the fringe of the matter, but have already trespassed too far on your space.—I am, &c.,

London, October 12. C. H. Wordingham.

Reviews.

Steam Turbines. By J. A. Moyer. (London: Chapman & Hall.) 4th Ed. Pp. xi. + 496. 21s. net.

The author in his preface states that this book was first planned for the use of his assistants in the experimental and testing departments of one of the large manufacturing companies. He goes on to complain that graduates of American schools are at sea in heat calculations, and generally suggests that they are not interested or well instructed in theory. To those who read this book this will not appear remarkable, since the writer, apparently, is a professor of mechanical engineering.

He displays his own knowledge of theory by the statement that the work expended in the "velocity of approach" to a nozzle is the same as that in a steam engine cylinder up to the point of cut off, and that designers of nozzles are only interested in the area of the diagram after cut off (p. 16). Furthermore, he prints and reproduces that fallacy regarding the use of steam turbines other than at sea level, which would be simply amusing if it had not become notorious in the well-known case of the Transvaal decision to adopt gas engines, the sequel of which is so widely known among engineers all over the world. A delightful paragraph dealing with this is to be found on p. 367. After his comment on American students, the author states that the volume is for the purpose of encouraging students to think. We have been accustomed of recent years to get a considerable number of books from our American friends written by specialists and dealing with a single subject in a comprehensive and entirely satisfactory manner, and generally produced in good literary style. The older type of American book was simply an ill-digested and non-critical collection of hearsay and catalogue information We are afraid this book under review (which was first published when such information was most of what was accessible to the ordinary public relating to turbines) has exactly this old-fashioned characteristic, and the new edition, although pretending to be up to date, is still almost entirely composed of matters which might have been of interest in 1900-1905. Most of the statements therein should have been entirely recast. This re-casting has been contemplated; but, as an example of how casually it has been done, one notices in the preface reference to a 70,000 kw. turbine with a consumption of 10 lb. per kilowatt, whereas there is a categorical statement at the foot of p. 209 that a 24,000 h.p. steam turbine is probably the largest turbine yet ordered.

From a literary point of view, it is extremely annoying to the English reader to find terms like "generally," "typical," "necessary" applied in their strongest form to the description of details which have long been obsolete, while at the same time other important statements freely made without reference are covered by such expressions as "said to be," "probably." To English readers, who are accustomed to the classical works of Ewing and Martin, and to the careful erudition of Stodola, the general literary plan of such a work as this produces great annoyance.

The book consists of 17 chapters, to which brief reference may be made. The first deals with history, and it is unfortunate that the very first illustration is one which is far from clear. The author appears to attach great importance to De Laval's work, while rather sliding over that of Parsons, and entirely omitting at this stage any mention of Rateau. In Chapter II. the author deals with the elementary theory of heat, and, subject to the observations we have already made, the standard $T\phi$ diagrams are given in their usual form. The author repeats Knoblauch and Jacob's diagram, evidently taken from Marks and Davis's tables, which is now well understood to be erroneous. He seems to be totally unaware of the classical work of Callendar, which has received such wide recognition, especially by the initiative of the B.E.A.M.A. in arranging for the publication of the Moss and Callendar's tables. This chapter is really quite out of place, and should be relegated to a work on thermo-dynamics. Chapter III. deals with a flow of steam in nozzles, and, while giving some of the earlier data, it will leave the student very much puzzled as to whether what was given was reliable and to what extent. Considering that from a single isolated reference it appears that the writer is aware of Martin's book, it is a great pity that many of the statements used about flow in nozzles have been used at all. The looseness of the editing is again apparent in this chapter, because, after already stating in a previous chapter words to the effect that it is a waste of time to shape a nozzle carefully, the author goes on to prove in this chapter that careful shaping is most important. His statement that the material used for nozzles is usually cast iron, but the great objection is that cast iron corrodes so readily, seems extremely strange. While referring to the use of metal such as cupro-nickel, he entirely omits any reference either to cast iron nozzles, with steel plates cast in, or to built-up steel nozzles, or to electric steel nozzles.

Chapter IV. deals with the difference between the principles of impulse and reaction, but in a rather casual way. An approximate method of calculation of turbine blading design is given, but not such as would be used in this country. It appears to the reviewer that the author takes a certain number of designs, generally of small turbines, which have become well known to him, and makes the assumption that every device or pattern used in these designs was of the best and of a necessary form, and, that having been so used, such thereafter became standard. This is a most irritating method, as most of these details are now obsolete. In fact, it is most remarkable how all makers of turbines are approaching a common solution for most turbine details.

Chapter V. deals with disc friction, giving the usual formula, and with very fair comments on them, although one expression about a wheel "cutting through the steam" at a high speed is not very intelligible.

Chapter VI. deals with correction factors, although it is headed "Correcting Steam Turbine Tests," which in ordinary English might have quite another meaning. Most of the corrections are now entirely old, and, in any event, have been quite superseded by those given in Baumann's classical Paper before the I.E.E., which is now accepted by practically all authorities.

Chapter VII. deals with the description of various types of turbine. It is unfortunate that no description is given of any good large modern turbine. Another example of loose editing is that of Fig. 104, which is a curve showing efficiency and size for turbines. This curve shows that the maximum possible efficiency at 60,000 kw. is 13·5 lb. per kilowatt-hour. The author might be excused for not knowing that several 10,000 kw. turbines are now running in England with a consumption slightly below 10 lb.; but he can hardly be excused not knowing the test of the 4,000 kw. turbine at Carville somewhere about 1907, which is quoted in many pocket-books as having a test consumption of 13·2 lb., still less the results of the Parsons' Chicago turbine, with 10·75 lb. per kilowatt-hour obtained some seven years ago, a result which made a great disturbance among the American designers, and which profoundly modified the whole of their practice. It does not seem that the book before re-publication has been submitted either to the Westinghouse or General Electric interests, or they would certainly have seen that greater justice was done to their new and more advanced designs.

Chapter VIII. deals with governing devices, and calls for no special comment. Chapter IX. deals with exhaust turbines, but is of very slight interest. One statement is made that accumulators should be worked at 10 lb. to 15 lb. pressure above the atmosphere. If this is American practice, it is profoundly different from that customary in this country.

Chapter X. deals with mixed pressure turbines, and is short and good, probably due to the fact that it is entirely new. The same remark applies to Chapter XI., which deals with pass-out or extraction turbines, familiarly described in Americanese as "bleeder" turbines.

Chapter XII. deals with marine turbines, but gives nothing particularly interesting about them. Exception would be taken in this country to the stress laid on the Macalpine gear. Considering the results which have been got without such devices on the new high-speed cruisers in this country, this chapter will certainly have to be quite re-written to bring it up to date. A short reference is made to turbo-electric ship propulsion. In this connection the author states that turbines for such work have over 80 per cent. efficiency. We have no knowledge of any turbine whatever which has reached this efficiency within 2 or 3 per cent., and then only in the case of the very largest land turbines.

Chapter XIII. deals with testing, but mainly gives results which are out of date and relate to small turbines. Chapter XIV. is termed "Steam Turbine Economics," and, since this is the chapter which has the paragraph about vacuum in relation to sea level, no further comment is necessary. Chapter XV. deals with stresses, and gives quite a useful description, culled from various sources, of the actual stresses in some well-known designs. Chapter XVI. deals with the gas turbine, and although interesting as describing some small experimental turbines, is not at all a useful contribution to the subject. Chapter XVII. is a short chapter on electric generators which would much better have been omitted.

On the whole, this is a book which will not appeal to English readers at all. As regards the manner in which it is published, it is exceedingly well printed in clear type on very good paper, and the illustrations are many and well reproduced. It is not a book that could be put into the hands of a student, neither would it be any help to the modern designer. It cannot in any sense, as we have said before, be classed with the many excellent books written by specialists which are continually reaching this country. The author has evidently stored his mind with a large mass of detail which he accumulated in the works before he had really comprehended the theory of turbine design, and he does not seem to have supplemented the want of clear thinking in his later experiences.

W. M. Selvey

Shorter Notices.

Malleable Cast Iron. By S. Jones Parsons, M.I.M.E. (London: Constable & Co.). Second edition. Pp. xi. + 175. 14s. net.

The first edition of this book appeared about 12 years ago, and was the culmination of a series of articles in the technical press by the author under the *non de plume* of "P. J. Giron."

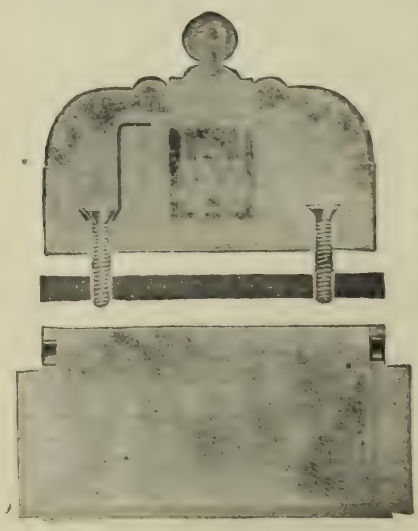
Considerable progress has since been made on malleable iron-founding and the present edition has been revised to include information on modern methods of production. Sections are now given on foundry chemistry, mixing by analysis, and temperature measurements; a few pages have also been added on malleable cast steel.

The author, who has a thorough grasp of his subject, deals with the whole process of manufacture step by step under such headings as design, patterns, melting, moulding, annealing, cleaning and testing. The term "annealing," being in general use, is retained, although it is explained that the process referred to is actually one of conversion. A table giving the results of mechanical tests of various samples of malleable cast iron which can now be readily and rapidly produced, shows that this material has remarkable advantages over ordinary cast iron. It is interesting to note that, despite contrary opinions, an addition of 10 per cent. clean sound annealed scrap is strongly recommended for all classes of work.

The volume is well printed and illustrated, and amongst many practical hints the advice that malleable cast iron must only be used by a designer having a thorough knowledge of its real structure and its limitations in practice is extremely important. Sub-division or leading lines for paragraphs would, however, make it more valuable for ready reference, and some actual figures on costs of production are desirable.

Universal Wiring Box.

In these days of variety of designs any arrangement which allows different classes of apparatus to be combined in an installation with a minimum of alteration and fitting being necessary should receive wide application. As far as domestic installations are concerned these conditions are said to be fulfilled by the use of a universal box, made by Messrs. Electrical Components, Ltd., of Birmingham, which is shown in the accompanying illustration This apparatus consists of an iron-clad box of the usual design, near the upper edge of which two holes are drilled at opposite ends of a diameter. Through these two holes are driven a circular steel bar $\frac{1}{8}$ in. in diameter which can be drilled and tapped to any convenient centres for taking ceiling roses, switches, plugs or other fittings. It will be seen that the work of erecting is facilitated and great rigidity is obtained. By the use of this equipment the the rule that metal switch dollies must be earthed is easily carried out. As will be seen from our illustration a thin copper strip is inserted under the dolly bridge and an effectual earth thus obtained. The makers further point out that a maximum space is allowed for manipulating the wires and that there are no sharp edges.



A London Electricity Enquiry.

Three of the Electricity Commissioners (Sir John Snell, Sir Harry Haward and Mr. H. Booth) held an enquiry at the Middlesex Guildhall last week into an application by the County of London Electric Supply Company for the permission to build an electric power station at Barking. The enquiry commenced on Wednesday and concluded on Saturday last.

The County of London Company was represented by Mr. H. Lloyd, K.C., and Mr. Tylor; whilst the opponents to the proposal (the London County Council, 38 local authorities owning electricity undertakings, and nine companies) were represented by Mr. Tyldesley Jones, K.C., and Mr. Kennedy.

Bulk Supply Unavailable.

Mr. Lloyd, K.C., for the County of London Company, emphasised the serious position in which the Company now found itself. It had two areas of supply, one south and one north of the Thames, and under a Provisional Order of 1913 it was also given powers over a large area in Essex. In the Essex area the Company had been compelled to limit its operations to the compulsory area by making an arrangement with a private firm to give a small supply, and it now sought permission to erect a station there in order to develop that area, and at the same time to assist in meeting the demand in the company's two London areas. An arrangement entered into with the City of London Electric Lighting Company for a bulk supply was to have been commenced this year, but owing to the moulder's strike the City Company had been unable to obtain the necessary plant. The agreement was for 5,000 kw. in the first instance and 10,000 kw. ultimately, but no supply had yet been given, and there seemed little probability of one being forthcoming at all. In these circumstances the Company had been compelled to order a new 6,000 kw. set for the Wandsworth power house. The Company was sorely pressed in order to meet their statutory obligations, and the 6,000 kw. set at Wandsworth would not meet the demand which it would be called upon to meet to an increasing extent in the future. The proposed station was not only to supply the Essex area, but also to assist the supply in the London areas. For the site about 90 acres had been acquired, and another Company intimately connected with the County of London Company had purchased a further 300 acres. Under the County of London Company's Act of 1918, which extended the time for the purchase of land, &c., under the Company's Romford Order, it was provided that no claim should be made upon the London County Council, as the purchasing authority, beyond the capital expenditure on the generating plant, with interest at 6 per cent. per annum. That restriction still applied, and if the Commissioners gave their permission to the scheme it would be necessary for the company to go to Parliament to get the rate of interest altered, because nobody would suggest that the money could be raised at 6 per cent. to-day. As to the suitability of the site for a generating station, history had shown it to be an ideal one, for it had been selected on several occasions for a large generating station to supply London as a whole, and the London County Council, which was opposing the present proposal, had itself selected the same site. The company would give any electricity authority which might be formed the option to acquire the power house now proposed. The Company expected a substantial load on the station from railways, because the area was bound to develop enormously, and there was no doubt that tramways or motor omnibuses could not deal adequately with the traffic. The objectors all seemed to suggest that such a large power station should be constructed by a joint electricity authority, but he was prepared to submit the plans to the Commissioners so that they could arrange for the station being constructed in such a manner that extensions could be made to meet future requirements.

Progress of the County Company.

Mr. C. P. Sparks (consulting engineer, and chief engineer to the County of London Company until Dec., 1919) said that both the London stations of the Company were limited in output by condensing water facilities. Under the most favourable circumstances the maximum output at the City-road works was 10,000 kw. and at the Wandsworth station 20,000 kw., or a total of 30,000 kw. A new 6,000 kw. generating set was being erected at Wandsworth, as the City of London Company had been unable to get the necessary plant to give the agreed bulk supply. Dealing with the progress of the County of London Company from 1909 to 1919, he said there had been a gradual increase in output up to the war, and then there was a definite drop for several years. Since the Armistice, however, there had been a very great improvement, and at the end of 1919 the load was 26,000 kw. Estimating on a lower rate of growth than this he calculated that the Company would be called upon to provide a further 10,000 kw., making 40,000 kw. in the existing London area in four years time, but even this took no account of important business coming along in the way of bulk supplies. In the past the Company had been hampered on several occasions because it had not sufficient plant to enable it even to negotiate for such supplies. The South London Company and the Post Office both wanted large supplies, but they could not even be considered. Under the Romford Order only the compulsory area had been dealt with, and that with the assistance of a brewery which charged an accumulator and enabled the Company to supply from 80 kw. to 100 kw. In 1914 he estimated the requirements in the Romford area at 8,500 kw., but he now put the immediate demand there at 10,000 kw. By 1924 he estimated a total load of 50,000 kw. in the London and Romford areas. The new station was urgently required to relieve the present London generating stations, because the difficulty of running the older London stations was increasing every year, quite apart from the question of greater efficiency in coal consumption. At City-road some of the plant was 13 to 15 years old, and turbo-alternators built in 1905 were decidedly aged. At Wandsworth the oldest plant was 14 and 15 years old, and in another four years he would not like to have the job of superintendent at these stations. The estimate of 14,000 kw. increase in the London area in the next four years was a very moderate one, because the Company had hardly scratched the surface of the demand there. He was satisfied that it would be economical to get the new station at Barking running as soon as possible and shut down the two existing stations in London. Certain of the more modern plant might be sold in reserve for some years in both stations, but the City-road station would be dismantled first and Wandsworth run for a little longer.

An Historic Site.

In cross-examination by Mr. Tyldesley Jones, Mr. Sparks said that the first section of the generating station would have a capacity of 200,000 kw., but there was land sufficient for extension to 600,000 kw. In the first place it was proposed to put down three alternators of upwards of 20,000 kw. each. The site was the same as that scheduled by the Administrative County of London Power Company, which was promoted by Mr. Merz some years ago. The 200,000 kw. station would eventually contain eight units of about 25,000 kw. each, but the actual size would probably be between 30,000 and 33,000 kw. each. The total cost was estimated at £4,500,000, of which the power house would cost £2,678,000, to which would have to be added certain charges for interest during construction. The main transmission lines were estimated at £507,000, including the mains to link up with the Company's existing power houses; the transmission and distribution system in the Romford area would cost £375,000; and interest during construction at 10 per cent. would be £404,000. The figures for the main transmission lines included sub-stations. The generating current would be stepped up to 40,000 volts. He put the cost of transmission at £0·7 per kw. per mile on the average, but a great deal depended upon road reinstatement costs. He did not agree that it was practical to extend the Bankside station of the City of London Company to 100,000 kw. on account of coal storage difficulties. The present capacity of Bankside was 36,000 kw., and the works were very much hemmed in. The total supply area under the Romford Order was about 130 square miles. He would not advise his Company to purchase power from the City of London Company as a permanent thing, because he could not regard such a supply as reliable. Moreover, even with the full 10,000 kw. which had been arranged for, that would only carry his Company along for a short time.

No Prejudice to Future Operations.

Mr. C. H. Merz, Consulting Engineer to the Company in conjunction with Mr. Sparks, considered the estimates of growth put in were on a most conservative basis. It would take one year to get going after the consent was obtained, two years of active construction and one year for tuning up, but he failed to see that the construction of the station would in any way prejudice the subsequent operations of an electricity board, if one was established; indeed, it should facilitate these operations. There was a large prospective railway demand, and it was necessary to prepare for that. He did not anticipate any difficulty in getting the necessary capital to construct the Barking station, and was convinced that a load of 50,000 kw., as contemplated in 1924, would give sufficient revenue to provide an adequate return on the 4½ millions capital and the existing two millions of the County Company. In regard to the North-East coast power companies, 8 per cent. was paid on the ordinary shares with a capital of five millions sterling and a load of 112,000 kw. He had not changed his mind on the general question of power supply in London since 1905. There was nothing experimental about a 33,000 kw. turbo-alternator running at 1,500 r.p.m. A 20,000 kw. machine running at 2,000 or 3,000 r.p.m. was a much more difficult problem.

The Alternatives.

The Chairman said that if the Barking station were not erected the Company could do one of three things; buy in bulk, extend the existing stations or erect a station on some other site. He would like some comparison of the cost of extending in the existing stations with small units and erecting the Barking station.

Mr. Tyldesley Jones said he was not going to enter into a discussion as to whether a generating station at Barking would be a cheaper way of dealing with the position than extending the London stations. His case was that such a discussion was wholly irrelevant at the moment; there was no urgency which made it necessary for them to do anything to prejudice the enquiry which would take place by the Commissioners as soon as possible after March 31, 1921, at which equiry the Commissioners would consider the area for London electricity supply, which had already been provisionally drawn up, and schemes for dealing with that area. That area would undoubtedly include the Barking district, and to give permission to the County Company to proceed with a station there would be to prejudice the larger question to be considered next year, for his clients were preparing a scheme for submission at that enquiry.

Sir Harry Renwick (Deputy Chairman and Managing Director of the County of London Company), gave evidence as to the acquisition of the site at Barking site, and said the only desire he had in coming forward now was to be able to supply his own needs.

Position of the Development Company.

Mr. Jones put it that the Thames Development Company was owned by the County of London Company, so that any profit made by the Development Company out of the land sold to the County of London Company would be shared by the County Company, yet a purchasing authority would have to pay the price agreed between the two companies, which, in effect, were one.

Sir **Harry Renwick** refused to discuss this question, and said that the price paid was on an independent valuation by Sir Alex. Stenning. When the sanction of the Commissioners to go ahead with the station was obtained there would be no difficulty in persuading the financial people to support the scheme. The biggest financial people in the country were prepared to back the scheme as it had been put forward.

Mr. **Jones** referred to a Conference called by the Electricity Commissioners a short time ago, when a suggestion was made that all electricity supply authorities in London should come together and endeavour to prepare a scheme for dealing with the electricity supply to the London district. Since then an offer had been made to the County of London Company by the others to join in such a scheme, but the County Company had declined.

Witness said he never declined to join any such combination of authorities, but he had never been invited. Moreover, if he thought that the London County Council and the companies had a really constructive programme, he would join them at once. Unless something was done at once he would not be prepared to take responsibility for working the County of London Company. Unless somebody would come forward and guarantee him 100,000 kw. to carry on his business he was not prepared to continue the responsibility. The position at present was that he was discouraging business, and the delays were making his position impossible. The London companies had been obstructive all along the line. It had all been talk, which had never led anywhere, and he was sure it was not going to lead anywhere now.

The Chairman said the Commissioners desired to call the Chairman of the County of London Company.

Mr. **Lloyd** said he was in Birmingham, but he would be wired for, but later it was announced that Sir Ernest Hiley was no longer Chairman, and the matter was dropped.

Sir **Harry Renwick**, answering the Chairman, said he agreed that he might get a temporary supply during the next two or three years from the City Company, but he wished to develop along proper lines. He had asked for 100,000 kw. because he believed the estimates of his engineers were too conservative and would be doubled or trebled if the plant were available to supply the power. He had not been able for years past to deal with the business which had been offered him, because he could not see the possibility of supplying it whilst he was baulked in developing Barking. Moreover, whatever supplies he got from the City of London Company would not help him to develop the large area in Essex. Croydon, Shoreditch and Barking had asked him for supplies, but he had not been able to give them. In the case of Croydon, they wanted 5,000 kw., whereas he was only able to give 1,000 kw. Wimbledon had also had to be refused, and, due to the difficulties, he could not see ahead. If he could see ahead they would take risks, because there was no Company more willing to take a business risk than the County of London Company.

The **Chairman** mentioned that the units consumed per head of population per annum in the Company's area were only 39·2, and the projected increase in the London areas of 14,000 kw. in four years would really represent a very small amount.

Sir **Harry Renwick** repeated that he considered his engineer's estimates too conservative. He regarded the possibilities even in the London area as unlimited. There was a large quantity of land available for factories, and he anticipated an enormous industrial development.

Mr. C. H. **Merz** was recalled and handed in the estimate asked for by the Chairman on the previous day, giving a comparison of the cost of extending the existing stations and of erecting the new station at Barking. Assuming that it was physically possible to instal an additional 36,000 kw. at the City-road and Wandsworth stations, the generating plant would cost £1,080,000, and the total cost, including two cables to supply Barking, would be £2,269,000, against 4½ million sterling for the Barking station. In operating costs, however, there would be a saving with the Barking scheme of £212,000 on coal consumption by the year 1925, a saving of £5,700 on the removal of ashes, and a further saving of £30,000 in operating costs compared with the extension of the London stations making a total of £248,000 in favour of Barking. Moreover, the capital spent on the London stations would only have a useful life of four years, as it would be necessary to build the Barking station in any event, and he held the view that any money spent on the London stations would only increase the financial burden of the undertaking. Taking into account the short life of the plant installed in the London works, the real saving by erecting the Barking station was much greater than he had shown, and would be nearer £500,000. The coal consumption of the Barking plant he estimated at 1½ lb. per kw.-hour. Neither he nor Mr. Sparks would undertake to carry out the programme of alternative generation in the London stations owing to lack of condenser water facilities.

The case for the Opposition.

Mr. **Tyldesley Jones**, opening the case for the opposition, said that he was in a most unique position, for he represented not only the London County Council (the purchasing authority for all the London companies in 1931, including the County of London Company), but also 16 Metropolitan boroughs owning electricity undertakings, three county boroughs (Croydon, East and West Ham), five borough councils (Ealing, Gravesend, Hornsey, Kingston-on-Thames and Wimbledon), 14 urban districts owning electricity undertakings, and nine out of 13 companies interested. All those people offered the most strenuous opposition to consent being given now to the proposal of the County Company at a time when the Commissioners had asked for schemes to deal with the whole area on comprehensive lines. It was now proposed to spend 4½ million sterling upon a 66,000 kw. station which could not become operative for four years after they had got permission to go ahead, and by that time the County of London Company would only have seven years' life left to it. The proposal was one of almost unparallelled magnitude for a London Company, and his clients instructed him to urge most strongly that the Commissioners should not consent to the scheme at a time when comprehensive schemes had been asked for dealing with London as a whole. He reminded the Commissioners that in May they called all the supply authorities in the London area together and the Chief Commissioner then urged them to get together with a view to preparing a joint scheme. Practically everybody, with the exception of the County of London Company, acted on that advice, and a Committee of Engineers had been appointed, consisting of Sir Alex. Kennedy and Mr. G. W. Partridge (representing the companies), Mr. J. H. Rider (the L.C.C.) and Mr. C. H. Wordingham (the local authorities), and had been at work preparing such a scheme for presentation to the Commissioners on March 31 next. The Commissioners were asked to sanction a scheme which involved the removal of the load from two London stations to a station at Romford, and that necessarily affected the whole of the deliberations of that technical Committee. It had been said that no harm would be done because the County Company was willing to be put under an obligation to sell the station to a joint authority, but he doubted very much whether a condition of that kind could be put upon the company in an Order sanctioning the erection of the Barking station. At any rate if it were inserted it was doubtful whether it would have any force.

The Need for Co-operation.

The **Chairman** said the Commissioners were convinced that it would be in the best interests of London as a whole if all the companies and local authorities concerned with electricity supply were to pool their resources and their brains in an endeavour to devise a comprehensive scheme. Would it be practical to suggest that all the technical advisers, including those of the County of London Company were to meet, and that the enquiry should be adjourned for a short time for that purpose ?

Mr. **Lloyd** said he did not think it would be much use adjourning if the opposition held to the view that on no account must the Barking station be erected as soon as possible.

Mr. **Jones** said a vast amount of information had been collected, but it was too early to say whether Barking would be the best site or not.

The **Chairman** said that the Commissioners were satisfied that there was a shortage of power in London, and that the needs of London must be met during the next three or four years. He did not wish to create a delay in meeting those needs by refusing sanction to a scheme such as was now before the Commissioners if there was no likelihood of an alternative scheme being brought forward.

Mr. **Jones** assured the Commissioners that those for whom he appeared recognised to the full the serious need for improving the electricity supply of London, but the proposal before them did not pretend to deal with the position during the next three or four years. It was only in 1925 that it was hoped to have the Barking station working, and therefore the needs of London meanwhile would have to be met in some other way. Therefore, to hold back consent to the erection of the proposed station at Barking until the comprehensive scheme had been presented could in no way prejudice the position of the future supply after 1925.

The **Chairman** again appealed to the parties to meet and discuss the position with a view to coming to an understanding, but after a short consultation among the parties, it was found that they could not agree.

The **Chairman** then said the Commissioners would desire to have very clear proof by the opposition that the growing needs of the County of London Company could be met in some other way than that proposed by the Company. The Commissioners were not going to adopt a policy of sterilisation or undue delay. There had been too much delay in the London problem already.

The Dagenham Station.

Mr. **Jones** said he was not going to put forward now a scheme for dealing with the whole of London. That would come before the Commissioners in March next. It was material to bear in mind, in relation to the question of the time when this power station could be brought into operation, that the Company could not connect it with its London area without the consent of the Minister of Transport, before whom opposition could be heard. The normal developments of electric power in London would have to be dealt with in a temporary manner until 1924, which was the date upon which the County Company anticipated getting their Barking power station into operation. That difficulty, however, was one which was common to all London supply authorities, and, so far as the County Company were concerned, they already had a contract for 10,000 kw. with the City of London Company, and on the south side of the Thames there was the South Metropolitan Power Company, with its Lewisham station, which had a capacity of 20,000 kw.; but a load of only 8,500 kw. That showed that the increase in demand between now and 1924 could be met in a temporary manner. 150,000 kw. of extensions were now in hand in London, and he repeated that the Commissioners should not deal with the prospective future demands o

London without taking the whole question of the area and the proper sites for the power stations into consideration. The whole intention of the 1919 Act was that there should be generation on a large scale in large districts, and that an end should be put to the parochial system, which had resulted in the present state of affairs. The Commissioners themselves had already called for schemes, and practically the whole of the undertakers in the area which had already been provisionally scheduled had come together and were busy preparing a scheme on comprehensive lines, and in those circumstances individual schemes should not be considered as far as the erection of new power stations was concerned. The County of London Company's scheme should be considered from two points of view; was it one that had been suggested merely for the needs of the County of London Company alone, in which case it partook of the parochial nature to which he referred, and should be refused on that ground, or had it an ulterior motive, as being a first instalment of the comprehensive scheme which the Commissioners were to sit and enquire into in March next year? In the latter case, again, it should be refused, because it meant that the big problem would be pre-judged, to the disadvantage of those who had taken the advice of the Commissioners and joined forces in order to produce a comprehensive scheme. Already West Ham and some other authorities had joined in a scheme for the erection of a large power station at Dagenham. All the plans had been prepared, but, in deference to a request by the Commissioners, an application to erect that power station had been postponed. If a large comprehensive scheme could be sanctioned by the Commissioners as soon as possible after March next year it would be possible for the joint electricity authority to have its power station in operation in 1925, at the same time as the County of London Company anticipated the station now proposed would be ready.

In reply to the Chairman, who doubted this, Mr. Jones said that under Sec. 18 of the Act of 1919 the Minister of Transport himself could take action, and by the time the electricity authority was formed the scheme which his engineers were now preparing would be so far forward that there would be a strong case for the Minister of Transport to take action under that section. Finally, Mr. Jones asked, on the assumption that the Commissioners did grant the Order that the capacity of the power station should be limited strictly to the requirements of the County of London Company, and that nothing should be sanctioned which would in any way prejudice or take away the rights of those who were now engaged upon the large scheme referred to.

The Chairman assured Mr. Jones that in any application of that nature they would limit the extent of the station and would also require to see plans.

Power Shortage Universal.

Mr. J. H. Rider, Consulting Engineer, said that the scheme now being prepared was on the basis that the County of London Company would be included in the area of any electricity supply authority which might be formed after consideration of the schemes in March next. The problem of shortage of power supply in London was universal at present, and evidence of that was in the number of applications which had been made to the Commissioners by existing undertakers to extend their plant. Figures which had been collected showed that, compared with 15 years ago, when the Barking site was first suggested as suitable for a power station, the total capital charges on such a power station had increased by nine times, and, although in 1907 it was possible to generate current at Barking and deliver it in London at a price lower than the average works costs of the then existing undertakers, the position was different to-day. Although he did not suggest that it would not be possible to do the same thing now, yet the altered circumstances brought about by the war demanded careful consideration before such a scheme as the present was sanctioned or started upon. Although a large addition to the existing electric power supply facilities in London was needed at as early a date as possible, he was emphatically of opinion that no new power station should be sanctioned in the area until the Commissioners had held their inquiry in March next.

In cross-examination, Mr. Rider said that at present 200,000 kw. of new plant had been authorised and were on order, and although about 50,000 kw. would replace old plant, there were many possibilities for the County of London Company to obtain a supply to help them along until the joint scheme was decided upon.

Transmission Costs.

Mr. C. H. Wordingham (for 38 local authorities in the London and Greater London areas) said the question of site was a very important one, having regard to the increased cost of laying mains. The cost of the transmission mains was about £1 per kw. per mile, so that an error of a mile in the location of the power house in relation to the centre of gravity of the load meant a loss of £500,000. It was not at all certain, either, that one power station would be sufficient to meet the needs of London, and there was evidence that other people thought the same because a company with which the County of London Company was associated proposed to erect a power station at Erith. West Ham could give a supply, because it had a capacity of 27,900 kw. and a maximum demand in 1919 of 11,450 kw.; Stepney had a maximum demand of 10,800 kw. and a plant capacity of 16,000 kw. with 10,000 kw. on order. Shoreditch had a maximum demand of 6,440 kw., a plant capacity of 8,000 kw. and 5,000 kw. on order.

The Chairman said that nevertheless important business could not be taken on in some parts of London, and there was a recent case of a 5,000 kw. chemical works load on the banks of the Thames, which had had to be refused.

Mr. Wordingham contended that the Commissioners would be fully justified in postponing a decision in regard to the application until after the joint scheme had been presented.

Sir Alex. Kennedy said he had no hesitation in saying that if a Joint Electricity Authority was created in 1922 a new power station could be in operation in three years. Even if it were a question of a delay of a year, that would be better than giving consent to a scheme such as was now proposed which would only stand in the way of the proper preparation of a full scheme.

The Chairman said the Commissioners thought it desirable that the Chairman or somebody connected with the Conference of local authorities and companies should give evidence because they were particularly desirous of being given some assurance that such a joint scheme as had been mentioned would be put forward in March. They could not go on the supposition that the parties to the Conference would agree and then find in March, having refused consent to the Barking station, that no comprehensive scheme was forthcoming.

Sir Alex. Kennedy expressed the view that there was room in the existing stations for plant to carry on until 1925, by which time a new large power station would undoubtedly be required for London.

In cross-examination, he said that he believed he was almost the only engineer who had not sworn by Barking, and although he had not turned Barking down it might be taken that the Conference would submit to the Commissioners in March a proposal for another site which he and his colleagues regarded as distinctly preferable; that site was west of Barking and would be sufficient to accommodate 400,000 kw. eventually. Negotiations were in progress with regard to acquiring the site. He was not sure that it would be wise to start building a capital station to-morrow, if it were possible, because the extensions which the Commissioners had by *force majeure*, been compelled to sanction in the existing stations would carry the undertakings along for several years.

Mr. Geo. H. Hume, Chairman of the Electricity Committee of the London County Council, said that the companies and local authorities were working in the greatest harmony, and had left the preparation of the technical part of the scheme to the Committee of engineers referred to. The financial and administrative aspects of the scheme were being worked out, and it was the intention to agree as far as possible and bring the contentious matters before the Commissioners for decision. In the unfortunate event that the parties could not agree on a scheme, it was the determination of the L.C.C. to bring a complete scheme forward on its own account, because the Council considered it was its duty to do so in view of the terms of the Electricity Supply Act of 1919,

Mr. Duncan Watson, Chairman of the Conference of local authorities and engineers which was preparing the scheme, said the utmost harmony prevailed, and there was a real hope that a comprehensive scheme would be submitted next year. He did not anticipate any substantial difficulty in financing such a scheme on account of the large amount of money which the local authorities and companies had already invested in the business. The Conference would welcome the co-operation of the County of London Company in the matter.

On Saturday, Mr. H. Lloyd, K.C., summed up the case on behalf of the County of London Company. He was content that the Commissioners should protect the opposition in their own way, provided they did not prevent his Company from raising money.

In answer to the Chairman, he said that the Company had agreed to sell to the larger undertaking, and the consent of the Commissioners could be granted upon that assumption. Supposing hereafter the Company said that they would not sell, what would be the effect? (Mr. Tyldesley Jones: "None.") Supposing his learned friend were right. Would not the Joint Electricity Authority go to Parliament and say it was a disgusting public fraud? In such circumstances he ventured to think that a Government Bill would be passed in a very short space of time providing for compulsory purchase.

Replying to further questions by the Chairman, Mr Lloyd said that if consent were given the Company could not proceed with the raising of the capital until after the Company's 1918 Act had been amended to provide for a higher rate of interest payable out of capital during construction.

We learn from the Annual Report of Lloyd's Register of Shipping that the number of vessels classed at the end of the year ended June 30 was 9,587 with a total tonnage of more than 25,000,000 tons gross, of which 5,421 vessels, with a tonnage of 11,885,931, were British. Classes were assigned to 1,319 vessels of 4,253,523 tons during the year, of which 594 vessels of 1,391,808 tons were built in the United Kingdom and 480 vessels of 1,930,705 tons in the United States. During the year 426 newly classed ships (1,995,788 tons) were fitted for burning oil fuel, against 211 vessels of 1,193,650 tons during the previous year. A very large number of steamers which had previously burned coal have also come under the survey of the Society's surveyors both in the United Kingdom and abroad, with a view to being converted to burn oil fuel. Of the world's total tonnage of 100 tons and upwards 76 per cent. of the vessels use coal as fuel, 16·3 per cent. are fitted to use oil as fuel for boilers and 1·7 per cent. use oil in internal combustion engines, 6 per cent. having sail power only. The figures for the previous year were 82, 10·5, 1·5 and 6 per cent. respectively.

The Committee have recently approved amended rules for electric fittings on board vessels. The Society's chief surveyors were members of the "Ship Electrical Equipment Committee" of the Institution of Electrical Engineers, which dealt with the recent revision of that Institution's requirements for the electrical equipment of ships, and the Society's amended rules are in accordance with the latest requirements of the Institution. The Chief Ship Surveyor is a member of the Standing Sub-Committee appointed by the I.E.E. to consider questions of interpretation of the rules drawn up by their "Ship Electrical Equipment Committee."

Electric Power Engineers' Association.

On Saturday last the Southern Division of the Electrical Power Engineers' Association entertained the members of the National Executive Council at their second annual dinner. This was held at the Holborn Restaurant, London, Mr. W. J. Jeffery (chairman of the London Division) being in the chair.

Mr. A. H. Allen, in proposing the toast of "The E.P.E.A.," gave a short sketch of the development of the Association in its attempt to improve the salaries and prospects of power station engineers. The Association grew so rapidly that when a rival association was about to be formed with the Institution of Electrical Engineers at its back the E.P.E.A. was able to show that it already covered the ground, and was recognised by the Institution as the representative Association. He reflected the sentiments of the technical press generally when he said it considered the raising of electrical power engineers' salaries was a most commendable object, and that it hoped to see them put on a proper basis, and would do its best to support that object.

Mr. J. H. Parker (President of the Association) in reply said the Association owed much to the help of the electrical press, which had faith in the Association when it was an unknown quantity. The Association had faced a tough proposition recently, and was always in a cleft stick between the employers and the manual workers. Strikes could not be tolerated, except as a last resource. For two years the Association, therefore, had contended that strikes, before conciliatory methods had been tried to the last limit, were unjustifiable in the public interest. In the past they had been up against the workers' unions, who believed that they were an employers' organisation. And it had been found that employers in the East End were also against them because they broke strikes. They had attempted for two years to induce the manual workers' unions to try peaceable methods, and this was the first time in two years they had consented. The Association could not throw the E.T.U. over when, for the first time in their existence, they showed a liking for peaceable principles; but equally they could not allow the members of the Association to be placed in the awkward predicament of coming out on a strike at a moment's notice when the other people gave a week's notice. One crime of the E.P.E.A. was that they did not drive the workmen into the arms of the Bolshevik party, and another, according to the correspondence in the Press, was that they had put into the minds of those innocent lambs, the E.T.U., the idea of extending the trouble to the whole industry. As a fact, the Association told the E.T.U. they would not fight them if they adopted constitutional methods, and the E.T.U. gave way to the Association's conditions. They agreed that seven days' notice was reasonable. If the Association had gone in and broken that strike, and said nothing about it, they would have helped employers who were not treating them fairly. Only 72 out of 500 had agreed to pay their schedule. They would have used the Association to break the E.T.U. in September, and then used the E.T.U. in October to break the Association. The only force that had stood between the electric supply industry and anarchy in that industry had been the E.P.E.A. Sir Robert Horne had promised that, as far as he was able, he would see that their wages schedule was treated properly, and the Electricity Commissioners were asking whether the electricity undertakings were paying their staffs the schedule rates. There were other troubles ahead, but so far they had emerged from every trouble stronger and better, because the Executive had always determined to do the straight thing for the members, the employers and the other unions.

In the course of the evening, Mr. Parker, on behalf of members throughout the United Kingdom, presented to Mr. A. Lunn (the first President of the Association) a silver tea service, accompanied by a gold bracelet watch for Mrs. Lunn, and a silver knife, fork and spoon for Master Lunn.

Electricity in Mines.

Part I. of the Annual Report of the Chief Inspector of Mines for 1919, which contains the divisional statistics and reports, has been issued. The total output of coal was 229,743,128 tons, against 227,714,579 in 1918, but the number of persons employed under and above ground increased from 1,008,867 to 1,191,313. It is satisfactory to record that there was an appreciable decrease in the number of deaths, the gross total being 1,118 (against 1,401 in 1918), of which nine were due to electrical accidents. There was also a decrease in the total number of accidents, and there was no fatality in connection with the use of electrical plant in metalliferous mines or quarries. These figures indicate better management, and a stricter observance of rules by the workmen.

Electrical and Other Coal Cutters.

In the report on the Scotland Division by Mr. H. Walker, it is stated that there was an increase of 108 in the number of coal-cutting machines at work, and of 177,364 tons in the quantity of mineral obtained by them compared with the figures for 1918. The total quantity of mineral cut by mechanical coal-cutters was 10,379,495 tons, of which 9,507,912 tons were got by machines driven by electricity and 871,583 tons by machines driven by compressed air. In 1919 there were 353 more electrically driven coal-cutters at work than in 1913, and 40 fewer driven by compressed air. The number of mechanical conveyors in operation at the working face during the year was 105, compared with 125 in 1913. There are 9,230 electric safety lamps in use. Electricity was used at 356 mines during the year, and the total horse-power in use on the surface was 42,241 and underground 157,135 h.p. Electrical plant was also used in 10 metalliferous mines, the total horse-power being 1,191 (449 h.p. underground, and 742 h.p. on the surface).

In Mr. J. R. Wilson's report on the Northern Division, it is stated that economies are anticipated from one or two large schemes of electrification, which are being held up for want of material. The use of coal-cutting machines has made some headway during the last five years, and probably would have made more progress if the machines themselves, and more particularly the air compressors for generating the power, had been available. During 1914, 3,574,312 tons of coal (6·8 per cent. of the total output) were obtained by the use of 702 coal-cutting machines; in 1919, the quantity had increased to 4,380,593 tons (10 per cent.), and the number of machines had gone up to 1,025. The air machines advanced from 546 in 1914 to 854 in 1919, but electrically-driven machines advanced only from 156 to 171. The horse-power of the motors increased from 79,422 in 1913 to 122,051 in 1919, together with 117,474 on the surface. There are 14,000 electric safety lamps in use. Electricity is also employed in 21 metalliferous mines, representing a total of 3,675 h.p.

In the York and North Midland Division, Mr. Thos. H. Mottram reports that the quantity of coal obtained by coal-cutting machines was 6,979,454 tons. The coal-cutting machines employed numbered 880, made up of 269 disc, 110 bar, 334 chain, 162 percussive, 5 rotary heading. Electricity is used in 245 mines, the total horse-power being 189,289. There are 87,237 electric safety lamps in the district. Electricity is also employed in 9 metalliferous mines, the horse-power being 588.

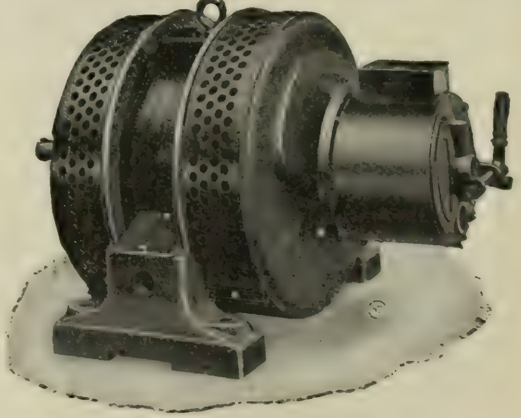
In the Lancashire, N. Wales and Ireland Division, the quantity of coal obtained by electric coal-cutting machines was 2,780,092 tons, of which 2,456,794 tons were got with machines worked by compressed air, and 323,298 tons by electrical coal cutters. There were 737 machines worked by compressed air and 58 worked by electricity, the total horse-power of the latter being 56,428. There are only 4,899 electric safety lamps. In 17 metalliferous mines in N. Wales electric motors of 3,466 h.p. are employed.

The quantities of mineral obtained by coal-cutting machines in the Midland and Southern Division were: Coal, 2,243,389 tons; fire-clay, 800 tons; and ironstone, 401,475 tons. The coal-cutting machines employed numbered 411, comprising 39 disc, 26 bar, 206 chain, 136 percussive, four rotary heading. The gross horse-power of all electric motors was 76,845 and there are only 3,497 electric safety lamps in use.

In the South Wales Division 78,859 electric safety lamps are employed, and electricity is used for coal cutting, pumping, haulage, &c., in 334 mines, the aggregate horse-power being 267,464.

Higgs Induction Motors.

Messrs. Higgs Brothers have recently placed on the market a line of induction motors fitted with both squirrel-cage and wound rotors. The illustration shows the wound rotor machine. The terminals are fitted in the feet on a specially insulated terminal bar, on the same principle as their standard direct-current motors. In regard to the method of ventilating the machine, the centrifugal fan is larger in diameter than the stator coils and draws the air through the perforated openings on one side of the machine through the stator coils, rotor coils and rotor core, and exhausts on the other side of the machine. They are fitted with ball bearings, and they are built throughout to the existing British standard specification for electrical machinery, and the range manufactured is from ½ h.p. to 70 h.p. Each machine is provided with a box containing spares that may be required for the motor, including bearing grease, spare brushes, lubricators, running instructions, &c. The slip-ring gear is of the short-circuiting and brush-lifting pattern. Two rings are fitted on a vertical hub which revolves with the shaft, the third phase being earthed. The short-circuiting switch actuates through the centre of the shaft and on the extension of the slip rings. The brush moving parallel with the switch considerably simplifies the construction of this gear. Both operations are performed by moving a lever about 120 deg. The operation is very definite in action. A tapped hole suitable for conduit is provided in the slip-ring cover for the cables. The squirrel-cage rotor was illustrated in a recent issue.



Wound Rotor Motor.

Commercial Topics.

Electricity Supply in Victoria.

Sir John Monash has been appointed chairman of the Electricity Commission in Victoria. The work of the Commission will include the administration of the Electric Light and Power Act, the co-ordination of electricity supply, the utilisation of the Morwell brown coal, and the development of water power. The Commission is about to invite tenders for three turbo-generator sets of 25,000 kw. each for Morwell, at an estimated cost of £500,000. A similar sum will be expended on e.h.t. switchgear and transformers. For the first section of the scheme 12 boilers, costing approximately £400,000, and cables costing £350,000, will be required. British manufacturers should be vigilant, and see that they secure some of these contracts, though probably the condensing plant and other items will be manufactured locally.

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The Future of Wages and Prices.

In view of the present serious industrial situation, the valuable statement on the "Future of Wages and Prices," by the Federation of British Industries, deserves careful consideration. Though it contains nothing but a reiteration of well-known economic principles, the statement is so clear that we think an abstract of it is worth reproduction. It is pointed out that the most conspicuous economic changes brought about by the war were (1) an extreme shortage of capital; (2) the withdrawal of a considerable portion of the labour force from the production of peace time commodities, resulting in a large reduction of supplies; and (3) owing to the financial methods of the Government, by artificially increasing the supply of money, this growing scarcity of commodities was accompanied by a continuous increase in the buying capacity of the public. Since the war the shortage of supplies has continued, owing to causes resulting from the war, including reduced efficiency of plant through lack of repairs during the war, the reduced efficiency of labour owing to reaction against war conditions, and the general reduction of working hours. At the same time, the methods of Government finance and the continued heavy Government expenditure, have made it impossible to reduce the supply of money. Since the general level of prices depends on the relation between the total buying capacity of the community and the supply of commodities available, the events referred to above have caused a continuous rise in prices.

Dealing with the question whether these advances in wages are likely to be permanent, the Federation point out that, so long as the purchasing power of the public retains its present volume relatively to the amount of goods and services available, the cost of living cannot fail. Either the supply of goods and servises must be increased without any corresponding netadditions to credit or currency, or else the purchasing power in the hands of the public must be reduced. Therefore all attempts to reduce permanently the cost of living by artificially keeping down the prices of certain commodities by Government subsidies, or otherwise, are bound to fail. The artificial reduction in prices not only serves to keep the consumption of the subsidised commodities at an uneconomically high level, but it also liberates additional purchasing power for other commodities and enhances their prices.

The Importance of Increasing Outpwt and Real Value of Wages.

In existing circumstances, therefore, the only effective means by which prices can be reduced and the real wages of labour improved is by working the existing instruments of production at their maximum pressure, and so increasing as rapidly as possible the mass of commodities to be bought. Any attempt by the workers to improve their conditions by ca'canny and similar methods not only fails in its object, but, by causing a rise in prices, actually reduces the purchasing power of their present wages. An increase in money wages may temporarily alter this state of affairs, but it cannot affect the final result.

Division of Profits and Industry.

It is pointed out that if the purchasing power which is now in the hands of capitalists were handed over to labour, excepting that portion which is devoted to personal expenditure, it would produce no material alteration in the position. The principal difference between the payments made to capital and those made to labour lies in the respective uses to which they are put. Payments to capital are devoted to the production of new industrial instruments which will be used to produce the future requirements of the world—*i.e.*, devoted to providing factories, machinery, railways, &c. The wages of labour are expended principally in satisfying present needs and requirements.. The transfer to labour of capital's share would, therefore, only result in its being diverted from the production of factories, plant, railways, &c., and devoted to the purchase of food and clothing, and the change would ultimately make the position very much worse. As a nation we are very considerably poorer than we were in 1914, and the working classes cannot expect any immediate improvement in their standard of living; they have, indeed, some reason to fear the reduction of it. The only way in which the position can be restored, and the fresh capital which the world needs can be obtained, is by working to their maximum capacity the few instruments which the war has left us. In conclusion, it is pointed out that "the price of labour has raised costs of production to such an enormous figure that industries can only afford to sell their goods at prices which the public decline to pay. Moreover, the profits of industry are carrying a deadly burden of taxation. The State is relying on profit to provide the money needed to meet current national expenditure; but the requisite profits are no longer being made in many industries, and, in fact, if means for decreasing the present cost of production are not found immediately, we shall see the disappearance of even that minimum return which is necessary to enable these industries to be carried on at all."

Electricity Supply.

West Bromwich Council has authorised the borrowing of £36,000 for the erection of a cooling tower, the extension of mains, &c.

The electricity Commissioners have sanctioned the borrowing by Burnley Council of £20,000 for the extension of electricity mains.

Electric motors and fittings in connection with four new turbine pumps are being installed at the Riddrie pumping station of the Glasgow Corporation Water Department.

At Lytham Council meeting last week it was stated that scores of people had left the district because they could not have electric light. The Council has been discussing the provision of electricity for many years.

As the result of a recent conference of representatives of local thorities and companies in Kent owning electricity works, the County Council, the S.E. & Chatham Railway Company, &c., a committee has been formed to consider and report upon the question.

Walsall Corporation decided this week to apply to the Electricity Commissioners, for sanction to borrow a further sum of £10,000 for house services and also that a contract be entered into with the Brush Electrical Engineering Company for supplying and erecting at the Birchills station a 5,000-kw. turbo-alternator and accessories for £46,670, subject to variation in prices of labour and materials.

The extensions of the Accrington electricity works are progressing satisfactorily. The turbo-generator will be on test the first week in December, the boilers are in course of erection, and the department anticipate that the new plant will be supplying energy early in the new year. The ban on overtime is having a detrimental effect upon the work, and an effort is being made to arrange some way out of the difficulty.

Electric power is now used in the Kilmours Boot Factory of Messrs. Kellie & Company. Energy is supplied by Kilmarnock Corporation at 11,000 volts, and is reduced to the usual voltage for power lighting by a transformer on the premises. Eleven motors have been installed and the steam boilers are only used for heating purposes, with the result that there has been a big reduction in coal bill.

Wolverhampton Corporation propose to give a supply of electric current to 172 houses upon the Birches Barn estate, and to provide for the street lighting, for which a cable 3,050 yds. long, and costing £2,955, is to be laid. It is also proposed to spend £1,750 in order to give a supply of current to the Corporation sewage works, and to lay an e.h.t. cable to a large works in Monmore Green.

The Asylum Committee of Derby County Council contemplate an outlay of £60,000 or £70,000 on electric lighting, heating and hot water installations at Mickleover Asylum, but before any actual expenditure is incurred, the matter will be reported upon further. The Committee has been granted a vote of £5,000, so that, in the event of the work being eventually approved, a commencement can be made during the current financial half-year.

The official inauguration of the Linton Locks hydro-electric works of the York Corporation took place on the 6th inst., when a foundation concrete block was moulded of the new power station by ex-Ald. Meyer, late chairman of the Electricity Committee. Three water turbines are to be installed, capable of producing 1,000 kw., whish will be generated at a voltage of 6,600 and transmitted to the City, where it will be converted to the normal voltage for lighting and power. The estimated cost is £63,000, and a saving of 4,000 tons of coal a year is expected.

Last week Morecambe Corporation were recommended by the Electric Light Committee to charge a flat rate of 8d. per unit for electric current, but Councillor Wilson moved that the Minute be deleted, pointing out that no other authority in the Kingdom charged a uniform price for power and lighting. If Morecambe attempted to do it they would become the laughing stock of the country. In reply, Ald. Brown said the electricity works had been losing from £1,700 to £1,800 per year for some time, and he failed to see why picture houses should have electricity at half price. The amendment was, however, carried.

The comprehensive exhibition of lighting, heating and cooking apparatus and of electrical labour saving devices for the home and office, which is being held this week at the Greenock Town Hall, is one of the first local exhibitions following the war to be organised on anything like a big scale. The Corporation electricity department and the burgh electrical engineer (Mr. F. H. Whysall) have organised the exhibition, and Mr. Cedric F. White is responsible for the arrangements, which include lecturettes by electrical experts, practical demonstrations of cooking and heating, &c. For illumination purposes there are 2,000 lamps, and as the show is exciting considerable interest the department should benefit considerably by its enterprise.

A conference of electric supply authorities in Carnarvonshire, Merionethshire and Anglesey was held in Carnarvon, last week, in order to consider their position under the proposed North Wales electricity district. After a discussion of various matters, the conference resolved that, while approving of the area defined by the Electricity Commissioners as most conducive to the efficiency and economy of the supply of electricity and to the convenience of administration, the three counties had the first claim on the natural water-power resources existent therein, and for that reason any scheme to be approved by the Commissioners should provide for a delegation of the powers of the Joint Electricity Authorities to a committee representative of the local authorities and electricity users in the three counties.

The Special Committee of Sheffield Corporation on electricity charges has issued an interim report, in which it is stated that the members are satisfied that a substantial increase in the revenue of the Electricity Department is necessary in order to meet the increased expenditure, the debt charges and the necessary appropriations to renewals and special expenditure fund and other appropriations. Various suggestions have been made as to the method by which this revenue should be raised, and before making any definite recommendations of a permanent character the Committee desire to go more fully into the whole question. They are of opinion, however, that immediate provision should be made for securing some increased revenue, and they recommend that, as from the readings for Sept., 1920, the total increase on the base charges should be as follows: On all units charged at over 2d. per unit, 50 per cent., instead of 40 per cent.; on all units charged at 2d. or under, 150 per cent., instead of 105 per cent.; on all units charged to tramways and motors department, 75 per cent., instead of 50 per cent.

As from January 1 next, the STALYBRIDGE, HYDE, MOSSLEY and DUKINFIELD tramways and Electricity Board have decided that the following increased charges for electricity will be made:—Lighting, 7d. per unit, less 2½ per cent.; mill and factory lighting, 5d.; heating, 2½d. per unit; theatre and cinema tariff, plus ½d. per unit; power not exceeding 50 units per quarter, 7d., less 2½ per cent.; exceeding 50 units, plus 0·85d. per unit net on pre-war rates.

For the purpose of laying electric supply mains BLACKBURN Corporation has decided to apply for sanction to borrow a sum of £50,000.

The Electrical Commissioners have informed BLACKBURN Council that they have postponed consideration of the question of laying a main transmission line between BLACKBURN and PRESTON until the submission of a scheme for the reorganisation of electricity supply in the Mid-Lancashire district. Nelson Council are objecting to the inclusion of Nelson and district in the proposed district on the ground that the supply could be more and efficiently controlled by an authority in N.E. Lancashire.

At Blackburn Council meeting last week the Mayor said Blackburn had the honour of constructing the first large electricity station, and it would be finished early next year. Arrangements had been made to supply the neighbouring districts of Great Harwood, Wilpsheir, Rishton and Darwen. There was an increasing demand for electricity for industrial purposes, particularly in connection with the cotton trade. The use of electricity in several of the spinning mills was likely to extend. There was a tendency to substitute ring spindles for the mules, and for that purpose larger power was needed. Electricity would undoubtedly play a more important part in cotton than it had ever done before, particularly in the spinning section.

The BARNSTAPLE Electricity Department is in a serious position owing to the lack of generating plant to meet the increasing demands for power. At the Council meeting last week an outline was given of the steps taken since December last with respect to plant, and the adoption of Mr. Highfield's scheme, which was estimated to cost about £40,000. Some time ago the Council instructed the electrical engineer (Mr. Hadfield) to report at once as to obtaining temporary additional plant, and to convene a further conference of power users and large consumers, with a view to asking for guarantees or deposits arising out of the proposed capital expenditure, and arranging for a modification in the demand for current between 4 and 6 p.m. At this conference certain consumers offered to give reasonable guarantees, and both employers and representatives of labour spoke strongly against any curtailment in working hours or supply of current. After some negotiations, Mr. Hadfield was able to obtain secondhand plant (a 500-kw. set) at £4,145, and the Electricity Commissioners intimated they would allow a loan for ten years for its purchase, but they were not sympathetic to the proposal to hire plant. The Council then authorised Mr. Hadfield to purchase the plant, and when it is installed the electricity department will be able not only to supply the present consumers, but connect up those waiting.

Electric Traction.

ILFORD Council, who have been authorised to borrow £8,500 for electric vehicles, are recommended by the Works Committee to purchase a 3½ ton Orwell electric lorry from Messrs. Ransomes, Sims & Jefferies, at £1,690. Six 2-ton electric wagons have already been delivered by the firm and are working satisfactorily.

WOLVERHAMPTON Tramways Committee recommend the Council to accept tenders for the supply of material for the proposed conversion of the tramways to the overhead system. The amount of the contract is over £40,000, and sanction is being sought for borrowing £46,279, the estimated total cost of the conversion

The City of London Coroner (Dr. Waldo) recently referred to the great value of ELECTRIC AMBULANCES in the London area, and suggested that the time was opportune for the City to instal a lung motor in connection with its two electric ambulances, so that it would be ready at hand in case of call to those recovered from the Thames.

An unusual and somewhat startling accident occurred on an ASHTON-UNDER-LYNE tramcar on Sunday. As the vehicle was proceeding along Katherine-street part of the ironwork underneath the car collapsed, bringing it to a dead stop. Some passengers were shaken, and the driver (Walter Hardy) was flung over the front of the car, suffering injuries to his head.

Correspondence has passed between the Treasury and the London County Council on the provision to be made for TRAMWAY RENEWALS. The Treasury refuse to admit as a general principle that any part of the cost of renewals should be charged against capital, but they recognise that the position this year is exceptional, and in the circumstances they are ready to assent, for the years 1919-20 and 1920-21, to half the cost of renewals being charged against capital and treated as repayable within 12 years.

Imperial and Foreign Notes.

It is proposed to establish electricity supply works at DUBBO (N.S.W.).

NARRABRI (N.S.W.) Council is considering the provision of electricity supply in the town.

Ripon (Victoria) Shire Council has applied for an order in council authorising the council to supply electricity in BEAUFORT.

The STAWELL (N.S.W.) has decided to retain the right of electric supply within the area, and Mr. T. W. Bridges has been retained to advise on the subject.

The new South Wales Public Works Department is considering the preliminaries of a scheme for supplying the KIAMA and GERRINGONG (25 and 30 miles distant, respectively) with electricity from the power house at Port Kembla.

West Maitland (N.S.W.) Council has completed negotiations with the Commonwealth Bank for a loan of £15,000 for the provision of electricity supply, the current being supplied in bulk by the Railway Commissioners. The council has accepted tenders for the distributing network, street lamps, &c.

A report on an electric supply scheme for the municipalities of KOGARAH, BEVERLEY, ROCHDALE, and HURTSVILLE (suburbs of Sydney) has been prepared by Mr. H. J. Hoggan. The scheme has been approved by Rochdale Council.

Under the agreement for the transfer of the undertakings of the North Melbourne Electric Tramway and Lighting Company to MELBOURNE and ESSENDEN Councils Essenden will have control of the tramway system and power house, and Melbourne City Council preserves its lighting and power interests in the Essenden and Kensington districts.

Tenders have been accepted by the Postal Department for the construction of a new automatic telephone exchange at COLLINGWOOD (Victoria) at a cost of about £123,000. It is the intention of the Postmaster-General shortly to submit to the Public Works Committee proposals for the establishment of three other automatic exchanges.

The N.S.W. division of the WIRELESS INSTITUTE has been informed by the director of radio services attached to the Navy department that it has been decided not to issue licences for the general and promiscuous transmission of wireless signals, but where such transmission is necessary to aid scientific development, special permission can be obtained.

The New South Wales Railway Commissioners recently installed a the port of NEWCASTLE (N.S.W.) six 15-ton electric cranes, designed by Mr Percy Allen, chief engineer of the Public Works Department at Newcastle. The cranes have a reach of 39 ft. from the front of the wharf, and the high speed at which they travel enables a ship to be coaled in 10 to 12 hours instead of about 60, as formerly.

The Victorian State Premier recently stated that the Victorian Electricity Commissioners' investigations into the possibility of using the water power of the KIEWA RIVER were now nearly complete, and a transmission line route from Kiewa to Melbourne was being surveyed. An alternative transmission route through settled areas running parallel with the railway line would also receive full consideration.

The annual report of Mr. Allbut, city electrical engineer, on the NEWCASTLE (N.S.W.) Council's electricity system, which takes current in bulk from the Railway Commissioners, states that the year 1919 closed with a net surplus of £3,084, after meeting interest, loans repayments, depreciation, &c. Revenue was £36,583, against £32,583 for 1918, and expenditure was £27,865 compared with £21,663. There were 795 consumers, against 410.

BULLI (N.S.W.) Shire Council has been invited by the adjoining shire of Sutherland to consider a proposition to take electric current from the Metropolitan colliery, which is near the border between the two shires. It is proposed to offer the company 2d. per unit at the colliery for 200,000 units per annum. CAMDEN and CAMPBELLTOWN Councils in the same district are considering a scheme for a central power-house to be erected half-way between the two towns.

It is reported that the output of the DUTCH ELECTRIC SUPPLY STATIONS this year will exceed that of 1919 by 50 per cent., but development is being delayed by the difficulty of obtaining generating plant and cables.

In a Paper by Mr. Gerard de Geer, mining engineer, read at the engineering fair, which was opened at Gavle, Sweden, on the 23rd ult., he dealt with the influence of ELECTRIC STEEL PROCESSES on the position of the Swedish iron and steel trade in the markets of the world. During the war a strong impetus was imparted to the development of processes for the production of electric steel owing to the enormous demand for steel of high quality, and the question was whether the great increase in the output of electric steel rested on a permanent basis or whether it was only a war-time phenomenon. He thought it could be established that the electric method *per se* did not afford any guarantee of high quality, as the process was extremely sensible to experienced and skillful management. The solid foundation for Swedish quality was represented by charcoal pig iron, and the Swedes could not regard electric steel processes as a weapon exclusively in the hands of their foreign competitors. Owing to their sensibility to skilful management, electrical methods might be easily adopted by Swedish manufacturers. As to the economic side of the question, he thought that the present prices for fuel would have to fall considerably before equality in the working expenses prevailed between, for instance, open hearth and electric steel. There were no obstacles in the way of the general "electrification" of the steel production in Sweden.

Miscellaneous.

The death is announced, at the age of 85 years, of Mr. Geo. Tangye, a member of the famous family of Birmingham engineers. Mr. George Tangye was chiefly identified with the business side of Tangye Bros., Ltd.

The death is announced of Prof. S. Sheldon, professor of physics and engineering at the Polytechnic Institute, Brooklyn. Prof. Sheldon was the author of some works on electrical engineering and was President of the American Institute of Electrical Engineers in 1906.

A Hotel, Restaurant, and Catering exhibition is to be held at the Agricultural Hall from October 30 to November 5. This exhibition should afford manufacturers of electric cooking apparatus, &c., an excellent opportunity for impressing the general public of the advantages to be gained by the use of electricity for cooking, and we hope to see that manufacturers have not been idle in this direction.

In the recent Martlesham Heath Aeroplane Competition four out of the five prizes were won by aeroplanes whose engines were fitted with B. T.-H. Magnetos. There was no first prize awarded in the large aeroplane class, but the second prize was won by a Handley-Page with Napier "Lion" engine. In the small aeroplane class the Westland six-seater with Napier "Lion" engine won the first prize: the Sopwith "Antelope" with Wolseley Hispano "Viper" engine, the second prize; and the Austin "Kestrel" with Beardmore engine, the third prize.

In connection with the recent threatened E.T.U. strike, the District Electricity Industrial Council for the W. Midlands area has passed unanimously. on the motion of the chairman (employers' side), seconded on the trade union side, the following resolution: "That in view of the recent threat to wirhdraw labour from the electric supply undertakings arising out of an extraneous labour dispute, this District Industrial Council is strongly of opinion that it should first be given an opportunity by the parties concerned to consider before action is taken any matters affecting the relations between employers and employees."

Major General Sir F. H. Sykes, C.B.E., K.C.B., C.M.G., Controller of Civil Aviation, in his address on Monday before the Air Conference, impressed upon aviation transport firms the great importance, in the interests of safety and regularity, of every commercial machine being equipped with wireless, and quoted as an instance of the utility of such an equipment the recent case in which an aeroplane with 10 passengers aboard was able to ask from the air for landing lights when forced to land at St. Inglevert after dark. In this connection it is useful to know that nine of the aeroplanes engaged in commercial services between England and the Continent have been equipped with the Marconi wireless telephone and that others are being similarly fitted.

By a combination of wirs and wireless, it is now possible to speak from an aeroplane to an office in London via Croydon, and vice versa. Sir Frederick also stated that wireless stations have been opened at the civil aerodromes at Castle Bromwich, Didsbury and Renfrew, and the number would be increased as the need arose.

Owing to the cost of cable drums being now three or four times what it was before the war, the members of the Cable Makers Association have been compelled to reconsider the arrangements hitherto in force as to the supply and loan of drums for the delivery of cables. From the 1st inst. onwards, members of the Association will adopt the following practice:—The prices quoted for cables will include the loan of a drum or drums with lagging where necessary for three months, the purchaser accepting responsibility for their return carriage paid, to the maker's works, and for any loss or damage sustained by them in respect of these drums. After the expiration of three months, rental will be charged in accordance with a schedule which will also give the prices at which the drums may be purchased, subject to the deduction of any rental already paid for them.

The Birmingham section of the British Industries Fair (1921) is again being organised by a joint council of the Birmingham Corporation and the Chamber of Commerce, and already the space for next year's Fair at Castle Bromwich is being booked very rapidly. The general manager (Mr. Charles Stanley) is experiencing no difficulty in getting exhibitors to take space. The display is being held as an integral part of the London and Glasgow Fairs, the latter of which will, however, overlap London and Birmingham by a week. Practically, the arrangements are the same as for the 1920 Fair, and at Birmingham will be found brassfoundry, hand tools and tools for use on machinery, cooking and heating stoves, mechanical rubber goods, tubes and fittings of copper, lead, brass, steel, &c., non-ferrous metals and alloys, ornamental metalwork, scales and measuring appliances, hardware, machine belting, motor cycles and cars, varnishes, &c. The promoters of the fair have secured the use of the aerodrome at Castle Bromwich, using the first three permanent buildings, and there will be a long covered corridor connecting the first two buildings. Information as to space available, &c., can be obtained from the General Manager, 95, New-street, Birmingham, to whom early application should be made.

Personal and Appointments.

St. Annes Council has appointed Mr. H. W. Laing manager of Blackpool, St. Annes and Lytham tramways as from November 1 when the line becomes the property of the Council. Mr. Laing is the present manager of the company.

According to the "Manchester Guardian," Herr Walter Rathenau, of the A.E.G., was prohibited, under the Aliens Act of 1919, from landing in England in order to attend the three day International Conference on Trade which was held in London this week.

Institution Notes.

The ninth annual dinner of the Finsbury Technical College Old Students' Association will be held on Saturday, Nov. 13, at 6.30 p.m., at the Trocadero Restaurant, the president, Mr. J. E. Raworth, occupying the chair.

A visit to the City and Central Telephone Exchanges has been arranged by the Committee of the North-Western Students' Centre of the Institution of Electrical Engineers for Saturday, October 23. A dance has been arranged to take place on Tuesday, November 23, at the Holy Name Hall, Manchester.

The "Thomas Hawksley" Lecture delivered annually before the Institution of Mechanical Engineers, will this year be given on Friday, November 5, at 6 p.m., at Storey's Gate, St. James's Park, S.W. The subject will be "Limit Gauging," by Sir Richard T. Glazebrook. The first informal meeting of the session will be held on October 29.

The Kings' College, London, Old Students' Association (Engineering Fadulty) will give a luncheon at the Holborn Restaurant at 1.15 on Wednesday, Oct. 27th, when the chair will be taken by Mr. C. H. Wordingham, C.B.E. Old students are requested to communicate with the hon. asst. sec., Mr. D. H. Kendon, King's College, Strand, W.C.2.

For the convenience of those attending the joint meeting of the Faraday Society and The Physical Society on Monday, Oct. 25, it has been arranged to hold a dinner at the Hotel Victoria at 6.30 p.m. The price of the dinner will be 12s. Those intending to attend should communicate with the secretary, Mr. F. S. Spiers, not later than Monday, Oct. 18.

Mr. H. E. Yerbury has been elected president of the Sheffield and District Wireless Society. An attractive syllabus has been prepared, including 15 Papers on wireless subjects, and a social evening is to be arranged at which members will have the unique opportunity of dancing to music transmitted by wireless. The society has over 100 members. Meetings are on alternate Fridays, commencing Oct. 29. Mr. L. H. Crowther, of 156, Meadow Head, Woodseats, is the secretary.

The Glasgow Corporation Electricity Department Engineering Society opened its winter session on the evening of the 4th inst., at the head offices of the department, 75, Waterloo-street, when Mr. R. B. Mitchell, engineer and manager of the department, delivered his presidential address. The Society was formed four years ago to encourage the interchange of technical information, and otherwise to further the interests of members and of the electricity department. Starting with 80 members, it has now over 400 members.

The tenth annual ladies' night of the Birmingham and District Electric Club will be held at the Grand Hotel, Colmore Row, Birmingham, on Saturday evening, October 23rd. At the meeting of the Club on the 9th inst., a Paper was read by F. S. J. Pile, M.A., a member, on "Thermo-Electric Currents as Applied to Pyrometry." The Paper dealt with the early difficulties both in the thermo-couples and in the indicating and recording instruments, and gave full and interesting descriptions of the most recent devices. It dealt specially with the compensating arrangements at the cold junction of the couple, and with the latest contrivances for preventing zero creep in the micro-voltmeter. The lecturer was assisted by Mr. Stone, inventor of the special appliances used in modern pyrometry.

A revised edition of the lists of British Standard Rolled Steel Sections for Structural Purposes (Report No. 1-1920 has been published by the British Engineering Standards Association. Returns supplied in 1913 to the Association showed that over 95 per cent. of the output of structural shapes in the country were rolled to the British standards, and in the 1914 edition the total number of sections given was 174. The experience of the war having indicated that a fewer number of standard sections would probably meet the requirements of shipbuilders, structural engineers and others, a revision was decided upon in 1917, and the total number of standard sections is now 113. Each series of shapes is numbered consecutively and independently as in the original list, and in order to prevent confusion with the latter the letter N is prefixed to the letters designating the form of section. For the same reason a new series of code words is provided for telegraphic purposes. The report is published at 1s. 3d., post free.

Catalogues, Price Lists, &c.

Messrs. Jones & Pardoe, 8, Crawford passage, Farringdon-road, E.C.1, have recently placed on the market the "Elba" accumulators for lighting and ignition. In a leaflet issued by the firm particulars of the special features, with prices, &c., of these cells are given.

The new export list of the Electrical Components, Ltd., 90, Great Charles-street, Birmingham, contains particulars and prices of some of the electrical accessories and apparatus manufactured by the company. There is listed a variety of ceiling roses, cutouts, d.p. distribution fuse boards, tumbler switches, wall plugs and sockets, lampholders, blocks, bell pushes, motor-car switches, fuses, small d.c. motors, &c. Of good design and sound construction, the various accessories comply with the Home Office and other official regulations. Owing to fluctuating markets for raw materials a general discount applicable to all the accessories is not given, but the company will be pleased to quote for any special requirements of the trade.

Tenders Invited and Accepted.

West Hartlepool Corporation require tenders by 10 a.m. Oct. 26 for a 1,000 kw. rotary converter and switchgear, for the electricity department. Specifications, &c., from the Borough Electrical Engineer.

Bradford Corporation require tenders by 10 a.m. Oct. 28 for two natural-draught, chimney-type cooling towers, pipe-work, troughing, valves, &c. (Contract R. 160). Specifications, forms of tender, &c., from Mr. Thomas Roles, Electricity Offices Town Hall, Bradford.

Bristol Guardians require tenders by noon Oct. 25 for electric light wiring and fittings in the Eastville Institution. Specification from Mr. H. T. Sully, Scottish Widows' Building, Baldwin-street, Bristol, after payment of £2. 2s. deposit to the Clerk, St. Peter's Hospital, Bristol.

Tenders are invited by December 28 for supply to the Postmaster-General's Department in Western Australia of telegraph and telephone instruments and parts (Schedule 689). Tenders forms from the High Commissioner for Australia, 406, Australia House, Strand, W.C.2.

London County Council require tenders by 4 p.m., Oct. 25, for the supply and maintenance of 125 bodies for electric tramcars, 125 maximum traction bogie trucks, and 125 electrical car equipments, with assembly of bodies, trucks, electrical equipments, &c., into complete tramcars. Specifications, &c., from the Clerk of the Council, Spring Gardens, S.W.1.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the Australian Commonwealth Postmaster-General's Department: telephone instruments (schedule 548) (Nov. 3) for S. Australia; also New South Wales: Telegraph and telephone instruments and switchboard parts, schedule 753 (Nov. 25). South Australia: Telephone instruments, schedule 547 (Nov. 10). Queensland: Protectors, schedule 505 (Nov. 30); iron poles, schedule 506 (Nov. 24); and protected cable terminals and cable distributing boxes, schedule 507 (Nov. 24). Tender forms, &c., can be obtained at the office of the High Commissioner for Australia, Room 406, Australia House, Strand, London, W.C. 2.

Bradford Tramways Committee has accepted the tender of Hadfields Ltd. for tram rails and crossings, at £6,329.

London County Council have accepted the tender of the Frodingham Iron & Steel Company for 1,500 tons of conductor rails, at £50,425.

Business Items, &c.

Messrs. Siemens Bros. & Company, Ltd., and Siemens Bros.' Dynamo Works, Ltd., will shortly remove their head offices from South Kensington to Caxton House, Westminster, S.W. 1.

Herbt. Rye Wood and David Arthur Roberts, electrical engineers, 7, Salem-street, Oldham, have dissolved partnership. Debts by Mr. Roberts, who continues the business in his own name.

Fredk. Percival Shefford and Walter Joseph Thomas, electrical engineers, Salisbury-chambers, Wind-street, Swansea, have dissolved partnership. Debts by Mr. Shefford, who continues the business.

The work of incorporating the British Electrical and Allied Industries Research Association has now been completed, and the registered address has been removed to 19, Tothill-street, Westminster, London, S.W. 1, where all communications should be addressed. The director of research is Mr. E. B. Wedmore.

Messrs. Chiswell & Company, Export Buying Offices, Imperial House, Kingsway, W.C.2, have just placed instructions for the delivery of a 450 b.h.p. Vickers-Petter semi-Diesel crude oil engine and a 300 kw. Brush alternator, part of a complete installation required by one of their clients in the West Indies.

Following the reduction of the list prices of "Exide" starting and lighting batteries the Chloride Electrical Storage Company notify that they are now able to offer users the further advantage of a first-class battery service. Already a large number of important firms all over the country have established "Exide" battery service stations in various towns and many of these are in operation, whilst others will shortly be in a position to undertake the work. The company's service system will ensure that an "Exide" battery user need never have his car out of commission through battery trouble, as he will have in his vicinity an "Exide" service station where he can obtain an expert's advice and assistance whenever necessary. In addition, all motorists will be able to obtain from stock at their nearest service station a new ready-charged battery suitable for their cars at any time.

Educational.

Sir Dorabji Tata has given a donation of £25,000 towards the expense of providing new buildings for the engineering school at Cambridge University. An anonymous gift of £2,000 has also been received, and the new buildings are approaching completion. Among the students entering this year are about 50 officers of the Royal Engineers and some officers of the Royal Air Force and the Signals Corps.

The Site Committee of the Senate of the University of London recommend the acceptance of the Bloomsbury site, subject to certain reservations. This recommendation will come before the Senate at its meeting next week. Further correspondence has passed between the Vice-Chancellor of the University (Dr. Russell Wells) and the Minister of Education (Dr. Fisher) in regard to the value of the site and of the existing buildings occupied by the University, and Dr. Fisher intimates that the University Grants Committee is empowered to recommend that a grant should be made toward the building and equipment of the future headquarters of the University.

Patent Record.

SPECIFICATIONS PUBLISHED

The following abstracts from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1918 Specifications.

121,485 F.I.A.T. Fabbrica Italiana Automobile Torino. Electrical furnaces. (12.12.17.)
149,701 Perl. Electric [illegible] (24.1.18.) (Cognate application 17.4.18.)
149,702 Eccles & Jordan. [illegible] (2.6.18.)

Relates to a method of amplifying electric oscillations or fluctuations by the use of a local source of higher frequency [illegible] normally employed for amplifying higher frequency [illegible] the higher frequency oscillations the lower frequency oscillations or fluctuations to be amplified, passing the [illegible] through the amplifier and separating or detecting the lower frequency oscillations or fluctuations.

134,810 F.I.A.T. Fabbrica Italiana Automobile Torino. Electrical furnaces. (2.11.18.) (Addition to 121,485.)
135,859 Soc. Anon. Calor. Electric stoves. (29.11.18.)
136,524 Bellescize, Bellescize & Bellescize. [illegible] (7/12/18.)
137,038 Fabriker Elektr. Apparate F. Sauter. [illegible] wound clock-work and other mechanism. (24.12.18.)
141,658 Dubilier Condenser Co. [illegible] (11.4.19.)
147,981. Sheppard. Magneto-electric machines for engine ignition purposes. April 22, 1919.
147,982. Hall. Construction of electric generators and motors for working under water or other liquid. April 22, 1919.
147,988. Teixeira. Electric furnaces. April 23, 1919.
147,994. Haslem & Stretton & Stretton. Electric lamps for miners' lamps and for similar purposes. April 24, 1919.
147,977. Guye, Bifel & Ramseyer. Automatic apparatus driven by electric motor for winding spring-driven clocks. April 24, 1919.
148,006. Wightwick. Electric switches. May 3, 1919.
148,009. Barr. Electrical water-heating elements. May 7, 1919.
148,012. Lemaire. Electric lamps for miners. May 3, 1919.
148,086. Barber. Electric switches. November 19, 1919.
148,095. Pestalozza. Electrolytic apparatus for the direct production of hypochlorites. December 19, 1919.
149,372 Bolton. Mercurial collector for electrical machines. (7/6/19.)
149,376 Rodriguez. X-ray apparatus. (11/3/19.)
149,409 B. T.H. Co. (G. E. Co.) Systems of radio communication. (9/5/19.)

A system for the production of alternating current of substantially constant frequency for systems of radio communication and the like, comprising an alternating current generator driven from a source of power, means for driving from the generator a unidirectional electric current which varies as a function of the frequency of current generated and means responsive to changes in the value of the unidirectional current for controlling the speed of the generator.

149,410 Ansingh & Metropolitan-Vickers Electrical Co. Electric switches. (9.5.19.)
149,411 Ireland. Electric motors and particularly electric traction motors. (9.5.19.)
149,422 Fleming. Thermionic devices. (12.5.19.)

Comprises a vacuous bulb, a filament, a pair of collecting plates and a pair of potential plates, the four plates being arranged symmetrically around and close to the filament.

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

April 19.

10,775 Morley. Electro-pneumatic solo and harmony device for organs.
10,802 Hornby. Commutators for motors.
10,831 Golledge & Lee. Electrically heated apparatus.
10,835 B. T.-H. Co. (G. E. Co.). Tungsten alloy.
10,836 B. T.-H. Co. (G. E. Co.). Electric protective devices.
10,872 Lacon, Robertson & Lee. Electro-magnetic generators and motors.

April 20.

10,893 Cotton. Fuse boards.
10,903 Weston. Machines for exhausting electric lamps.
10,905 Lownie. Electric conduit fittings.
10,939 Greenwood. Terminals for conductors.
10,943 Western Electric Co. Electric signalling systems.
10,944 B. T.-H. Co. (G. E. Co.). Electron discharge devices.
10,961 Lincoln Electric Co. Arc welders. (26.2.15. U.S.)
10,996 Telephone Mfg. Co. & Palmer. Inter-communication, &c., telephones.

April 21.

11,016 Norton. Oil break switches.
11,018 Automatic Telephone Mfg. Co. Railway signalling apparatus.
11,045 Hallahan. Electric light switch.
11,066 Western Electric Co. Electric wave filters. (15.7.15. U.S.)
11,072 Siemens-Schuckertwerke. Conversion of pulsating currents. (15.11.15. Germany.)
11,078 Law (Smith). Storage batteries.
11,080 Igranic Electric Co. & Bergmann. Relays.
11,111 Sullivan. Duplex telegraphy, &c.
11,117 Zehunder & Sohne. Electro-magnetically fixing work pieces.

April 22.

11,161 Lindley. Electric fog signalling apparatus.
11,165 Neale. Electro-magnets.
11,182 B. T.-H. Co., Clough, Warren & Young. Magneto-electric machines.
11,183 B. T.-H. Co. & Young. Electric signalling devices.
11,184 B. T.-H. Co. & Martin. Electric ship propulsion.
11,191 Rose. Electric machines.
11,198 Rushmares, Ltd., & Naylor. Secondary batteries.
11,239 Igranic Electric Co. (Cutler Hammer Co.). Utilising an electric current to produce a modified current or magnetic flux.
11,240 Igranic Electric Co. (Cutler Hammer Co.). Utilising an alternating current of a given frequency to produce alternating current or magnetic flux of a different frequency.
11,241 Igranic Electric Co. (Cutler Hammer Co.). Electrical discharge.
11,242 Igranic Electric Co. (Cutler Hammer Co.). Electro ionic relays.
11,243 Igranic Electric Co. (Cutler Hammer Co.). Vapour arc devices.

April 23.

11,255 Sanders. Electrical double-pole switching plug.
11,277 Dictagraph Products Corporation. Telephone sets. (21.8.17. U.S.)
11,278 Crowther, Grenfell, Erskine-Murray & Robinson. Radio navigational systems.
11,311 Chandler. Wireless direction finding apparatus.
11,312 & 11,313 Chandler & Robinson. Electro-magnetic wave receiving systems.
11,345 Jambert. Systems for supplying energy to electrical circuits. (7/3/19. France.)

April 24.

11,401 B. T.-H. Co. (G. E. Co.). Electric protective devices.
11,413 Evans. Machine for winding and shaping armature coils.
11,436 Sullivan. Duplex, &c., telegraphic systems.
11,445 Hague. Apparatus for remagnetising magnetos.

Companies' Reports, &c.

The Submarine Cables Trust notify that the coupons due on the 15th inst. will be paid by Messrs. Glyn, Mills & Company, 67, Lombard-street, E.C. 3.

The directors of the United River Plate Telephone Company, Ltd., have declared an interim dividend at the rate of 6 per cent. (3s. per share) on the ordinary shares for the past half-year.

The Eastern Telegraph Company, Ltd., announce the payment by warrants on Nov. 1 of interest for the half-year ending Oct. 30 on their 4 per cent. mortgage debenture stock. The transfer books of the stock will be closed from Oct. 27 to 30 inst. inclusive.

The report of the directors of the Direct United States Cable Company, Ltd., for year ended March 31 last has been delayed pending conclusion of negotiations in regard to the company's cable. A total income of £55,292 was received during the year, but in view of the heavy expense of maintaining the cables and the necessity of providing for the costs of the action against the Western Union Telegraph Company, the directors are unable to recommend payment of a dividend for the year. They have, however, declared a dividend at the rate of 4 per cent. per annum for the six months ended Sept. 30, 1920. The cost of maintaining the cables for the year amounted to £89,210, and of this sum £62,590 represented the cost of the "Faraday" expedition to repair the main cable in May, June and July, 1919. In recognition of his services to the company as manager and secretary, the directors have elected Mr. William Miles, O.B.E., to a seat on the board.

In a circular accompanying the report it is stated that the negotiations with the Western Union Telegraph Company for a continuance of the lease of the cable were unsuccessful, but an offer has been received from H.M. Government for the purchase of the company's undertaking, and the directors recommend its acceptance.

The board have resolved upon payment of an interim dividend of 4s. per share (less tax), being at rate of 4 per cent. per annum for the six months ending Sept. 30, 1920.

At the recent meeting of the Cordoba Light, Power & Traction Company, Ltd., the chairman (Sir George A. Touche, Bart.) said it was proposed to elect Mr. A. C. Whitmee to fill the vacancy on the board created by the death of Mr. T. N. Vail. The importance of the San Roque lake was accentuated now that fuel prices had risen to such an alarming extent. From that lake they derived all their water for the generation of electric current, but they maintained, in accordance with the concession, a reserve steam-power station for use in case of emergency. Although there was no drought during the year they had been obliged to put their steam station into operation frequently, and the resulting loss would have been avoided had the regulation of the overflow of the water from the dam been arranged with more regard for the company's requirements. It was gratifying to know that the Provincial Legislature had under consideration measures for raising the dam.

During the year the gross receipts of the combined businesses were £200,635, an increase of 18 per cent. over those for 1919 and of 26 per cent. over those for 1914. The improvement was being more than maintained in the current year. The tramway figures showed a considerable increase over those of the previous year, in spite of the strike. They had acquired the only other tramway system in the city, and when they had electrified a portion of it, it should prove a useful addition to their system. In regard to the Light & Power Company, there was no dearth of new business offering, and the expansion of late had been remarkable, but extensions which under pre-war conditions would have been satisfactory, were no longer attractive owing to increased cost. At present some consumers were actually paying less than the present cost of the service, and that could not be continued. As regarded the tramways, there were many points under discussion with the Council.

Arrangements for the Week.

FRIDAY, October 15th.

Royal Society of Arts : Indian Section.

4.30 *p.m.* At John-street, Adelphi, London, W.C. Paper on "British Trade with India," by Mr. T. M. Ainscough, O.B.E.

Institute of Metals, Sheffield Branch.

7.30 *p.m.* At the Mappin Hall, Sheffield University, St. George's-square, Sheffield. Paper on "The Development of Non-Ferrous Research," by Mr. E. A. Smith.

Junior Institution of Engineers.

8 *p.m.* At 39, Victoria-street, London, S.W. Lecturette on "Elementary Physics and Chemistry in Relation to Motor Cars," by Mr. R. S. Fox.

MONDAY. October 18th.

Batti-Wallah's Society.

1 *p.m.* At the Holborn Restaurant, London, W.C. Lunch.

The Institution of Electrical Engineers.—Western Centre.

7 *p.m.* At the South Wales Institute of Engineers, Park-place, Cardiff. Ninth Annual Meeting and 36th Ordinary General Meeting.

FRIDAY, October 22nd.

Institution of Mechanical Engineers.

6 *p.m.* At Storey's-gate, St. James's Park, London, S.W. Presidential Address by Capt. H. Riall Sankey.

Junior Institution of Engineers.

8 *p.m.* At Caxton Hall, Westminster, London, S.W. Lecturette on "Impulse Turbines," by Mr. A. H. Fitt.

Forty Years Ago.

(The Electrician, October 16, 1880.)

St. Michael's Church, Cornhill.—The income of this church is estimated at £3,000 a year. The prodigality of the expenditure may be estimated from the statement that, in order to give the organist complete control over the choir, electric communication has been made from his seat on one side of the church to the organ on the other.

Submarine Telegraphs.—Seventy miles of submarine cable for the repair of the West India and Panama telegraph was despatched from the works of Mr. Henley, North Woolwich, on Tuesday, in the telegraph ship "Duchess of Marlborough." She will be joined at St. Thomas by the company's ship "Grappler," and they will proceed together to find the fault which has suspended communication and repair it. In several recent instances in which repairs of this description have become requisite it has been found that the cable has been deliberately cut, and it is said to be the custom of ship's crews when their anchor foul and drag up the cable to set themselves free with a blow of the hatchet rather than take the trouble of rigging up the tackle necessary to lift the cable over the fluke of the anchor. The Peterhead and Denmark telegraph cable, which was recently found severed in this way, was otherwise as sound as when it was laid down 17 years since.

The Postal Telegraph Department.—We make the following extracts from an article in the "Pall Mall" on "Administrative Reform : the Rearrangement of the Estimates":—There ought to be no hesitation in separating the cost of the Post Office and of the telegraphs from that of the Civil Service and the other revenue departments. The public ought to receive in the case both of the Post Office and of the telegraphs the same information which every railway company supplies to its shareholders. In the case of the Post Office, indeed, there is, happily, no capital account; but in the case of telegraphs there ought to be a distinct capital account and a distinct account of revenue and expenditure. The charge of the telegraph debt should be transferred to this account, and if, unfortunately, the profits of the telegraphs should be insufficient to meet all the charges of the Department, there should be an account, similar to that adopted by the Indian guaranteed railways, of the advances made from the Exchequer for the purpose of supplying the deficiency. . . . . It may, perhaps, be objected that the recommendations which have thus been made involve no real economies. They only suggest certain transfers of charges. But the first advance towards economical reform should probably be made by effecting transfers of this character. If the Postal and Telegraph Departments are required annually to produce an account showing their gross cost, their net revenue and their estimated expenditure, the persons responsible for the administration of these departments will have a very different inducement to that which they feel now to economise their outlay. And this result will be further secured by compelling the Postmaster-General to make an annual statement in Committee similar to that which is always now made by the Secretary of State for War and the First Lord of the Admiralty. A regular debate will in this way occur on the estimated expenditure of the Post Office and of the Telegraph Department; and the Postmaster-General will have personally to defend his proposals, just as the heads of the War Office and of the Admiralty have now to defend their own estimates.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics."—"Prizes, Official and Private"; and "Mail Transport," by Major P. L. Holmes.

"The Cabinet Maker."—"The Vindication of the Trade"; "Old Furniture and Environment"; and "Commercial Motors and the Furniture Industry."

"The Chemical Age."—"The Concentration of Sulphuric Acid," by S. J. Tungay; "Present Day Methods for the Manufacture of Hydrogen"; "A Critical Analysis of the Four Leading Processes."

"Farm and Home."—"Increasing the World's Wheat Yield" (special article); "The Lincoln Tractor Trials" (supplementary report); and "The Value of Whey," by A. H. Murray.

"The Fruit-Grower."—"Apple Packing and Grading"; Wisbech Fruit Show Arrangements (illustrated); and "Railway Rates Inquiry."

"Gardening Illustrated."—"Potato Disease: Cutting off Haulm"; "Planting Evergreens"; and "May Flowering Tulips" (illustrated).

"The Gas World."—"The Truth about the Multi-cooker," by W. M. Mason; "Discussion on the Distribution of Gas"; "Regulation of Water Gas Plants."

"Hardware Trade Journal."—"Railway Rates for Light Castings"; "The Financial Status of Overseas Traders"; and "The Electric Lighting of Shop Windows."

"Ways and Means."—"Trade Unions and the Law," by J. Scott Duckers; "The Excess Profits Duty," by the Editor; and "An Open Door," by Miss Evelyn Miller.

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Notes.

The Coal Strike.

THERE will be something like relief in many sections of the industry that the coal strike has come at last, and that the long game of bluff, talk and negotiation has given place to something definite. For during the past few weeks trade has been falling steadily and strike conditions have been reproduced without the presence of that sense of duty and self-restraint which influences the public at such times. It is unnecessary to recapitulate the history of the dispute. It will be sufficient to say that up to the last moment there was a general optimism that settlement would be reached, and that finally, much to the astonishment of large sections of the miners themselves, a strike was called on an authority that had been given for quite a different issue. Astonishment is also the prevailing feeling of the public, so much so that the general expectation is that mediators will soon step in, and that by the time these lines are published the men will be back at work. To think thus is to misread all signs and portents. There is no more prospect of either side receding from the attitude they have taken up than there was a week ago. The Government have assumed a position from which they cannot retreat without irreparable loss of prestige, and unless the miners' leaders can secure some wages advance their days of leadership are over. There is, therefore, a conspicuous lack of the conciliatory spirit, and the one chance of agreement before the stoppage has shaken the industry of this country to its foundations seems to lie in the investigation of all the points at issue by an independent tribunal. To be of any lasting use, however, the decisions of such a body would have to be respected and its stipulations loyally carried out by both sides. This should be the easier, as both sides now seem to recognise the necessity for higher output as a condition of more wages.

Automatic Telephone Progress.

IT is a pleasant custom, followed by both the technical and lay Press, periodically to call attention to the shortcomings of the Post Office methods of managing the Nation's telephones. While admitting there is something in these charges we are equally certain, as we tried to show in these columns a week or two ago, that the Engineering Department of the Post Office, when judged by their record during the past few years, can hardly be found guilty of a wholesale neglect of their opportunities for improvement. On the contrary, they have done a great deal with circumstances very much against them. A recent charge (in which we ourselves joined) was that they had failed to employ automatic telephony to the extent that our present knowledge of that method of working warrants. As will be seen by an article which we publish on another page of this issue this charge also to some extent fails, for it has now been decided to erect an automatic exchange in London at an early date. This exchange, which will have an initial capacity of 3,500 lines, will be worked on a system devised by the Western Electric Company. This system, though it has not so far been employed in this country, has been widely used in America and includes some interesting features.

The Difficulties of Change Over.

THE introduction of automatic telephony into an area where the manual system is already largely used is attended with some difficulty, and this in itself makes progress in the use of the new method of working slow. There is first of all the education of the subscriber, a point which has not always been sufficiently emphasised. There are also the numerous problems of organisation connected with exchange and trunking lay out. These are complicated by the fact that with the ordinary automatic system the trunking scheme is conditioned by the numbering arrangements, and must preferably be laid out so that any future modifications in it are reduced to a minimum. This is due to the fact that the name of the exchange forms part of the calling code, indicating the level on the switches to which the junction circuits are permanently connected. In the panel system this disability has been overcome. Another point of importance is that an automatic system introduced, as this will be, into the middle of a manually operated area, must not have the effect of reducing the efficiency of the system as a whole by failing to meet tariff conditions and causing more complications than it avoids. These questions have received full consideration from those concerned, and have been solved in a way which should make the change over from manual to semi-automatic and from semi-automatic to full automatic as easy as possible.

The Future of Telephony.

THE panel system is very similar to the original automatic system of the Western Electric Company now in use at Dudley and Darlington. It differs in the fact that the banks are in form of vertical panels instead of having the circular arc-form, and in various small modifications in the general design of the equipment which this change necessitates. Although for the causes already mentioned progress must be slow, this is no reason for failing to investigate all the phenomena which allow and prevent satisfactory working. We are therefore glad to learn that the Research Branch of the Post Office Engineering Department is to be largely extended and to be accommodated in a new building at Dollis Hill, where a special staff will be engaged in telephonic investigations. In fact, so urgent is this work considered that it is to be begun in Army huts pending the erection of the permanent buildings. We feel sure the results of this enterprise will be extremely satisfactory.

Gas and Housing Schemes

THE report in the "Gas World" of the half-yearly meeting of the Eastern Counties Gas Managers' Association indicates the anxiety that is being felt regarding the effect of the new housing schemes on the supply of gas for domestic purposes. Complaint was made by Mr. JOHN TERRACE in his paper on "Gas Supplies for Housing Schemes" that local authorities were inclined to favour electricity for lighting; and a protest was made against the slackness of permitting a house to be built without it being piped for gas, as "the gas consumption on a cooker would surely yield a better return on the capital expended than the revenue obtained from, say, three electric lighting points." In the discussion it was pointed out that for local authorities to insist on electric lighting was "unfair competition," that to install electric lighting in such houses as the housing schemes dealt with would cost £20, while gas for all purposes "would cost less," the price being estimated by another speaker as £9, and still a third acknowledged that local authorities thought gas retrograde. What a change there has been in a few years from the superciliousness of 1913 to the misgivings of 1920! It is noticeable everywhere, even in the ranks of the B.C.G.A. It would be amusing, if it were not rather sad.

Electricity and Housing Schemes.

MEANWHILE the development of electricity in connection with housing schemes is going ahead. An interesting example of this is to be found at Billingham, near Stockton-on-Tees, where a number of houses have been erected by the Newcastle-upon-Tyne Electric Supply Company for the use of the employees at the North Tees Power Station. Care has been taken in laying out and planning these houses to comply with the most modern ideas on the subject, and we may emphasise the fact that electricity is to be used for all domestic purposes save for one concession to tradition—a coal fire is to be fitted in the sitting room for fulfilling the dual role of providing comfort, and, what is almost synonymous, a supply of hot water. The remainder of the rooms are electrically heated, and all are so lighted and ventilated. The estimated consumption of the houses is 3,780 and 3,480 units per annum according to size, and actual tests have shown that a meal for six persons can be cooked for 5·27 units. The Newcastle Company are to be congratulated on thus providing a means for obtaining some interesting data on the cost and behaviour of electric cooking apparatus. The collection of such data is most important, and for this reason we should like to see at least one "all electric" house in each area. The days of "secret diplomacy," at least in domestic electricity, have gone, and we have nothing to gain and a great deal to lose by not publishing true working results obtained from actual experience. It is the only way to kill the bogey that electricity is "so expensive!"

Electricity and Hiring.

GAS engineers will be the first to admit that their domestic business would not have reached its present pitch of prosperity had it not been for the ease with which the necessary apparatus could be cheaply hired by the consumer. Equally the development of domestic electricity has suffered from inability to do business in the same way. We, therefore, hope that the hiring powers now given to every electricity undertaking by the Electricity (Supply) Act of 1919 will be used in the way which gas practice has shown to be beneficial. There is no need to spend a great deal of capital, for in electricity at any rate to-day is the day of small things, and the hire at judicious charges of fires, irons, and the less extensive cooking articles will help the domestic electric education of the public along most satisfactory lines.

The Frequency Problem.

ONE of the results of the way in which electricity supply has grown up in this country is the surprising variety of systems, voltages and frequencies that are now employed. As is well known, this variety was encouraged by those responsible for the inauguration of the undertakings, but engineers who ought to have known better seemingly enter into the idea of exclusiveness with zest, and with the determination at least to use some voltage and frequency which were not employed by anyone in the immediate district. How true this is, a perusal of THE ELECTRICIAN Tables of Electricity Supply indicate. They show that while 223 undertakings have a frequency of 50, 24 have a frequency of 40, 19 a frequency of 100, 17 a frequency of 25, though this does not include a number of traction stations, and 17 a frequency of 60. In addition, there are a number of freak frequencies. For instance, three undertakings rejoice in a frequency of 83, the same number in 80. Frequencies of 89, 90 each have two representatives, while 93, 77, 75, 70, 33 and, most astonishingly, 67·5 have one representative each. Such a variety is an obvious obstacle to linking up and the supply of large areas in capital stations. Fortunately the effect of this obstacle has been mitigated to some extent by the standardisation some years ago by the Board of Trade of 25 and 50 as frequencies, except on the North-East Coast, where 40 was standardised.

Future Policy.

IT would therefore seem that in the large majority of districts except on the north-east coast, and perhaps in the south Midlands and in the West of Scotland, where frequency of 25 has a certain popularity, it would be best to standardise 50 as a national frequency. The only objection to doing this is the increase in the traction load which we may expect in the near future; but, as far as questions of supply are concerned, traction will have to be dealt with to a certain extent separately, and will continue so to be dealt with, unless our designers can produce equipment which will operate as well at a high frequency as the present traction motor does at the lower. This standard of frequency is a question of great technical importance to which the Electricity Commissioners must soon give close attention. It is interesting to note that a referendum taken on this point in the United States shows that the most popular frequency is 60, and a suggestion has been made that this should be standardised, not only because it predominates to a large degree, but it is probably better suited to general power requirements than any other. There are, of course, no great advantages between 50 and 60, and the great point is that some standard should be fixed. In connection with this question, it is interesting to note that a deputation of American engineers who recently visited France suggested the adoption of 50 as a standard frequency, with a possible use of 25 on long-distance transmission lines, owing to its great ease of regulation. As we said last week some early decision on this point is highly desirable.

Electric Vehicle Progress.

The Commercial Motor Exhibition, to which we referred briefly in our last issue, although containing a representative exhibit of electric vehicles, shows that the progress that is being effected is humdrum rather than spectacular. It is, however, none the worse for that; and the only person likely to suffer from this state of affairs is the journalist on the look out for copy. At the same time we are glad to see opportunity has been taken to make improvements in both the chassis and body design, due no doubt to the wider running experience that has recently been obtained, and that there is an indication that the electric vehicle is finding an ever-increasing market. While we expect that this development will continue it must be pointed out that there is a danger in claiming too much for this class of road transport. The electric vehicle has its own field in which it could be much more employed than it is at present, and it is worse than useless pretending it can be used for all and every purpose. On the other hand, it need not be saddled with disadvantages which it does not possess. To say, as was said in a recent article in a contemporary, that it had a limited radius of action, excessive dead weight, low speed and required time for expensive charging, is to fail to realise its true scope and to try to make out that it is suitable for work to which it has never made a claim.

Progress in Electric Lighting.

Quite a number of discussions on industrial lighting have appeared recently, the latest being the address delivered by Mr. Leon Gaster before the Association of Engineers-in-Charge last week. Mr. Gaster pointed out the great advances that had been made in this and other fields since he last read a Paper before the Association in 1907, at a time when the formation of the Illuminating Engineering Society was still under discussion. Events since that time, as the audience recognised, have fulfilled Mr. Gaster's expectations, and industrial lighting offers a good instance of the change in the point of view from which lighting problems are now regarded. Apart from the improved knowledge gained on the technical problems of factory lighting, managers of works now regard proposals for obtaining better illumination much more sympathetically. We have little doubt that if, as is anticipated, statutory provisions for adequate lighting are introduced into the Factory Acts, they will be well received. Both Mr. Gaster and Mr. Haydn Harrison, who presided, urged that engineers in charge are in a position to obtain much valuable information on the lighting of factories. They have exceptional opportunities for judging the performance of lamps in practice, they could often report cases of accidents or faulty work due to inadequate lighting, and their practical experience would be useful in suggesting how particular classes of machines ought to be lighted. The general trend of the Paper showed that a modification in the acceptance of "overhead general lighting" as the fundamental method of lighting factories is taking place. Doubtless this method marks an advance on the older system of using a forest of lamps suspended at a low level, and often exposed in the field of view. But there are many machines which require supplementary local lighting as well, and in many cases, textile machinery for instance, the best method of arranging such local lights has not yet been satisfactorily determined. Generally speaking, designers of machinery are apt to overlook the fact that they have to be lighted artificially. In time to come, it is possible that they will make special provision for the approved form of artificial lighting in the design, in the same manner as they already incorporate safety guards in many cases.

Maximum and Minimum Supply Charges.

Applications continue to be made with painful frequency for authority to increase the charges for electrical energy, and in view of the present dark outlook as regards coal, and in consequence of the recent revision of the salaries of the technical staffs, the repeated demands for higher wages by workmen and other causes it is probable that these applications will continue until more settled conditions prevail. It is, therefore, essential that every effort should be made to stabilise the position, for these frequent increases of tariffs greatly militate against that extension of electric supply which is so important for industry and so desirable for the comfort and convenience of the general community. On the whole the Electricity Commissioners appear to take a reasonable view of this matter, as in recent orders the maximum charge allowed represents an increase of only about 50 per cent. over the figures in pre-war provisional orders. For instance, the maximum in the Sevenoaks order is now 1s., and in Dorchester and Montrose 10d. a unit. As we noted some time age the principle of the minimum charge has also been reintroduced, for at Sevenoaks the Company may charge up to 15s. for 15 units in each of the two winter quarters, and 10s. for ten units in each of the two remaining quarters. At Dorchester and Montrose the corresponding minima are 12s. 6d. and 8s. 4d. There has always been considerable opposition to the application of the minimum charge, and owing to its unpopularity there were, at the outbreak of war, very few supply authorities which availed themselves of the right to insist upon this payment. The difficulties created by the war, however, compelled a number of undertakers to increase their charges and to revert to the earlier practice of demanding a minimum for a supply service. Though very unpopular, it is essentially just to insist upon such a return upon outlay as will cover the works costs and the capital charges involved, but whether even now it is the best policy is open to question.

Maximum Charges and Dividends.

Another debatable point has arisen in connection with the maximum charge for supply. It is generally admitted that there is an economic limit beyond which it is useless to go, but the question is, what is this limit? In our opinion, this must depend upon the district and upon local circumstances. A good many, however, believe that 1s. a unit is as much as consumers can be expected to pay, but other well-known authorities, such as Mr. W. L. Madgen and Mr. F. E. Gripper, appear to think that there is no difficulty in getting more than a shilling a unit, which is the highest rate approved by the Electricity Commissioners, and all supply companies were urged, at the recent meeting of the Provincial Electric Supply Committee, to endeavour to get such a rate put into force. We do not think the policy of getting as much as consumers can be induced to pay is the right one; it may succeed for a time while industrial conditions are unsettled, but it is not calculated to encourage consumers to extend the applications of electricity or to popularise its use for domestic and industrial purposes. We think, however, that every supply company is entitled to a reasonable return upon its capital outlay, and for this reason it is a pure mockery to provide (as the Sevenoaks and the Dorchester orders do) that "the company *may*, during the continuance of this Order, pay a dividend on the ordinary stock or shares at a rate of not more than three-quarters of the pre-war rate of dividend," when, as a matter of fact, there never has been any ordinary dividend. It is not clear whether the average pre-war or the highest dividend paid in any one year is meant, but whichever it be the North of Scotland Electric Light & Power Company, which owns the Montrose electricity works, cannot pay under the Order more than about 2½ per cent., which is quite an inadequate return upon capital in these days. The Minister of Transport can easily provide a remedy by introducing a short Bill to deal with the question, just as he did in the case of the tramways earlier in the year, and we would urge him to do so at the earliest possible moment. We refer to another phase of this important question in our Leading Article.

Breach of Factory Regulations.

There are apparently still a few of the older generating stations where the switchboard arrangements do not comply with the Home Office Regulations. It will be remembered that the regulations governing operations on switchboards came into force on January 1, 1909, and we should, therefore, have thought that all supply authorities were fully acquainted with them by now. The proceedings against Plymouth Corporation Electricity Department last week, however, disclosed not only a breach of Regulation 18 of the Home Office Code, but a somewhat lax method of cleaning the switchboard and general ignorance of the Regulations. It may be pointed out that to comply with the Regulation it would be necessary to install additional apparatus or to make the switchboard dead for half an hour. The first alternative, of course, means considerable expense, and the second would no doubt be awkward for the consumers as they would be deprived of supply for a short time. It appears that at Plymouth the method was for a semi-skilled man to stand on a chair, which was placed on a table, and from this acrobatic position to clean the insulators with a wiper fixed on the end of a stick. It is not surprising, therefore, to learn that an accident occurred and that the prosecution of the Corporation followed. Fortunately, these breaches of the Regulations are very rare, but Mr. Scott Ram, H.M. Electrical Inspector of Factories, pointed out the practice adopted was a very dangerous one, for even a skilled man in such a position might easily slip or some other accident might happen. No doubt the switchboard arrangements at Plymouth would have been modernised long ago but for the war. No avoidable risk should, however, be incurred in the generation or supply of electricity, and we think the time has come when nothing of a risk character, more especially when a remedy can be readily found as in the present instance, should be tolerated in station practice.

Undeveloped Provisional Orders.

Many provisional electric lighting orders and special Acts granted prior to the war were allowed to remain in abeyance for one reason or another. They might, however, very well be put into force now, especially in cases where a bulk supply of electricity could be obtained without much difficulty. We therefore welcome the decision of the Ministry of Transport not to grant the Deal & Walmer Gas & Electricity Company any further extension of time for putting their electricity powers into force, unless arrangements are made forthwith to take a supply of electricity in bulk from a neighbouring colliery or other suitable source. It may be noted that under its Act of 1914 the company obtained authority to supply electricity in Deal, Walmer and in Ringwould. Though several extensions of time have already been granted, no definite steps have been taken to establish a generating station or to obtain a supply in bulk, but no doubt a supply will now be obtained from the East Kent Colliery Company. It is pretty obvious why nothing has been done, and it is high time this dog-in-the-manger policy was checked. Stone is another instance of the right to supply electricity being granted to the local gas company without any effort being made either to establish works or to obtain a bulk supply. We could cite other instances of this abuse of Parliamentary powers, and we think the time has now come when the Electricity Commissioners should inquire into the true facts of each and either insist upon a supply being given within a reasonable time or refuse to grant any further extension of time.

The Idolatry of Science.

When science, particularly in its applied manifestations, is the subject of so much lip-worship, it is refreshing to come across an instance of a frank objection to its achievements and a denial of its services to humanity. This is provided by Mr. Stephen Coleridge in a recent article, "The Idolatry of Science." He thinks that travelling by train has not added to the pleasures of life, and that the telephone has doubled its sorrows. He protests against the strain and stress of modern times, and sighs for the greater leisure, simplicity and freedom of thought of byegone days. This outlook is not infrequently met with in representatives of a passing age. The period that is passing is always the best. Well, it is always open to those who hold such views to refuse the so-called benefits of science. By exercising ingenuity, a man may abstain from the use of railways and cut himself adrift from telephones and still live. But we are inclined to believe that the impression that each age involves more strain and stress than its predecessor is largely a fallacy. If people execute work more rapidly now, they still do it, on the whole, in greater comfort, with less effort, and for shorter periods than their ancestors. In the days of Dickens, which to some are the most delectable period, hours of work were very much longer than to-day, and the working classes had certainly far fewer opportunities of leisure, culture or refinement. In any case, Science has always one strong position to fall back upon—her gifts are her own, their consequences what men make them. We have just passed through a period during which the world has been straining the resources of science to the utmost for purposes of destruction; even in times of peace the gifts of science are largely misused and frittered away. We still hold, however, that in the main they prove for the benefit of mankind, and we look forward to a period when wisdom will keep pace with knowledge and their full advantage will be reaped.

The Newcomen Society.

A short time ago we called attention in these columns to the establishment of a society for the study of the history of engineering and technology. We are glad to hear that this Society, which readers of The Electrician will remember is known as the Newcomen Society, has now got past the obstacles which surround the birth of all such institutions, and has issued a statement of aims and objects which are not unworthy of study. It may be pointed out that the Society desires to be international in its scope, and that its primary object is to rescue the history of engineering from the neglect into which it has most unjustifiably fallen. Such a study is not only a proper tribute to the work of pioneers, but is of real educational value as a guidance of future progress. We are told to praise famous men. It would be better to study their work, and from their mistakes and success to mould a monument which shall be both a landmark and a guide to a new world.

A Word to the Wise.

There are already enough Jeremiahs in evidence to make further recruits to their ranks both unnecessary and undesirable. Nevertheless, we propose temporarily to join this mournful band, putting forward in defence the fact that while the original Jeremiah was a prophet, and therefore primarily concerned with the future, like others of his tribe he often found it convenient to draw attention to existing disabilities in order that he might emphasise how much worse matters would shortly be, if his advice were not taken.

The Decadence of the Small Undertaking.

There will be general agreement that the condition of many of the electricity undertakings in our smaller towns is deplorable. This condition is, perhaps, more evident when these undertakings are privately owned, though stagnation and bad finance are equally present in some of the municipally-owned concerns. The reasons for this are not far to seek. The increasing cost of fuel, material and labour and the pressure of other difficulties of a like kind connected with the generation of electricity on a small scale have all helped to call attention to the sandiness of the foundation on which many of these undertakings have been built and have forced those which are privately owned to look anxiously for a remedy which shall adjust the old balance between revenue and expenditure and bring the profits back at least to their pre-war figure, low though this often was. Statements at the recent annual meeting of the Provincial Electric Supply Committee indicate that it is believed a remedy has been found by increasing the rates, but we are very much afraid that the suggested specific will turn out only to be a patent medicine after all; and that it is not unlikely before long to exercise the deleterious effect on the system which usually follows the administration of quack nostrums. It must, however, in fairness be pointed out that the only difference between these small private companies and the equally small municipally-owned undertakings is that the latter are able to conceal their losses by resource to "rate aid" or by increasing the charges for street lighting in a way which is not open to their rivals. Both these are remedies whose ability to effect a permanent cure is as likely to be as elusive as the one we have just mentioned.

The Psychology of Disabilities.

We shall be told that thus to compare the municipally-owned with the privately-owned undertaking is to overstep the limits of fairness; that the companies have always worked under restrictions from which the municipalities have been free and that even now the policy of the Electricity Commissioners seems to be to grind the former still lower into the dust. We admit the disabilities and the weight of their deadening effect on enterprise, but we do not agree that they are entirely responsible for the present state of things. Or, perhaps, it would be better to qualify that remark by saying that the psychological effect of the restrictions has been as great, if not greater, than the financial and technical effects. Indeed, it might almost be said that the shadow of ultimate purchase has so effected the policy of the privately-owned electricity undertaking as to prevent the growth in them of any of that enterprise, foresight and desire for subsequent development which are the concomitants of commercial concern with the least claim to progressiveness. Even if we agree that in future it is the duty of the Electricity Commissioners to help the small electricity supply companies by the removal of disabilities and by the provision of capital on easy terms(and we have no doubt that all these matters are receiving the sympathetic consideration of that body) we must reiterate that assistance in whatever form it may come will not go to the root of the evil and that what is wanted is a new spirit in the management of these undertakings, the realisation that here is a field at their doors that will pay for development, and a determination that the *laisser aller* policy of the past shall be replaced by an *aller faire* policy in the future. This advice is equally applicable to many municipally-owned undertakings whose present lack of progressiveness is the more regrettable when we consider the easier conditions under which they have been working.

The Possibilities of the Impossible.

We shall be told that all this is impossible and that we do not understand the insuperable obstacles which prevent the carrying out of our suggestions. We reply that it is not impossible, for a beginning has already been made in developing at least one undertaking on the lines we have just laid down. On another page of this issue we describe what has been done in the small city of Hereford to increase the employment of electricity for all sorts of purposes, in supplying the needs of the surrounding agricultural districts and in realising that in increasing the domestic load along progressive lines lies the future of electricity supply. The supply industry should be grateful to Mr. Kerr for showing them what can be done in this direction. Whether they will be, of course, is quite another thing.

Irony and Truth.

The way in which Mr. Kerr has brought this state of things about shows that there is many a true word spoken in irony. For Mr. P. D. Tucket, addressing the annual meeting of the Provincial Electric Supply Committee, said "The companies would be happier as caterers with the supply business as a side line," and this is just what Mr. Kerr is finding in actual fact are the right lines upon which to work if electricity supply is to be developed in areas where a power load is not ready to hand and where something must be done, something new if need be, if stagnation is not to set in. Get farmers, housewives, domestic servants and everyone else, he advises, interested in electrically-operated churns, hair driers and irons; in a word go into the hardware and domestic business with electrical apparatus in the one hand and sympathy and determination in the other and there will be no difficulty in selling current both cheaply and abundantly. The difficulty will be to keep people from buying it.

The Fundamental Fact.

It is, we think, the inability to realise this fundamental fact that is the principal cause of the present condition of the majority of small electricity undertakings. Most of them, whether they be municipally or privately-owned, cling pathetically to the lighting load as their only salvation. And if their service suffers as the result their only remedy is to put up their prices. A most retrograde policy! Electric lighting in its present state of development is an excellent advertisement properly used and is a useful adjunct to other means of using current, but for a "bread butter" load, where owing to local conditions the possible power load is small, resource must be had to such an employment of electricity as Mr. Kerr has found so satisfactory. To develop this load means hard work, but the results are worth having as shown by the fact that in Hereford 100 units are consumed per annum per head of population.

We have said that it is highly desirable that such a scheme of development should be inaugurated in all small electricity undertakings. But to do this will require, we are afraid, in many cases, a change of spirit. Admitting all disabilities whether financial or technical that can be advanced as reasons for the small progress that has been made in certain districts we are still faced with the fact that the really great obstacle to electrical development in many quarters is the lack of belief on the part of manufacturers and contractors no less than of supply engineers in its possibilities for domestic purposes. To introduce belief in place of scepticism must, therefore, be our first task.

Automatic Telephone Progress.

Introduction of a New System into the City of London.

The Post Office authorities have for some time been studying the practicability of employing automatic telephones in very large cities, and particularly in London. It is generally admitted that an automatic telephone system, to be suitable for handling heavy traffic in a large city, must be capable of selecting an idle junction circuit from within a large group; and although most of the systems hitherto in common use have banks designed upon a fundamental group basis of relatively small dimensions—namely, 10 contacts—some device has generally been proposed for use in special cases with a view to combining a number of these small groups, and thus producing a large one. In most of the existing systems special additional apparatus has been suggested for the purpose; but this clearly tends to make the trunking system complex, under conditions which were already very severe, and under circumstances where simplification would have been an advantage. Further, the amount of apparatus and the complexity involved were such that the proposal could not be universally adopted, but was capable of restricted application only on special routes. The panel automatic system of the Western Electric Company, which is about to be tried in London, provides access, without special modification or accessories, to large groups of junction circuits (or trunks, as they are technically described); this produces a trunking scheme that is relatively simple. The panel system is not yet in use anywhere for full automatic service, but it has been well tested in America under semi-automatic conditions.

The Panel System.

The panel system possesses another outstanding feature of great importance—namely, flexibility of trunking. In the ordinary course of events the introduction of an automatic system involves a traffic study of the area, followed by the introduction of plant, in quantities and in distribution suitable for the conditions of the city, attention being paid, not only to the initial, but also to the ultimate, traffic conditions. Under these circumstances it is necessary at the outset to prepare a numbering scheme for the city as a whole in order that the junction circuits which link together the various exchanges may be selected by the dialling of specific code numbers. This numbering scheme is rigidly fixed, and is inseparable from the trunking scheme. It is difficult and inconvenient to alter the trunking scheme once it is designed, but modifications may frequently become necessary owing to the fact that under practical conditions it is unlikely that development studies, projected a number of years ahead, will remain accurate for any particular locality. The difficulty involved in modifying the numbering and trunking scheme follows from the fact that the subscribers' numbers which appear in the Directory must contain the junction code, and that code is the key to the level on the switches (located in the various exchanges) to which the junction circuits are permanently connected. In other words, the code has a rigid engineering significance, associating the trunking layout with the Directory, and it is a principle that alterations to the latter must be as infrequent and few as possible. With the Western Electric Company's panel system it is possible to keep the numbering scheme constant, although the trunking scheme may be modified drastically from time to time, as will be indicated later.

The Problem of Junction Layout.

Another consideration having great weight is the fact that, in laying out an automatic area upon a rigid numbering and trunking scheme, it is found in practice that the junction circuits under that scheme are very different in layout and distribution from those in use as part of the manual system which the automatic plant is designed to replace. It is very important, of course, that the transfer from manual to automatic working shall involve the minimum disturbance of external plant, and it is not too much to say that the Western Electric Company's panel system permits the introduction of automatic exchanges without any change in the number of junction circuits being necessitated. The importance of this facility will be recognised at once, and it is due partly to the fact that, whilst the system is designed to serve a trunking group numbering as much as 91 circuits, groups as small as 10 circuits can be worked economically where necessary. In addition, the fact that the numbering and trunking schemes are independent permits, where necessary, a wide range of traffic routing via "tandem" centres, as used in manual practice.

The Planning of an Automatic System.

The introduction of an automatic system into a large city must be planned so that it can take place in stages—*i.e.*, exchange by exchange. It is important also that the traffic facilities afforded by the automatic plant shall be such that during the process of introduction the mechanical system shall not have the effect of reducing the capacity or impairing the efficiency of that portion of the system which remains working on a manual basis. Although the adoption of machine switching may be expected to alter the conditions of telephony so that a simplification of tariffs may ultimately be realised, the system must at the outset be capable of meeting the complex tariff conditions that now exist.

It is also necessary that the conditions of operation in a large area shall remain simple and uniform so far as the subscribers are concerned, and with that object in view it is desirable that the Directory be planned so that it will be applicable to both automatic and manual subscribers, because in a large city both services will exist side by side for a long period. Whilst the automatic exchanges are being introduced it is desirable that a subscriber on an automatic exchange shall be placed in direct communication with any other subscriber in the local area without the necessity for speaking to an operator, even when the wanted party is connected to a manual exchange. To make this possible, it is proposed, in large cities such as London and New York, to fit all the automatic telephones with special dials, the finger holes of which correspond to letters as well as to figures in the manner illustrated in Fig. 1. The whole of the letters of the alphabet, with the exception of Q and Z, appear in finger holes 2 and 9 inclusive. The entries in the Directory will be printed as indicated in Fig. 2. So long as a subscriber is connected to a manual exchange, the Directory will be used in the ordinary way and no attention will be paid by him to the fact that the first three letters are printed in heavy capitals; but when he is transferred to an automatic exchange he will be told to call, say, Mayfair 2163, by dialling in addition to the subscriber's number, the first three letters of "Mayfair," thus, "**MAY** 2163." Of course, it will be recognised that the placing of letters in the dial is merely a convention for simplifying the subscriber's work, and that the mechanical operation results in the transmission of a numerical code; for instance, **MAY** 2163 is in reality 6292163. By the design of the panel type of automatic equipment it is possible and necessary to transform the numerical or traffic code 629 into an engineering code which is different, and is determined by the position that the junction circuits occupy in the selector bank or panel. If for traffic or other reasons

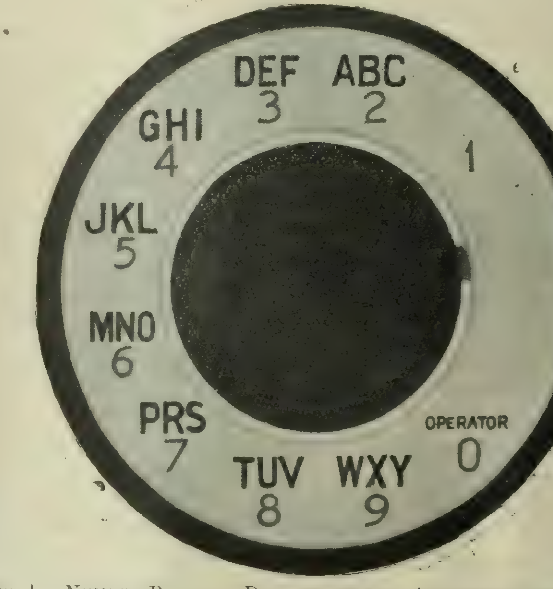

Fig. 1.—Number Plate of Dial for use on Automatic Telephones in large cities.

MAYfair	...	2163	Beath (A. J.) & Co., 6, Deans-square.
CENtral	...	7880	Beech (H.) & Co., 14, Bethlehem-street.
MIDland	...	8095	Beesley, J. C., 407, Abbey Park-road.
VICtoria	...	3836	Beeson, J., 18, Market-place.
NORthern	...	8101	Behrens, K., 8, Victoria-street.
SOUth	...	4914	Bell (T.) & Sons, 207, Victoria-street.
EAStern	...	0234	Benham (A.) & Co., 27, Cannon-street.

Fig. 2.—Specimen Telephone Directory Entries.

it is required to alter the position of the junction circuits, this will be done by a cross-connecting operation, and the transformation associated with the code **MAY** (or 629) will be suitably modified also by cross-connecting the "sender" equipment, so that the same group of junction circuits can be found in its new position when "**MAY**" is dialled by the automatic subscriber.

If Mayfair is an automatic exchange, the distant end of the junction circuits will terminate on automatic switches, which will respond to the digits 2163, and find the called line as described later.

"Automatic-Manual" Working.

When a subscriber on an automatic exchange makes a call to an exchange that is still working manually, he dials the exchange code and number as before, and the mechanical arrangements are such that the machine at the automatic exchange will connect him to an idle junction circuit outgoing to the manual exchange. This junction circuit will be associated in the usual way at the incoming end with a "B" operator's position, and the call, instead of being passed orally over an order wire to the "B" operator, as in ordinary manual practice, will be displayed visually on a special call indicator fitted on the "B" operator's keyboard.

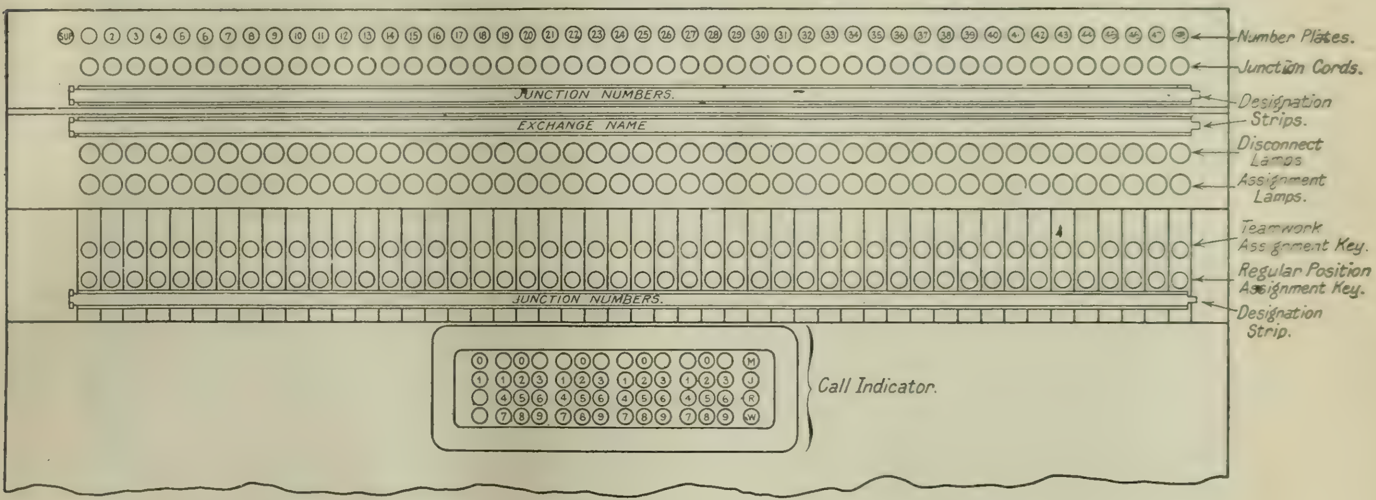

Fig. 3.—Keyboard Arrangement of Call Indicator, "B" Position.

This call indicator fitted in the keyboard contains a number of small lamps, and is equipped with a glass cover which is opaque, except for certain places where there are transparent outlines of figures, arranged in four groups as indicated in Fig. 4. When the call is received by the "B" operator, the four digits of the wanted number are shown by the glowing of the corresponding four lamps, which illuminate the relative compartments of the indicator giving a luminous outline of the transparent figures. Fig. 3[*] shows the keyboard arrangement of a call indicator "B" position. In the case of a call for 2163 the indicator would glow as shown in heavy type in Fig. 4. On receiving a call the first indication to the "B" operator is the glowing of a calling supervisory lamp on one of her junction cords. She then depresses an assignment key associated with that cord, and this connects the call indicator to the junction circuit, permitting the display of the wanted number. The "B" operator then "tests" in the ordinary way, and on inserting the plug into a jack the call indicator is released and thereby becomes available for the next call.

0 1 **2** 3 4 5 6 7 8 9	0 **1** 2 3 4 5 6 7 8 9	0 1 2 3 4 5 **6** 7 8 9	0 1 2 **3** 4 5 6 7 8 9

Fig. 4.—Arrangement of Call Indicator.

Call indicator "B" positions are expected to carry more traffic than a corresponding order wire "B" position, not merely because the visual signals are more definite and more orderly than the oral messages of an order wire, but also because team work as between "B" positions is made practicable by the provision of a "helping out" assignment key on each junction, thus enabling the adjacent operator to transfer a waiting call to her call indicator. When an automatic subscriber calls a manual subscriber the apparatus stores the impulses, so that the calls can reach the "B" operator in a systematic way; the "B" operator knows what traffic is waiting by the glowing cord circuit assignment lamps.

When a subscriber makes a call from a manual to an automatic exchange the alternative methods of operation are:—

(a) If the call is from a manual exchange, which has few positions and not a great volume of traffic to the automatic exchanges, the "A" operators' positions will be fitted with ordinary calling dials for use on the outgoing junctions.

(b) If the manual exchange is likely to remain in service as such for a long period and has many positions and a great volume of traffic to the automatic exchanges, a special high-speed keyboard equipment will be provided for the use of the "A" operators.

(c) If the manual exchange is similar in type to (b), except that it will shortly be transferred to automatic working, the provision of special equipment for the "A" operator is not justified, and the traffic will be transmitted by order wire to special "B" positions at the automatic exchange.

A few special "B" positions will be provided at all automatic exchanges for receiving traffic under category (c) above. These positions are known as cordless "B" positions, and consist of a plain desk without a multiple, equipped with supervisory lamps and keys for 60 incoming junctions. Each junction is extended to selector mechanism direct—*i.e.*, without the interpolation of plugs and cords—and the operator's keyboard is equipped with a press key

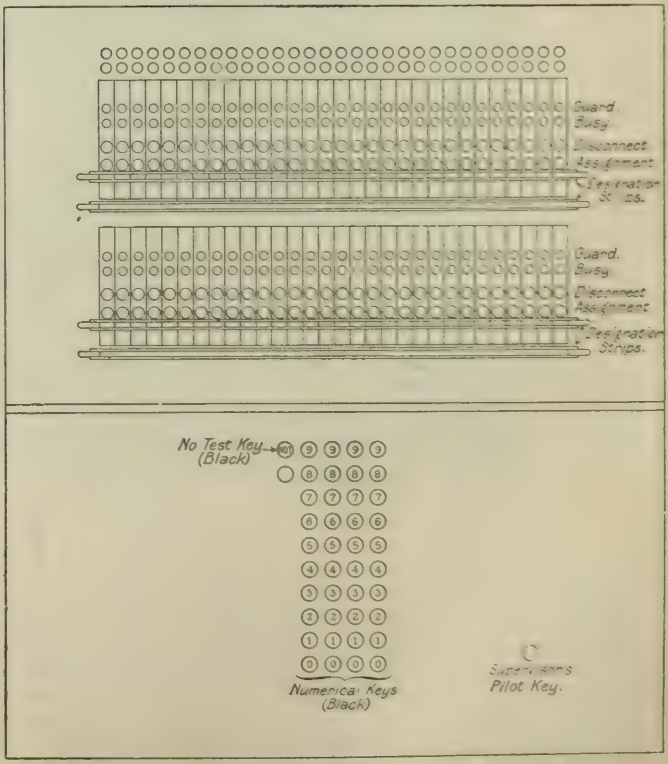

Fig. 5.—Cordless "B" Position.

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[*] The two single rows of lamps at the end of the call indicator are provided for special services outside the scope of this article.

calling set. Fig. 5 shows the arrangement of such a position. The "B" operator receives the call in the usual way on an order wire, and allots a junction after observing that it is free by the absence of glows on the supervisory lamps. She depresses an assignment key, which connects her keyboard calling set to the junction, and causes the back supervisory or "guard" lamp to glow. The operator sets up the call, say, 2163 by depressing the corresponding numerical keys. The guard lamp is then extinguished, and the "busy" lamp glows and remains glowing throughout the connection. At the termination of the call the "A" operator clears as usual on her cord circuit signals, and the withdrawal of the "A" plug from the junction gives the clear to the "B" operator by a flashing signal on both "guard" and "busy" lamps. The "B" operator then releases the selector by depressing the "disconnect" key.

Exchange Arrangements.

The Western Electric Company's "panel" automatic system is so named because the banks are constructed in the form of vertical panels instead of the circular arc form used on other systems. Each panel contains multiples of the tip, ring and sleeve contacts of 100 circuits. These circuits appear in numerical order vertically on the panel, and each circuit is multipled horizontally 30 times on each side of the panel, making 60 multiples in all. Five panels are placed on the same frame, so that each rack provides capacity for 500 circuits. The panel type of apparatus constructed in this manner will function either as a group selector or a final selector equipment.

The normal design of exchanges operating on the panel system is based upon a nominal capacity of 10,000 lines. Such an exchange would consequently require 20 final selector racks of 500 lines each to accommodate subscribers to its full capacity. Equipment is, of course, required in the same exchange to distribute originating and incoming calls to the appropriate final selector racks, and group selector apparatus used for this purpose is known as "incoming selector" equipment. Consequently, each exchange will require a number of incoming selector and final selector frames, the precise number of the former depending, of course, on traffic requirements.

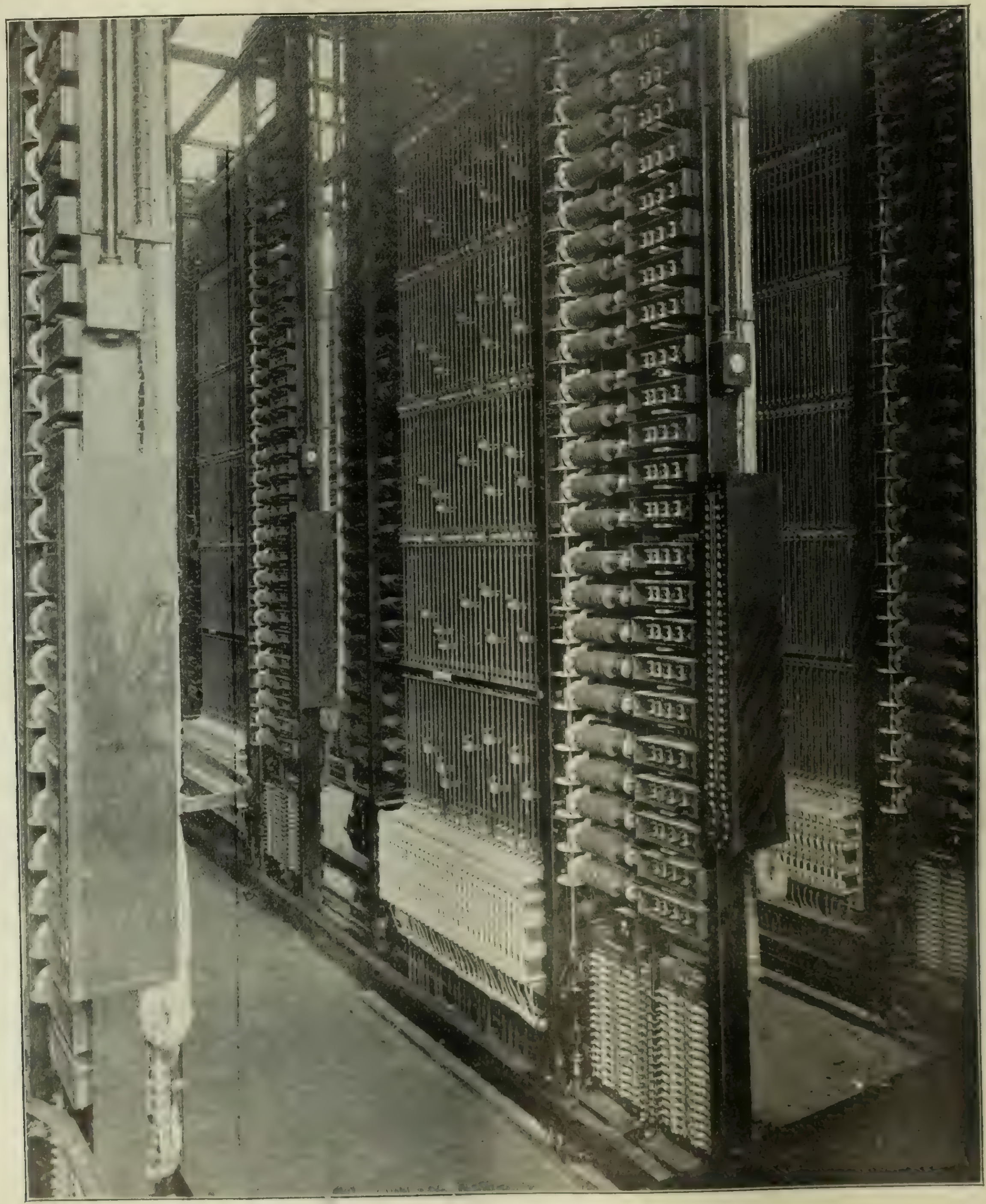

Fig. 6.—View of Selector Rack used in the Panel System.

Considering as a unit a 10,000 line exchange consisting of incoming and final selectors as described above, it is necessary to provide equipment for two other main functions. An originating subscriber must be provided with equipment to connect his calling line to the selective apparatus and the panel type switches used for this purpose are known as "line finders." The call having been connected to a line finder, it is necessary for connection to be made with apparatus that will distribute the call to the required exchange, including, of course, the special case in which the call does not leave the building, but is completed in the exchange where it originates. Switches provided for this purpose are known as "district selectors."

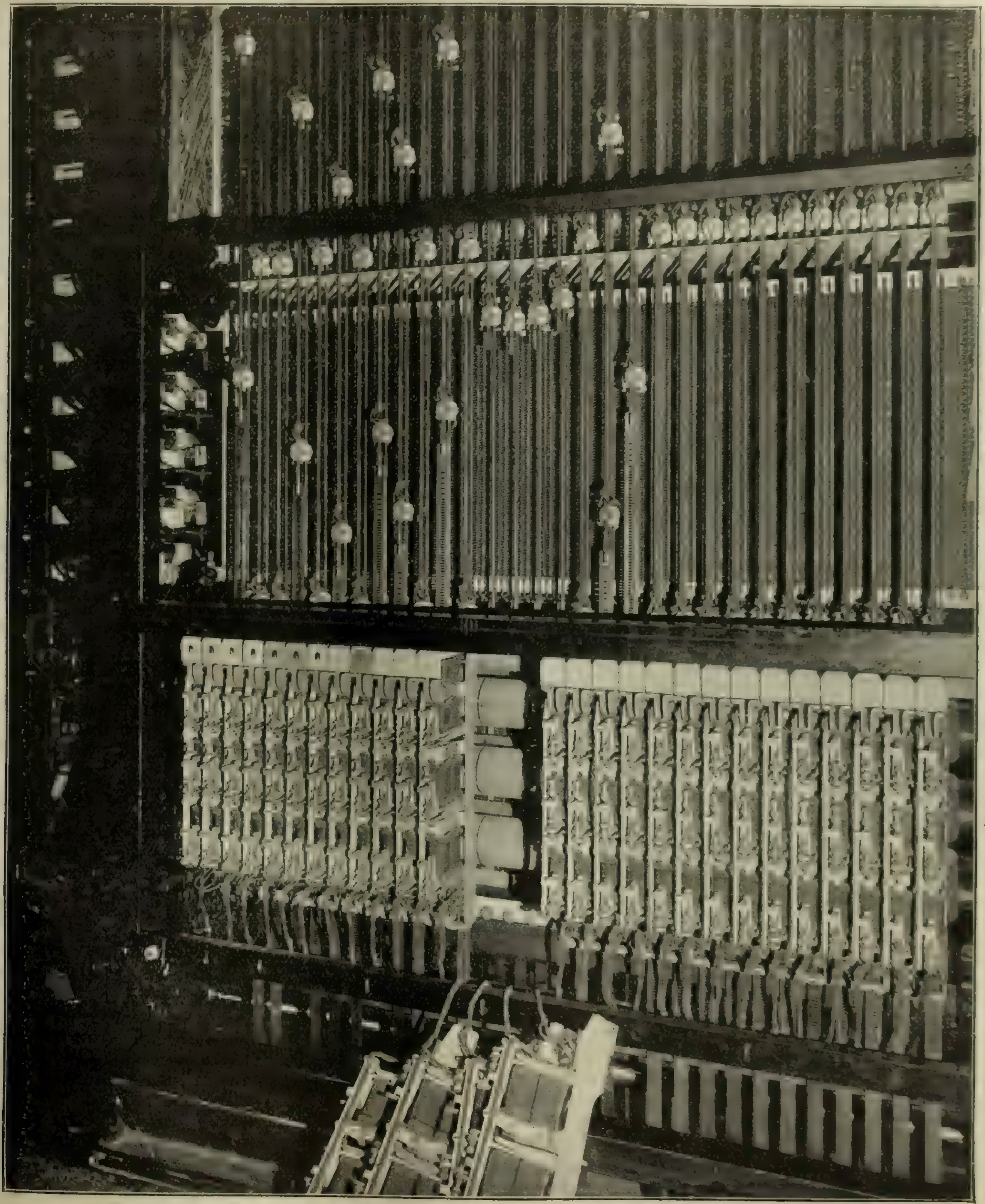

FIG. 7.—OPERATING MECHANISM OF SELECTOR RACK.

MAKING A CALL.

Fig. 8 shows in diagrammatic form the various types of apparatus and their inter-relation. The process of making a call is as follows: The subscriber lifts his receiver and listens until he hears a distinctive tone, known as the "dialling tone." This tone announces the fact that a line finder has been set in operation, has made connection in his calling line and at the same time has extended it to a district selector associated with which is a special switch known as a "sender selector." The sender selector at the same time automatically finds an idle sender, the functions of which are to accept the impulses from the calling subscriber, store them and translate them into a correct form for guiding the call to its destination. The subscriber hearing the tone now dials, say, "**MAY** 2136"; the operation of dialling is normal and well understood, and therefore needs no special explanation. The impulses having been stored on the sender, their transformation commences, and as a result the district selector operates until a selected brush makes contact with the bank, to which are connected the outgoing junction circuits to Mayfair. At the distant end the junction circuits are connected to incoming selectors. At this stage the impulses corresponding to "21" are transformed by the sender, so that the brushes of the incoming selector are guided to the junctions which serve the particular 500 line final group that contains, along with others, the subscribers whose numbers commence with the digits 21, and an idle line to this group having been found, the appropriate brush of the final selector is operated, so that connection can be made to subscribers in the 21st hundred group. The final stage of the connection is made by the brush taking a long step, so reaching the tens group corresponding to the digit "6" and a short step corresponding to the units digit "3." The bell of the called subscriber will at this stage be rung, if his line is disengaged, conversation will ensue, and when at the end of the conversation the originating subscriber restores his receiver to the hook, the whole of the switches that have been used in maintaining the connection will be restored to normal. The sender selector and the sender itself were released before the conversation commenced, that is as soon as the process of selection was completed.

In Fig. 8 it will be seen that there is a fifth type of switch, known as an "office selector." This has a similar function to a district selector, but is provided for miscellaneous services in cases where the district selector bank is not of sufficient capacity to accommodate the whole of the circuits necessary to carry the traffic efficiently.

It is not possible within the scope of this article to give full technical details of this interesting type of automatic equipment, but some idea of its appearance and operation can be obtained from the view of a rack which is given in Fig. 6. The panels "P" have in front of them a series of vertical rods or elevators, "E," extending from top to bottom of the rack. There are 60 such rods in a fully-equipped rack, 30 on each side. When a call reaches the rack it is associated with one of the elevators, the connection being made by means of sliding contacts on the commutator panel "C" fitted at the top of the rack. Each of the elevator circuits connection is multiplied five times to the five brushes with which each elevator is equipped, one brush being provided for each panel. According to the numbering scheme of the system, the brush proper to a particular panel will be thrown into contact with its bank by the action of a magnetic tripping device, the operation of which coincides with the preliminary steps of the elevator. As its name suggests, the elevator moves up and down in front of the panel as required. The distance that the brush travels depends upon the control exercised by the sender through the medium of the commutator, the well-known principle of reverted impulses being employed. Fig. 7 is an enlarged view of the lower part of the rack illustrated in Fig. 6, four of the clutch magnet sets having been removed to show the means adopted for converting the rotary motion of the driving motor into motion of translation of the elevator. *UF* is one of three steel rollers that are covered with cork and are kept in constant rotation by a driving motor. When a connection is made the clutch magnet M_2 is operated. The armature of M_2, by means of a wheel extension, presses the flat rack termination *R* of the elevator against the roller *UF*, and this drives the elevator upward. The slots of the rack are arranged to engage with a pawl, so that when the clutch magnet is de-energised the elevator will not fall. As stated above, the first operation is to trip the correct brush, thus giving access to the proper panel. This is done by the control of the commutator in conjunction with the five uppermost slots of the rack, each of these slots corresponding to a brush tripping position. After the correct brush has been tripped, the elevator proceeds, *UF* driving the elevator shaft until the brush reaches the correct tens group, when the clutch magnet of *UF* is switched out of circuit, and is replaced by M_1, which operates in conjunction with *US*, driving the elevator slowly and deliberately, so that the brush will engage with the correct units set of contacts. M_1 is then switched out of circuit and the rack is retained in position by the pawl. When the conversation is terminated, M_3 is brought into circuit, the pawl is withdrawn and the rack is pressed against the roller *DF*. This roller rotates in a direction opposed to that of the other two rollers, and the elevator is thereby restored to normal.

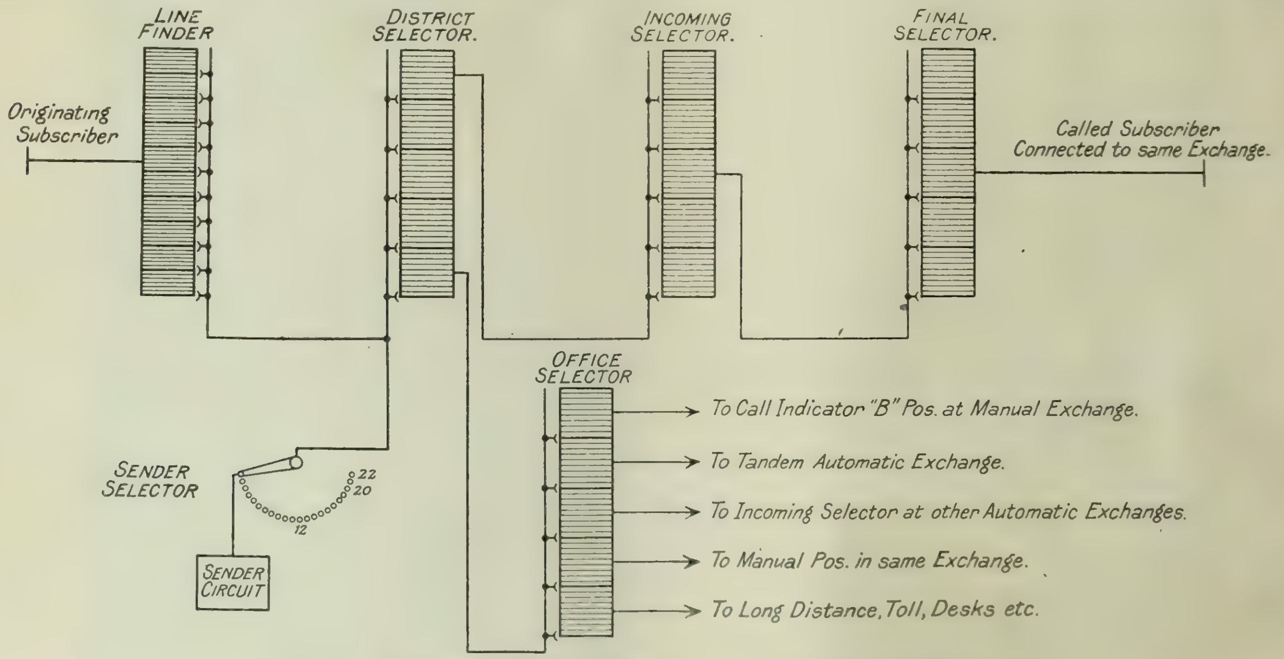
LINE FINDER
DISTRICT SELECTOR.
INCOMING SELECTOR.
FINAL SELECTOR.
Originating Subscriber
Called Subscriber Connected to same Exchange.
OFFICE SELECTOR
SENDER SELECTOR
22
20
12
SENDER CIRCUIT
To Call Indicator "B" Pos. at Manual Exchange.
To Tandem Automatic Exchange.
To Incoming Selector at other Automatic Exchanges.
To Manual Pos. in same Exchange.
To Long Distance, Toll, Desks etc.

Fig. 8.—Schematic Diagram of Panel Automatic Switching Scheme.

Note.—The Office Selector is provided only when the capacity of the District Selector cannot accomodate all the outlets—the outgoing trunks shown connected to the Office Selector may therefore be associated with the District Selector.

Development of the System.

The foregoing is a brief description of the Western Electric Company's panel type of automatic equipment as proposed for adoption in very large cities. An extensive programme for the use of this type of equipment in New York and other large American cities is at present being engineered. The trial installation proposed for London is one of 3,500 lines, to serve a busy district in the cenret of the city of London. It is hoped that the information obtained from this trial will be such as to enable the Post Office authorities to decide, not only on the type of system to be adopted for London, but the extent and speed of introduction. It will, of course, be realised that the installation of automatic apparatus to serve so large a telephone area as London will be a work of immense labour, will cost many millions of pounds, and must of necessity extend over 10 or 12 years at least, since automatic exchanges can only be introduced economically as the corresponding manual plant becomes due for replacement, or additional exchanges are opened. There are good reasons for saying that in a large city like London uniformity of system is essential. Under the very best conditions, immense complexity is involved, and the additional complexities that would follow the mixing of systems and the provision of arrangements for complete intercommunication would be very serious. Further, the introduction of automatic plant is not a matter of essential urgency, as there is no question that an up-to-date manual system would provide London with a first-class telephone service for many years to come—at any rate until the number of subscribers had increased to a figure four or six times the present total. The selection of the best and most suitable automatic system is, therefore, a far more important consideration than haste in commencing the substitution of automatic for manual apparatus, and the Post Office is following a sound principle in installing under practical conditions a trial exchange of this promising type of equipment.

The proposed new automatic exchange will be installed in the building known as the G.P.O. (South), in which are housed at present the existing Central and City exchanges. It will serve in the first nstance as a relief exchange for improving the telephone facilities in the central areas of the city, and it will be laid out in such a way as to provide for gradual expansion and the ultimate replacement of the Central and City exchanges if the system should prove so satisfactory as to be chosen for the general service in London. It should, perhaps, be stated that the Post Office already has two provincial exchanges—Darlington and Dudley—equipped with the Western Electric Company's original automatic system. This system, which has been fully described in The Electrician,* has many fundamental points in common with the panel system now under consideration.

The Post Office and the "Automatic."

The Post Office already has either in service or in course of provision installations of all automatic telephone systems which have so far been developed to a practical stage. The well-known Strowger system is installed at Leeds, Portsmouth, Paisley, Epsom, Accrington, Blackburn, Newport (Mon.), and a number of smaller centres. The "Siemens" system is working at Grimsby and Stockport, and a new equipment is about to be installed at Southampton. The "Lorimer" system is working at Hereford. The "Relay Automatic" system is now being installed at Fleetwood, and the "Clement" or North Electric Company's system is about to be introduced at Dundee. The last-mentioned system has been operated in America at a number of exchanges on the semi-automatic (or auto-manual) system; but the Dundee installation will be the first occasion on which it has been developed to furnish a full automatic service.

It may be fairly stated that the British telephone service can already claim that a larger proportion of its subscribers are served by automatic systems than is the case in any other large administration, and it has certainly been far in front of any other administration in its readiness to study the practical results of all good available systems by actually installing them in its public service. At the same time, each individual installation has been the subject of careful preliminary study, and the various automatic exchanges have been introduced where they were best calculated to throw light on particular engineering or traffic problems, or where the calculation of the total annual costs of running the service showed the automatic system to be more economical than the manual system, which is by no means invariably the case. At the present moment comparative financial studies are in hand in connection with the forthcoming reconstruction of a number of exchanges in towns which appear favourable for the introduction of automatic switching plant.

Co-ordination in Libraries and Abstracts.

By A. B. EASON, M.A.

This article is written in order to plead for the better and faster dissemination of technical knowledge. It contains some suggestions for the improvement of existing methods. It may be that some readers are aware of publications which need no improvement, and feel that any criticism is out of place. The writer, however, has not yet found perfection in either library catalogues, or in abstracts, and therefore hopes to point a way towards a better state of things than exists at present. Attention is also directed to present-day publications containing abstracts and similar information.

First, as to libraries. It is probably known to most readers that in New York the large engineering societies have a central building and a central library for technical works. It has been suggested that in London the large engineering societies, *i.e.*, those for the civil, mechanical, electrical and mining engineers, should adopt the same plan. But the size of London and the lack of money has prevented the fruition of such a scheme so far. In the meantime the writer would like to see the formation of a complete (in so far as any list can be complete) triplicate or quadruplicate catalogue of the books in the various science libraries in London which are available for the use of engineers and students. The catalogue would be of the card index form, and would indicate the libraries in which the relative books could be found. For example, the card index catalogues might be housed respectively in the Patent Office Library, the Library of the Imperial College of Science, in the British Museum, and at the Institution of Civil Engineers. If this were done, when anyone wanted to consult a book, he could go to the most conveniently situated card index and learn in which libraries the book he required could be found.

It may be objected that almost every book can be found in the British Museum, but it may not be convenient to get to the Museum during the hours at which it is open. There would be no reason for making the entries in this card index catalogue refer only to books held in the four above-mentioned libraries. Certain volumes which are not in these libraries may exist in the smaller libraries of scientific societies, and an entry to this effect could be made. For those books in the smaller libraries which are also available in the main library no entry would be made of the fact that they could be seen at the smaller libraries. The need for going from one library to another to find a particular book on chance of its being there, should be avoided if possible.

Lists of Scientific Books.

Before leaving this subject the question of lists of books on scientific subjects may be referred to. The writer does not know what is the most complete one. Apart from ordinary library catalogues there exist: (1) "Technische Bucherei," published in 1913 by the Frank'sche Verlagshandlung, Stuttgart, giving a list of German, French, English and American books on various technical subjects; (2) the British Science Guild catalogue includes a section with names of books—this year the list is to contain British books which are in print and available for purchase; (3) the Chemical Engineering Catalogue (1, Madison Avenue, New York) has a section mentioning various books. It is very incomplete, and does no mention the publisher of the books.

The Need of Good Abstracts.

Secondly, as regards abstracts. In The Electrician, Vol. LXXXII., p. 326, March 21, 1919, the author mentioned various bibliographies and abstracts in existence. Since the war has ceased others have been resuscitated. They all tend to overlap one another, and none of them is complete. The field of engineering as a whole would be surveyed with more certainty if they each dealt with a certain defined area. The proposals and criticisms outlined here falls under three heads: (a) Definitely divide up the field of scientific articles from which abstracts are made, and increase the numbers of journals surveyed; (b) Index abstracts definitely under subjects, using the Dewey system if desirable. A suggested decimal nomenclature for the classification of engineering subjects is given in the "Transactions" of the American Society of Civil Engineers, Vol. LXXXII., p. 1620, December, 1918; (c) abstract articles of the "resumé of progress" type, which are left unnoticed sometimes, as not being directly the report of original work. A good example of such articles are Pannell's on air flow measurement which appeared in "Engineering," Vol. CVII., p. 261, 1919. This was a valuable Paper to those who were interested in the subject, but who had not been in direct contact with some of the features mentioned by Pannell. The articles did not appeal to some abstractors.

Bibliographies and Abstracts.

The following bibliographies and abstracts are now published:—

1. Revue de l'Ingénieur et Index technique.
2. Technische Zeitschriftenschau.
3. Revue générale d'Electricité.
4. Les Fiches industrielles.
5. Technical Review.
6. Institution of Civil Engineers' Abstracts.
7. Science Abstracts.
8. Industrial Arts Index.
9. Engineering Index.
10. Journal of the Society of Chemical Industry.
11. Engineering Management (Cassier's Abstracts).

The publications 7 to 11 have been dealt with in the article previously mentioned. We shall now give some indication of the scope of publications 1 to 6.

The "Revue de l'Ingénieur et Index technique" (published monthly by the Bureau d'Organisation Economique, Paris, 124, Rue de Provence, or New York, 149, Broadway) contains a bibliography of current articles indexed on the Dewey system; the titles of the articles are in the original language, the subject headings being in French, English, Italian and Spanish. Mention is made of the various places where articles are reproduced (*i.e.*, if the E.T.Z. publish an article which is reproduced in The Electrician, or the "Journal" of the American Society of Mechanical Engineers, these references are given). Considering the scope and type of article referred to, it seems that the field of journals surveyed could be increased with advantage.

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* *See* Vol. LXXIV., pp. 390, 420, 453, 494.

The "Technische Zeitschriftenschau" (published weekly by the Verein Deutsche Ingenieur, Berlin, N.W.7, Sommerstrasse, 4a) contains bibliographical references which, in addition to the title, give a list of the contents of the article. The alphabetical indexing is fair; one only needs to glance down the keywords at the right-hand side of the page. The references are grouped under four big headings: (*a*) General Engineering, 57; (*b*) Electrotechnics, 20; (*c*) Manufacturing, 11; (*d*) Mining, 11. The figures give the number of references in each section of the January 17th issue, there being 11 or 12 references per page. It is easy to look through 11 references, but 57 in one big group is rather too many. A valuable feature is the list of new books; in each case the index of contents is given, but only German books seem to be included.

The "Revue Générale de l'Electricité" (12, Place de Laborde, Paris, published fortnightly) has a separate portion ("Documentation") containing abstracts of scientific articles and patents concerning electrical work. The classification follows a numerical system; some entries have unnecessarily complicated numbers—viz., 621, 312, 16, 00, 46—to explain the contents of an article.

Trade Abstracts.

"Les Fiches Industrielles" (Paris, 21, Boulevard Bonne-Nouvelle, 2e, published monthly) contains abstracts of articles in a large number of journals. These journals are of a very miscellaneous nature, and are of the "trade" type rather than the "technical" type. Each monthly issue deals with particular groups of subjects. The December, 1919, number dealt with paper, rubber, &c.; the February, 1920, number dealt with mining, metallurgy and electricity. It contained abstracts from 55 journals. The abstracts are all of the same length, printed on one side of the paper only, and take up one quarter of a page, so that if a page is cut in four the abstracts can be filed in a card index cabinet. The index follows the Dewey system. The number of the page upon which the original article appears is not given, and the references are not clear. Part numbers may be confused with volume numbers.

The "Technical Review" (published fortnightly, 2, Central Buildings, S.W.1) is the offshoot or continuation of the "Technical Supplement" published by the War Office. It contains both abstracts and bibliographical notices to articles appearing in scientific publications, comprising 62 British, 42 American, 50 German, and 55 of other nations. Mention is made of new books. This used to be done in one section at the end of the review, but is now done under the various subjects, which is a pity. A single list of books seems more convenient, as the list is never large, and books on one subject may be useful to men engaged on subjects of an entirely different nature. The references to books are not restricted to English books. Another valuable feature is that the review is up to date.

Institution of Civil Engineers' Abstracts.

The Institution of Civil Engineers' "Abstracts of Papers in Scientific Transactions and Periodicals" is now issued separately from the minutes of proceedings. It contains good abstracts of the best articles appearing in high-class technical literature. It is beginning to include abstracts of telegraphic, telephonic, illuminating and other electrical engineering articles. The indexing is not perfect, because the abstracts are indexed under the title of the Paper, and two articles on the same subject are sometimes indexed under different headings. Considering the "Technical Review," "Science Abstracts" and the "Civil Engineers' Abstracts," it is apparent that, for the same amount of work done, a completer and fuller series of abstracts could be produced if there was suitable co-ordination. "Science Abstracts" and "Civil Abstracts" do not abstract much from journals of The Electrician, "Electrical Review" and "Electrical Times" type. This means that they sometimes miss Papers of use to general engineers. The "Technical Review" avoids this mistake. If the Institution of Civil Engineers left the field of electrical engineering abstracting to "Science Abstracts," except where the articles covered big hydro-electric schemes and similar work involving "civil" work, and if "Science Abstracts" included references to Papers in journals of interest to the less scientifically trained but more commercial engineers, and if the abstracts were published sooner after the publication of the original article, additional abstracts could be provided at no extra cost.

It is undersirable that the "Civils' Abstracts" should duplicate abstracts appearing in "Science Abstracts," Series B; and yet, unless they do, their electrical engineering abstracts will be quite incomplete.

Finally, if journals giving abstracts and bibliographies would agree upon one alphabetical index, and would all use the same index, the work of finding Papers on any subject would be easier. For instance, let Papers on electrical fuses be always indexed under one heading, either "Fuses, electrical," or "Electrical fuses," but not sometimes under the one and sometimes under the other, and sometimes under "Switchgear" and sometimes under "Transmission." The author would not like to say under how many different titles he has found Papers dealing with the balancing of machinery and with the prevention of vibration from unbalanced machines in buildings.

The Development of Rural Electricity Supply.

Hereford's Interesting Enterprise.

The steps which are at present being taken by Mr. W. T. Kerr, the City Electrical Engineer, to develop electricity supply in Hereford are not only of intrinsic interest, but provide an example which might be followed in other parts of the country. Hereford, it may be as well to remind our readers, is a small cathedral city of some 22,000 inhabitants, whose principal industries are cider making, acting as a centre for the commercial side of the agricultural trade of the surrounding district, and providing attractions for sight-seeing Americans and plutocratic miners from South Wales. In these respects it does not, therefore, differ greatly from many other cities and towns of similar size and outlook throughout the country, where electricity has had little or no application. But it does differ from them in the fact that the annual electrical energy consumption per head of population is no less than 100 units. The history of this development is, therefore, worth consideration.

Intensive Electro Culture.

Electricity supply from a municipally-owned station has been given in Hereford since 1899. And we mean nothing derogatory when we say that this undertaking was started mainly because in those days the possession of an electricity supply undertaking by a municipality was "the thing." It could not, indeed, very well be otherwise. The principal application of electricity was for lighting, and electric lighting was a precious thing not to be used without much consideration. But while in places like Manchester and Bradford it was soon found that the power load became of gradually increasing importance, and that in adopting an electricity supply they had built better than they knew, in Hereford no such industrial development was possible and it soon became evident that to use an apt simile unless some form of intensive culture was undertaken a state of stagnation would soon be reached.

Mr. Kerr, therefore, decided not only to initiate a campaign in favour of the use of domestic electric appliances within the City area, but to obtain facilities for the supply of electricity for all purposes, to farmers and others in the surrounding district. This development has meant a tremendous amount of pioneer work in which tact has had to be exercised, fixity of purpose has had to be the main characteristic and disappointment has had to be faced, as will be realised by the statement that it was only after five years' continuous effort that Mr. Kerr obtained his first agricultural consumer. Now, however, consumers and applications for connections are coming in more quickly than they can be dealt with; and it is not too much to say that the scheme has proved a complete success.

A Variety of Consumers.

It should be added that with the development of this rural supply has gone an equal keen endeavour to increase the number and variety of the consumers within the City boundaries. Messrs. Bulmer & Company, the well-known cider manufacturers, have long had the whole of their works driven electrically, such a wide range of apparatus as bottle washers, serving machines, cider pumps, conveyors, &c. being installed. At a tile works within the city a heating apparatus is being put in which will have a load of 180 kw. at 100 per cent. load factor (such a consumer is worth having), while interesting experiments are being made in the pasteurising of milk by mercury-vapour lamps and in speeding up the fermentation of barley by electrical means. Indeed, it may truly be said that Mr. Kerr's policy is to find out the character of his prospective consumer's particular fancy or problems, and then to presuade him that they are best pandered to or solved by electrical means. In this connection it should be mentioned that though the streets of

Hereford are not electrically lighted, the municipal gas works are, and that all the machinery therein is electrically driven.

It is evident that for such a policy to meet with financial success close regard must be had to the financial side of the undertaking. We shall refer to the question of tariffs below, but to show that all this development has not been rashly undertaken it may be remarked that after the whole of the interest and sinking fund had been paid there was a balance of £1,000 on last year's working.

THE USE OF CHEAP FUEL.

Brief reference may be made to the generating station, where Mr. Kerr has again shown enterprise in using metallurgical coke-oven dust for steam raising purposes. This form of fuel has now been employed by him for $3\frac{1}{2}$ years, and its use has enabled the fuel costs of the undertaking to be cut down to 0·34d. per unit with coke at 11s. 2d. per ton. The price has now been increased to 15s. or 16s., but doubtless with the higher output that may be expected the price per unit will remain round about the present low figure. The consumption of this fuel per unit generated was $4\frac{1}{2}$ lb. last year, but has now been reduced to $3\frac{1}{2}$ lb. This fuel is obtained from coking ovens and steel works. In starting entirely from cold a certain amount of coal has to be used, but in practice, of course, this is not often necessary as firing is obtained from one of the other boilers. Induced and forced draught is fitted to each of the boilers, which are of the Stirling type, and in addition oil fuel can be injected at peak load, so raising the capacity of each boiler from 14,000 lb. to 21,000 lb. per hour, thus avoiding use of an additional boiler. Under normal conditions natural draught is used. Though at present the oil fuel is injected by hand, a compressed air apparatus to enable it to be supplied automatically is being installed. What was thought to be a great disadvantage of using this form of fuel is the large amount of dust to which it gives rise. But investigation showed that this dust far from being simply a nuisance had a considerable value for agricultural purposes, containing as much as 6 per cent. of potash. It is now therefore being sold at £3 per ton. It will be seen that little is not grist that comes to Mr. Kerr's mill.

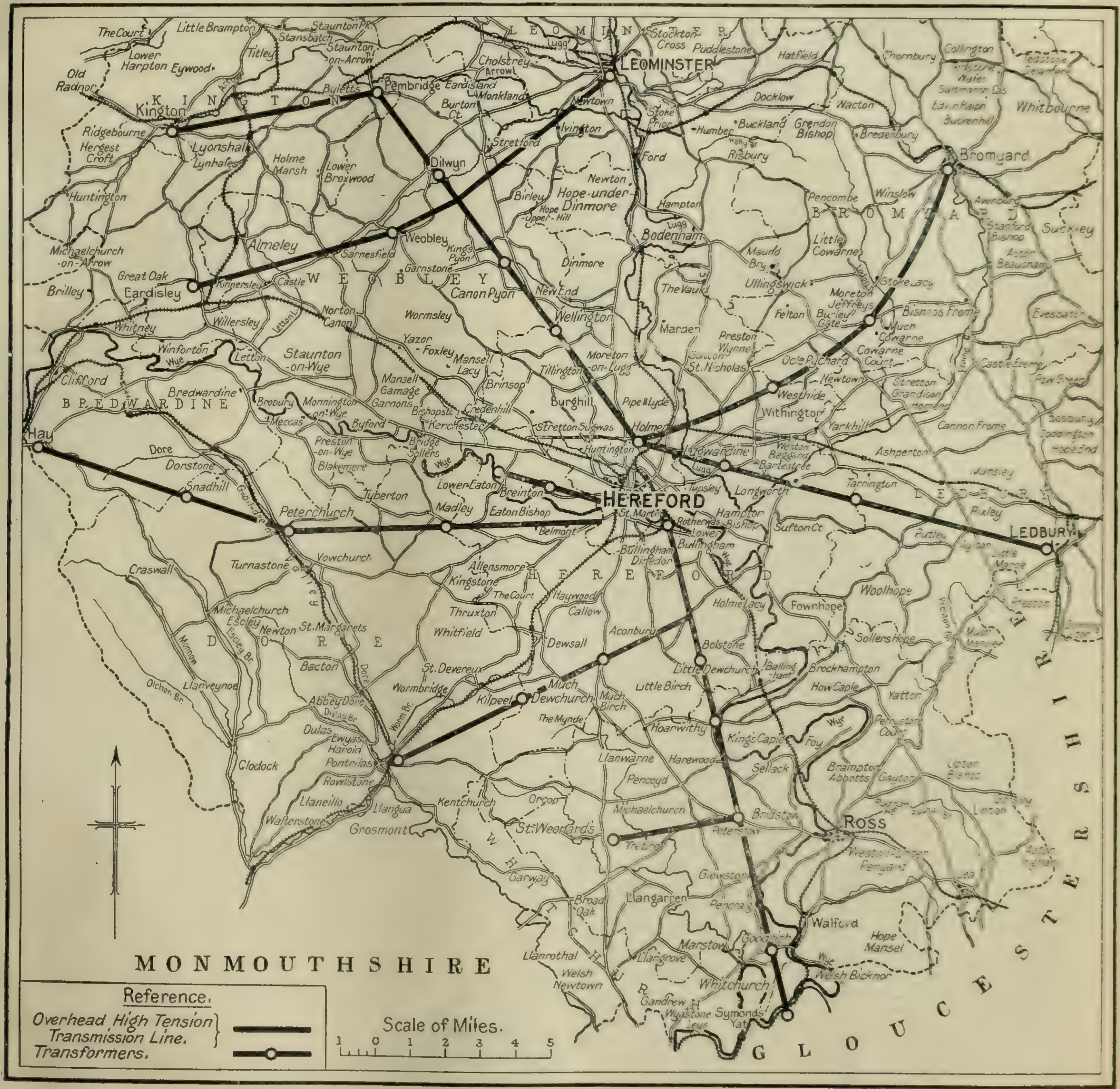

FIG. 1.—MAP SHOWING RURAL AREA SUPPLIED BY THE HEREFORD ELECTRICITY UNDERTAKING.

GENERATING PLANT.

The generating plant at present in use consists of two 1,500 kw. Ljungström and one Fraser & Chalmers-Siemens 1,000 kw. turbo-alternators, supplying three-phase current at 3,300 volts and 50 periods. Energy is at present either transmitted to outlying districts at this voltage, or converted to direct current by rotaries for use in the centre of the town. There are, in addition, two relics of the original generating plant, consisting of 300 kw. Belliss-Dick Kerr sets, which are still used on the winter peak, but will shortly be replaced by three-phase plant of a more modern type. It is eventually intended to use 11,000 volts as the transmission pressure to outlying districts, while to provide for still further extensions all the equipment, including poles and transmission lines, have been designed on the basis of a working pressure of 33,000 volts.

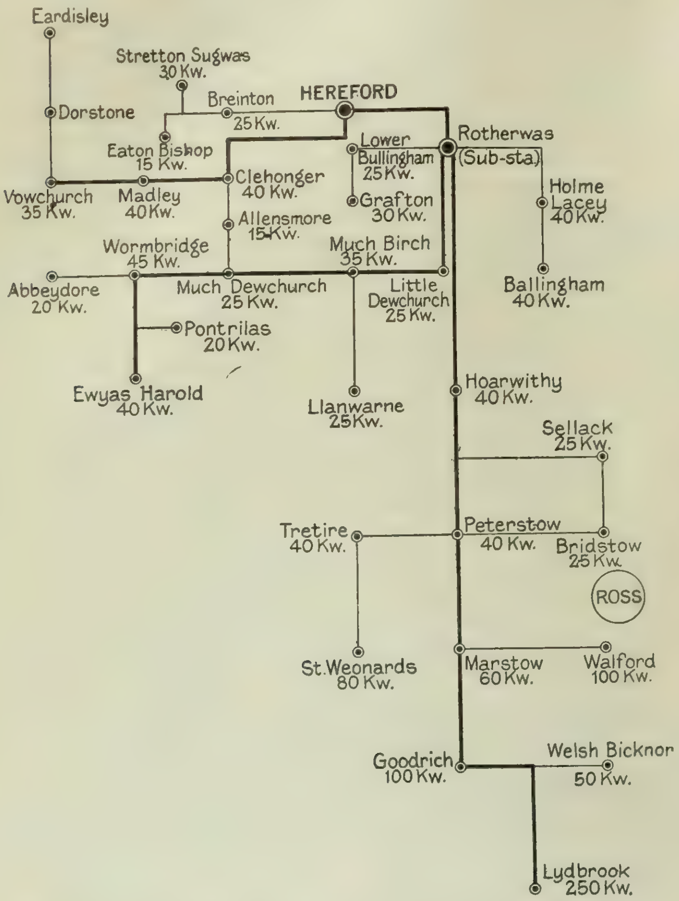

Fig. 2.—Diagram Showing Layout of Rural Supply.

The Rural Network.

Turning now to the question of rural supply the accompanying map (Fig. 1) and diagram (Fig. 2) give an idea of the geography of the scheme and of the electrical arrangements followed in providing electricity for individual consumers. The general policy is to use underground transmission in the centre of the town and overhead transmission once the houses are left behind. For the main transmission lines, steel poles of the lattice girder type are being used, while the distributing low-tension lines and the service line connections are being carried on local-grown larch poles, the arrangement being a series of four insulators in the vertical plane, the top three, the phase wires, and the fourth or bottom the neutral wire.

Where roads are crossed the protection is by means of simple V. guarding on low-tension lines, and net guarding on the high tension. Where telephone lines are crossed by extra-high-pressure mains, one or other are placed underground.

The type of transformer station used is shown in Fig. 3. It possesses the merit of simplicity and consists only of a transformer mounted on channel iron fixed to one of the transmission poles. There are isolating switch fuses on the high-tension side, and the earth wires from the neutral line of the low-tension lines above are carried to the transformer casing and the centre point of the windings, and then down to a Paragon earthing cone. With the exception of the steel poles, which are now being erected by the British Insulated & Helsby Cables, Ltd., the whole of the work in connection with these extensions has been carried out by semi-skilled ex-Service men under the supervision of the department's officials.

Tact and Psychology.

The most interesting thing about this development is, however, the methods by which the rural load has been obtained. We mentioned above that Mr. Kerr believed in discovering each individual's electrical weakness; and this is the general policy that has been adopted. It has been found that the present of an electric iron to this one or the demonstration of the time and labour saving of an electrically-driven churn to that one, or by some other appeal to masculine weakness and feminine vanity, have time and time again been successful in securing the wide adoption of electricity on the farm. Electric lighting is also an advertisement, especially in the cottage, so that it need suffer under the stigma of being the rich man's light no longer. The housing shortage is forcing people from the town into the country, preventing migration from the country into the town and causing the demand for more amenities in the cottage. The high price of oil and its other disadvantages are also leading to an increasing demand for electric light.

Mr. Kerr and his assistants have borne all this in view and the results obtained justify their policy. Not a little of this success is due to the wise way in which Mr. Kerr has chosen his assistants. These are men highly interested in their job and keen for success.

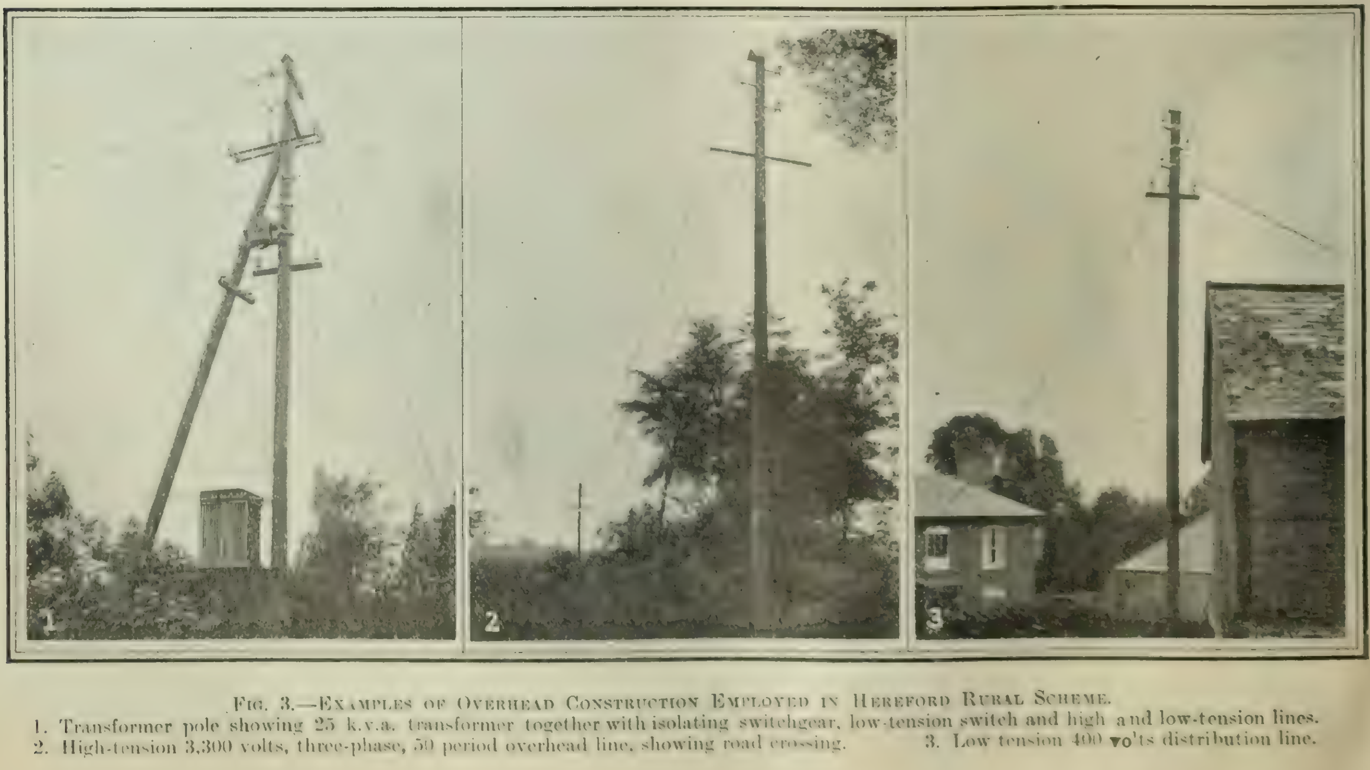

Fig. 3.—Examples of Overhead Construction Employed in Hereford Rural Scheme.

1. Transformer pole showing 25 k.v.a. transformer together with isolating switchgear, low-tension switch and high and low-tension lines.
2. High-tension 3,300 volts, three-phase, 50 period overhead line, showing road crossing.
3. Low tension 400 volts distribution line.

They make a point of becoming acquainted with everyone in the district, of losing no opportunity of inculcating the domestic idea and of pointing out that the connection of an iron is just as useful as of a 6 kw. radiator. The effect on the load curve is shown in Fig. 4. The great thing is to get a start.

WAYLEAVES.

The same psychological principles have been followed in obtaining wayleaves. It is true that under the Electricity (Supply) Act these may be compulsorily obtained, but compulsion in such matters is most unwise except as a last resort. Mr. Kerr has proved that by a policy of conciliation he can obtain wayleaves and not only obtain them, but leave behind him a train of satisfied consumers. There must, however, be some give and take in these matters, and it has, therefore, been found necessary to sacrifice some of the artistry of the lines to the farmer's convenience and to arrange that except in fields that will be permanently used for grazing, the poles are placed in the hedgerows.

We may briefly refer to the tariffs in force for this class of supply. As it is desired to develop the use of electricity generally, rather than lighting, heating or cooking individually, the contract system is employed with a fixed charge based on the wattage installed plus 2½d. per unit consumed. In calculating the wattage a distinction is made between "active" and "inactive" lamps, those in such places as passages, larders and lavatories being placed in the latter class and not included in the wattage figure. This, of course, is greatly to the consumer's advantage.

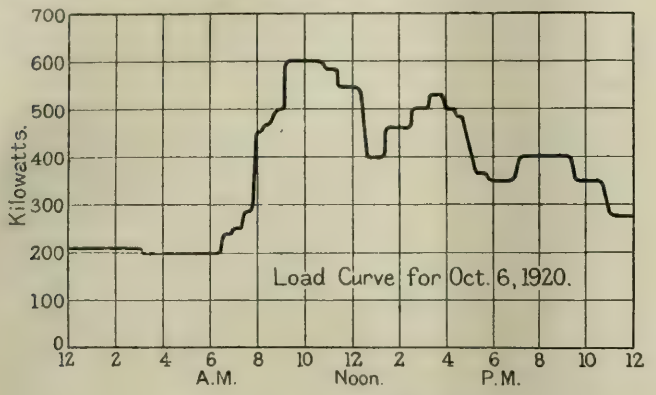

FIG. 4.—A TYPICAL LOAD CURVE.

As a matter of practice, however, it is found that among this class of consumer the question of cost is quite secondary to that of convenience. That precious jewel, the domestic servant, is beginning to insist that an electric iron must be part of the equipment of any house in which she will deign to stay, while the farmer's wife sees distinct advantage in employing an electrically-driven churn which quite outweighs any shock that may be administered on arrival of the quarterly bill. It is not, therefore, surprising to learn that the demand for connection is exceeding the rate at which they can be supplied.

In conclusion, we wish to thank Mr. W. T. Kerr for allowing us the opportunity of seeing this very interesting installation, and for spending a great deal of time discussing his policy with our representative.

Books Received.

[Copies of the undermentioned works can be had from THE ELECTRICIAN Office on receipt of published price, plus postage.]

"Experimental Science," Section V. Light, by S.E. Brown. (Cambridge: University Press). Pp. vi.+151. 6s. net.

"Electric Switch and Controlling Gear," by Dr. C. C. Garrard. (London: Benn Brothers, Ltd.) Pp. xxii+654. 25s.

"Electrical Handling of Materials. Vol. I. Electrical Equipment." By H. H. Broughton. (London: Benn Brothers, Ltd.) Pp. xiv.+200. 25s. net.

"A Course in Electrical Engineering, Vol. I., Direct Currents.. By C. L. Dawes. (London: Hill Publishing Company.) Pp. xiv.+496. 25s. net.

"Rudiments of Electrical Engineering." By P. Kemp. (London: Macmillan & Co.) Pp. 255. 6s. net.

"A Second Course in Mathematics for Technical Students," By P. J. Haler and A. H. Stuart. (London: University Tutorial Press.) Pp. viii.+363. 6s. net.

"Slide Rules and How to Use Them." By T. Jackson. (London: Chapman & Hall, Ltd.) Pp. 30. 1s. 6d. net.

Correspondence.

WOMEN IN THE PROGRESS DEPARTMENT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. W. J. Hiscox in his article published in your issue of the 8th inst., referring to the war record of women, states that "the duties she performed in the engineering factory could not by any stretch of imagination be classed as Grade 1," and goes on to say that "the demand for production was so great and the insistence on speedy delivery so intense that . . . as a consequence, the standard of workmanship was not too closely criticised." This statement is surprising. It may be true for some operations, but if Mr. Hiscox will take the trouble to discover the very large number of operations and grades of work, which were done by women in the shops during the war, he will realise that for much of that work, accuracy was of the very first importance. Lady Parsons, in her Paper on "Women's Work in Engineering," read before the North-East Coast Institution of Engineers and Shipbuilders on the 9th July, 1919, instances girls milling gauges to 0·00003 in. and the average girl could certainly work to 0·0005 in.

Mr. Hiscox seems to think that because during the war women did not fill any of the important administrative positions in the engineering world, that therefore they are incapable of so doing. But it was only in 1915-16 that women began to be employed to any extent in this industry, and he would be a very exceptional man indeed who, entering an engineering works, with no previous training and with no chance of transferring from one department to another in order to gain experience, could at the end of three years have gained any such administrative position.

Under the heading "Progress Work—a Profession," Mr. Hiscox says that, as patience and tact, &c., are necessary qualifications of a "Progress Engineer," he is "constrained to ask—Could a woman succeed?" Surely these attributes are among the first to be conceded to us as a sex. Later, he states that "she (a woman) cannot be expected to understand and appreciate the moods of a foreman." A woman's intuition is one of her greatest characteristics and students of psychology will readily admit, that usually, it is an extremely safe guide. It may also interest Mr. Hiscox to know, that we do not by any means accept at its face value, all the information that is dealt out to us by foremen.

Much of the distrust which exists is due to prejudice and wil wear off as women prove their capabilities. The idea of women taking up any branch of engineering is rather revolutionary and, rightly or wrongly, it is only natural that men should hesitate before having complete confidence in us, but to a very large extent that confidence is to be won even to-day when "the novelty has worn off."

Mr. Hiscox does not define what he means by "Progress Department." As usually understood, this is the department which is responsible for the progress of the order through the shops. Its duties consist of: (1) Maintenance of stocks of standard or semi-standard parts; (2) the distribution of work to various feeder departments; (3) the chasing of raw material to enable feeder departments to complete; (4) the chasing of material when feeder department is supplied; (5) the collection of the necessary parts to complete the assembly. The first is mainly clerical, and therefore, according to Mr. Hiscox, is "beneath the dignity" of "the lordly male." The second is determined by the character and composition of the feeder departments and is seldom altered. A feeder department can seldom undertake work except of a particular class, and if a new distribution became necessary a woman who had served an apprenticeship as chaser would probably be as capable of dealing with it as a man in the same position. As regards (3), (4) and (5), there is no reason why a woman should not eventually become a successful chaser. The only argument which Mr. Hiscox can bring against it is the prejudice of men. This certainly would make the chaser's life a difficult one, but surely one may hope that the male sex who claim to have a monopoly of logic and common sense may someday act on a reason rather than prejudice.

Considering how few women have yet attempted any work on the technical side of engineering, it seems to me that he has taken up a rather too specialised point on which to prophesy.—I am, &c., Gertrude L. Entwisle, A.M.I.E.E.

Sale, October 18th.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: We should like to thank you for your encouraging comments concerning us in your Editorial on the above subject. It would not be difficult to expose the fallacy in Mr. Hiscox's argument, but we should prefer, rather, to prove to the world at large the absurdity of such statements by making a huge success of our enterprise. If we do so I trust that Mr. Hiscox will be sufficiently magnanimous to acknowledge himself guilty of an error in judgment.

Personally, I am not at all interested in the question of the rival capabilities of men and women, but consider there are only two types of individual in the world. Some are fools and some are not. Nevertheless, one or two notes on my own experience in the Progress Department of an engineering firm may be interesting.

In the first place I found the foremen in charge most willing and anxious to co-operate with me in getting work through expeditiously. The practical engineer has generally a deep-rooted objection to anything in the nature of book-keeping, and looks to the Progress Department as the "Enquire within upon everything" concerning work done and to be done. He is not concerned in the very least as to whether the "chaser" be male or female, so long as the instructions he receives are prompt and definite. In contradiction to Mr. Hiscox's statement, any slight hitches that have occurred in my experience were during the "novelty stage," when neither the chaser herself nor the workman were sure of her exact status and responsibility. As for the complete organisation of a Progress Department, we have all had our dreams, but I think no woman up to date has had the opportunity of proving her capability in this direction for the simple reason that the "mere male' in charge is generally either too *sure* of his own powers, or too much *afraid* of hers. Miss Ashberry, my friend and partner, joins with me in thanking you for your interest in our affairs, and expressing our pleasure in finding any one with such a broad-minded and generous outlook.

D. W. Turner (Secretary), Atalanta, Ltd.

Loughborough, October 17th.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I should like to make a few comments on the article on "Women in the Progress Department," by Mr. W. J. Hiscox, which appeared in your issue of October 8.

Firstly, with regard to the assertion in the first paragraph that, "Woman's work in the engineering factory could not by any stretch of imagination be classed as Grade I." It is true, it does not require any "stretch of imagination," as no imagination is necessary at all. Of course, all women's work is not Grade I. any more than all men's work; but a good deal of it is.

The author's views on this subject do not seem very consistent, as in the last paragraph he states that "In the electrical factory it has been demonstrated that winding can be done more expeditiously by the woman." This has been recognised by nearly all large electrical firms for many years, and shows that man is not all that he would sometimes claim to be, even in the engineering world, which is almost the last to be thrown open to women.

Another point which the author brings up is that during the period that woman's activities were manifest (which, by the way, is only just beginning), quality was sacrificed to quantity. This apparently relates to shell factories, which were extensively worked by women. This being the case, the statement seems rather ridiculous, since everyone realises that shells must be made and gauged accurately, otherwise they are useless. Had this work not been done efficiently the British army would have fared very badly with "dud" shells.

With regard to women's limitations, a woman has only one natural drawback, which affects her manual work only, and that is her inferior muscular strength; and it is questionable whether this is really of much disadvantage. It is absolutely necessary for any woman or man, taking up any branch of engineering, to serve an apprenticeship; and this is where the author seems to expect difficulties; whereas, in reality, there are very few.

Mr. Hiscox also states that the foremen in the works object to women in their department. In general this is not so. The present writer served her time in a large electrical factory, and never once came across a foreman who objected to her presence or withheld any information that he would have given to a man.

Considering it is only five years since women first found it was possible for them to enter engineering firms for technical work, and that they have usually done so, up to the present, without any of the necessary previous training, which should take about five years, it is rather early to state that women have not got further than the clerical side of the Progress Department. This is a side of the engineering profession which has not yet been tackled by a qualified woman. Before a man takes such a position he has had his college training and apprenticeship, but a woman is expected to come into the department without either of these and some men expect her to do the same work as the qualified man.

In the last paragraph the author infers that the same qualities are necessary for a successful progress section leader as are required for a blacksmith or a boiler maker; whereas the first requires patience, tact and a quick brain, all of which women usually possess, while the latter requires manual strength and endurance, which are not usually found with the former.

Women's greatest drawback is that many firms will not open their doors to them; and, therefore, the woman who knows she will have to earn her own living when her education is completed, is debarred from taking an engineering course at college owing to the uncertainty of her being employed by the men, who are as yet, heads of all these departments in large engineering firms.—I am, &c.,

Stretford, October 19. (Miss) M. Nott.

AUTUMN TRADE PROMOTION NUMBER.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Replying to Mr. Tilney's letter, which appeared in your last week's issue, I give below a note of the electrical apparatus installed in each of the two three-apartment houses referred to in my article:—

Kitchen.—One electric cooker, with boiling table on top, 4 kw.: one electric fire with 3-heat control, 3 kw.: one two-pint electric kettle 800 watts; one electric immerser inserted in hot water tank for hot water supply, 1 kw.; one electric smoothing iron, 500 watts.

Parlour,—One electric fire, 3-heat control, 3 kw.

Bedroom.—One electric fire, 3-heat control, 1½ kw.

Bathroom.—One electric fire, 3-heat control, 1 kw.

Let me repeat, this was an all-electric experiment—neither *firewood*, peat or oil was used—not a pound of coal, coke, anthracite, or other fuel. The consumption for 12 months (10,052 units in the one case and 10,981 in the other) quoted by me were actual figures; the two tenants being of Scottish birth, exercised characteristic thrift. The figures may appear unduly high, but I shall be surprised to learn that they can be reduced by any one, adopting a complete electric service.

Analysis of Consumption.

Cooking	2,315 units
Hot Water	2,888
Lighting	70
Heating	4,779
	10,052 units

It will be evident that the bulk of the units consumed were dissipated in (1) the water heating and (2) the 3 kw. fire installed in the kitchen, which, in an artisan's house in Scotland, is the living room. The cooking units are reasonable, and the units used in heating the parlour, bedroom and bathroom, all intermittent, were negligible (in the forthcoming test, referred to in my original article, I will have all rooms metered separately). I am satisfied that by the installation of one coal fire in the living room or kitchen, to provide the necessary heat in the apartment, and hot water for sinks and bath, the electricity bills will be at least halved. This is the partial service, if we may so describe it, upon which I argue we should concentrate.

Reverting to Mr. Tilney's 14-room house, with annual consumption always under 10,000 units, over 5,000 of which are accounted for by cooking consumption, if we add 500 units for lighting, and say, 2,000 to 3,000 units for his 2 kw. hall fire, which runs at full heat for 16 hours daily in cold weather, this does not appear to leave a large margin for the general heating of the house, the operation of small household motors, not to speak of water heating. In fact, I make bold to say that should he cut out his " wood " fires, and adopt complete electrical service throughout, his consumption would reach a total, compared with which my figures of 10,000 units would appear paltry.—I am, &c.,

Glasgow, October 18. R. Hardie.

Reviews.

La Theorie et la Pratique des Radiocommunications. Part I.: Introduction a l'Etude des Radiocommunications. By Leon Bouthillon. (Paris: Librairie Delagrave.) Pp. xiv.+193. Price 20 Frs., Cloth bound 25 frs.

There are some books which are only read by hundreds and understood by tens. This volume is one of them. Unattractive to all but the deeper thinkers, it is one of the most extraordinary of its kind, and probably the most valuable.

Léon Bouthillon is one of those mathematical physicists, one of whose aims in life has been to represent physical phenomena by equations. He firmly asserts that pure physics are the foundation of all we know, and that therefore too much attention cannot be given to the mathematical side and theory of wireless telegraphy. He feels that this aspect of the science has been largely neglected, that there is room for a volume which will not simply be a collection of circuit-diagrams, but an ample theoretical discussion of all the different aspects and complex problems of radio communication. Hence this book. The " beaux livres " of Fleming and Zenneck will only cover a portion of the task the author has set for himself. Judging by the present Introduction, Bouthillon's work is certainly likely to go far beyond these well-established text-books, and, when complete, will undoubtedly form the most valuable contribution to wireless literature so far published.

The book is to consist of eight separate volumes. The first is the subject of the present review, and deals with the mathematical foundation on which the physics of electromagnetic waves is built. The second deals with the propagation of electromagnetic waves on the surface of the earth. The third with electrical oscillations. The fourth with antennæ, and the direction of wave propagation. The fifth is concerned with transmission systems. The sixth with the reception of waves. The seventh will discuss different kinds of radio communication systems, while the last volume is apparently to be a radio-telegraphist's handbook.

Bouthillon apologises for the mass of mathematics, which entirely constitutes his first volume, by stating that no apology is necessary. Mathematics is the language, and the instrument of scientific research. The practical engineer presses for concrete results, for immediate applications. His attitude, however, must not disturb the calm mathematician who loves the problem he has set himself for its own sake alone. Bouthillon considers that the long way round is often the shortest in the end. It needs no quotations from scientific history for us to appreciate his remarks. The whole science of wireless telegraphy has been constructed from the work of Maxwell and Hertz. The study of pure physics and pure science generally has never received in this country the encouragement it deserves. We are too slow to understand that the endowment of pure scientific research is one of the finest investments for the good, not only of commerce, but of civilisation. We need imagination.

While admitting all this, we can overrate the value of the work done by the mathematical physicist, as he himself often does. All progress is not due to induction. Some of the most important developments of science have been due to experimental work. The results of such work have then been mathematically analysed. In hundreds of cases such analysis has done nothing to advance the science. Often the analysis has had to give way to empirical results. This is frequently the case in radiotelegraphy, which far from falls into the category of an exact science. Mathematics, perhaps, have done less for wireless telegraphy than for most other sciences. The world is the experimental bench, and mathematical results have very frequently been totally unreliable. The radio engineer of to-day probably relies far more on experience and experimental data than on abstract mathematics. The science owes nearly all its progress to the experimental investigator. While the mathematician has devoted his time, perhaps months or even years, to represent a phenomenon mathematically, others have been getting on with the work of development.

The mathematical physicist if he possesses the genius for invention—which is not usually the case, since by stopping to analyse he loses his place in the race—is one of the most valuable assets to radio science. Bouthillon falls into this class and he is, besides, a radio engineer of the highest international standing. He is a professor, an ingénieur des Postes et Telegraphes and Directeur du Bureau Centrale de la Télégraphie Sans Fil. It is therefore with the deepest respect that we receive his opinions, while remembering his weakness for the mathematical treatment of problems, some of which cannot with any profit be treated theoretically.

The first chapter of his introductory volume deals with the electromagnetic field and electromagnetic waves. The second chapter is concerned with radio communication through a perfect dielectric. In Chapter III. is discussed the theory of communication in the case of a flat earth which is a perfect conductor, and an atmosphere which is a perfect dielectric. Chapter IV. is a conclusion and a very short descriptive résumé of the results obtained.

It is gratifying to note that the mathematical work of Fleming and Eccles receives full credit in this new volume. Nor will the book be complete without full reference to the practical developments in wireless telegraphy due to them.

The paper-backed edition of the book, at least, is poorly presented, a fault too common with French and Belgian scientific books. The pages are mostly uncut, and it is questionable whether the wrong type of reader will trouble to cut them. The sheets partake of the nature of blotting-paper, and the general format is more suited to the works of Omar Khayyam than those of Bouthillon. The practice of folding great sheets of drawings in the book is also to be regretted.

Apart from these considerations which are no fault of the author's, the first volume is one to be recommended to those who are chiefly interested in the purely mathematical side of radio communication. To others, the succeeding volumes will have a wider appeal. Even at this stage, we can predict that the complete volume will probably hold the premier position in the list of treatises on wireless telegraphy.—John Scott-Taggart.

Shorter Notice.

The Motor Mechanics' Handbook. By G. W. Watson and F. H. Rogers. (London: Cassell & Co.). Pp. viii. + 267. 3s. 6d. net.

This little book is intended to give those who drive their own cars, and garage mechanics, a good general idea of the operation and maintenance of the various parts of an automobile.

The book opens with a short account of the four-cycle and two-stroke engines, after which the question of fuels and lubrication is discussed. Carburettors, their faults and adjustments, are then dealt with, and there are some good sectional illustrations of modern carburettors, which should be very useful. In the chapter on ignition the authors stray a little in discussing the transforming action of the secondary coil. The paragraph on self-induction is misleading, and gives the impression that there are two currents moving simultaneously in opposite directions in the primary circuit.

Following a chapter on self-starters and lighting sets, there is a useful chapter on engine faults, repairs and adjustments. The car transmission is then dealt with in detail, and there are many useful hints in these chapters. There are also chapters on axles and brakes, steering gear, various kinds of bearings, frames, springs, tyres and tyre repairs, driving hints and repairs. This is a very useful book, in a very handy size, and the price (3s. 6d.) should commend itself to everyone. H. F. H.

Street Lighting Improvements in London.

Recent improvements which have been effected in the lighting of part of the City of Westminster demonstrate the advantages which can be gained by the use of gas-filled incandescent lamps in conjunction with scientifically-designed fittings. The area involved includes the Strand, St. Martin's-lane, Northumberland-avenue, Trafalgar-square, Leicester-square, The Haymarket, Long-acre, and part of Charing Cross-road and Whitehall, which is supplied by the Charing Cross, West End & City Electricity Company, where it will be remembered open type arcs were originally used to be replaced later by flame arcs. The chief reasons for making the present change were the low maintenance costs of gas-filled units compared with arcs, and the improved control of light which could be obtained. In all 122 standards have been converted.

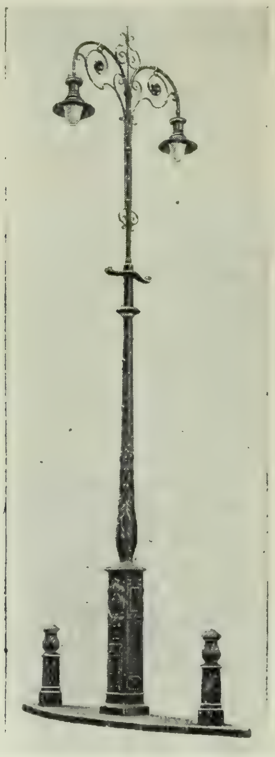

Fig. 1.—Standard used on West End Lighting Scheme.

Fig. 1 shows the general design and proportions of the posts. The lanterns are of a special pattern, each one containing a 200-volt 750-watt Osram gas-filled lamp. The total wattage per post is therefore 1,500. Fig. 2 shows an illumination curve plotted from readings taken on lamps in Northumberland-avenue. The posts were 160 ft. apart, the distance from the lamp filament to the ground being 25 ft. The maximum illumination recorded, directly under the lamps, is 2·6 ft.-candles, the minimum is 0·3 ft.-candles, midway between the standards. These figures show the even distribution of light, the diversity factor, or ratio of maximum to minimum illumination, being as low as 8·6. Fig. 3 is an untouched photograph taken by artificial light, and gives some idea of the excellent effect obtained.

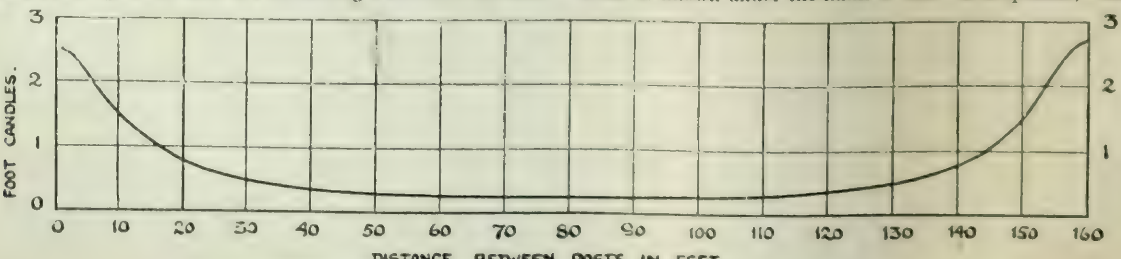

Fig. 2.—Distribution Curve of New Lamps in the West End of London.

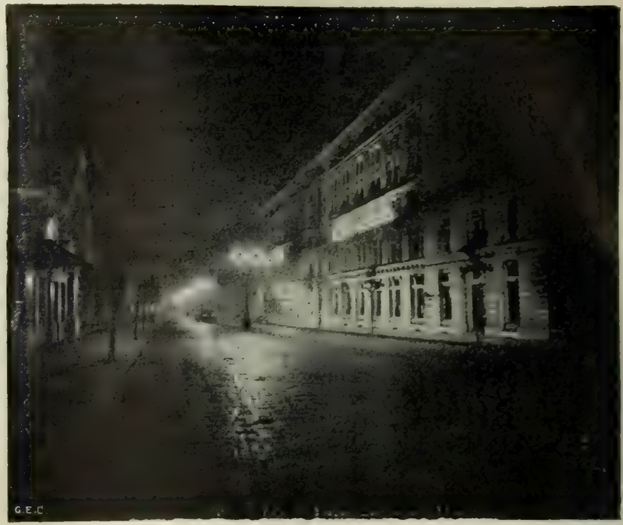

Fig. 3.—The New Lighting at Work.

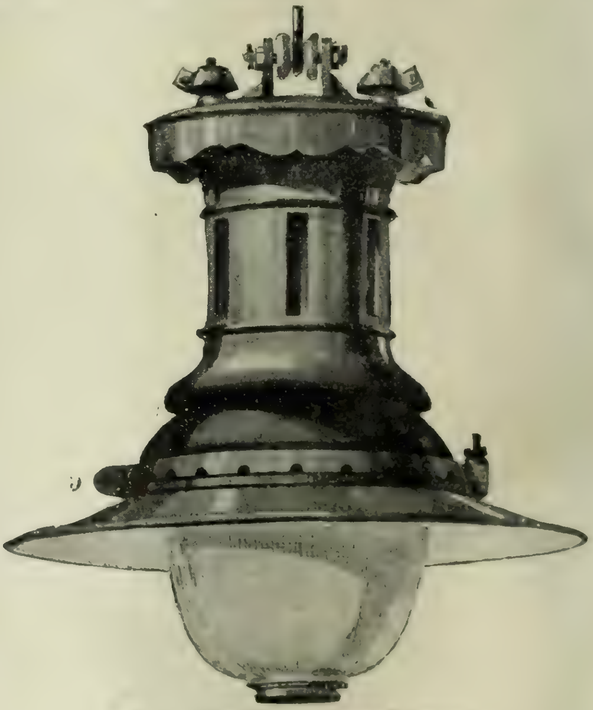

Fig. 4.—The Metropolitan Lantern.

The fittings used were supplied by the General Electric Company, Ltd., and embody the latest improvements in design, the lantern, which is known under the name of the "Metropolitan," being shown in Fig. 4. This is fitted with holophane globes and with a ratchet focussing device, which allows any changes in the lamps to be compensated for. An efficient system of ventilation is also provided.

Electric Vehicles at Olympia.

There are four exhibitors of electric vehicles at the fourth international Commercial Motor Exhibition, which opened at Olympia on Friday last, and will remain open until to-morrow.

Refuse Collection.

A comparatively new name in the field of electric vehicle makers is that of Newton Brothers (Derby), Ltd., who show a 3½-ton vehicle with a special body for refuse collection, the tipping gear being operated also by electric motor. A claim which the firm is proud of is that every part of the vehicle, except such components as spring leaves and tyres, is made at their own works. Two of the firm's special standard tractor type motors are employed per vehicle, one being geared to each of the two rear driving wheels. They are easily accessible without the necessity for gymnastic contortions or pulling the vehicle to pieces to get at. The motors have an independent springing system of their own, so that no vibration shocks on starting can be transmitted to them except through the ordinary springs of the vehicle, and the special springing system referred to. After exhaustive trials, the firm have come to the conclusion that a straight system of parallel control is undoubtedly the simplest and the best. In any case, only an extremely slight return of power to the battery can be effected, but at the expense of serious complications in the details of component parts, as well as supervision duties. The use of two motors, of course, does away with the usual differential. The standard battery equipment consists of either 44 Exide cells or 60 nickel iron cells. The drive eliminates all universal joints, differential gears, gear boxes, cardan shafts, chains and bevel wheels, as it is effected by means of one pinion and one internal spur wheel for each motor direct to the rim of each one of the two road driving wheels.

Electric Vehicles for Sheffield.

The General Vehicle Company, Ltd., of Birmingham and London, show a 2-ton vehicle to the order of the Sheffield Corporation Cleansing Department, with electric tipping device, a 3½-ton vehicle and a 1-ton chassis, whilst among the small items on the Stand is a rotary converter which has an uncommon likeness to a gas stove. The general outlines of these vehicles have already been described in our columns, and there are 6,000 of them in use for 135 different classes of transport.

The Company supplies its own batteries, in which a "pillar strap" construction is adopted, enabling each battery to be sealed and thus preventing spilling the electrolyte.

Garrett and "Orwell" Vehicles.

Richard Garrett & Sons, Ltd., of Leiston, Suffolk, show a 3½-ton electric with a brewers' body. In this case a single series wound motor, capable of withstanding 300 per cent. overload, is used, the drive being by means of roller chains. A feature of the vehicle is the control. There are three speeds forward and two reverse. The controller, of the segmental drum type, is fitted with the Garrett patent trip gear, which is so designed that as soon as the foot-brake or hand-brake is applied, the controller automatically returns to the neutral position.

The well-known "Orwell" electric vehicles and industrial trucks are shown by Ransome's Sims & Jefferies, of Orwell Works, Ipswich. A 3½-ton electric tipping wagon, a 2-ton chain-driven electric chassis, a type C electric elevating platform truck and a type B 1 electric platform truck are exhibited. Here again, a two motor drive is adopted. The chassis includes a number of special features calculated to increase the life. The control of the motors—series-parallel—has been designed to give very gradual starting. The cost of running an Orwell truck is put at £200 per annum, taking the driver's wages at £120 per annum, said to be a high figure, and each truck will, it is claimed, do the work of five labourers.

The only other electrically- or semi-electrically driven vehicle in the Exhibition is a Tillings-Stevens petrol electric single deck saloon omnibus and a 50-h.p. petrol electric chassis.

Electric Lighting Sets.

It is an item of interest that British magneto makers have come into their own as a consequence of the war, but it must be confessed that, it has been found impossible to improve much on the old Continental type of magneto which held such sway before. The puzzle always was why British electrical engineers did not take up the manufacture of magnetos until they were forced by dire necessity to do so. Anyhow, it is a great satisfaction to see British made magnetos on all the vehicles, and there is no reason why there should ever be a departure from this. Among the firms exhibiting magnetos are the British Thomson-Houston Company, the British Lighting & Ignition Company, Conner Magneto & Ignition Company, and Joseph Lucas, Ltd.

Although on the electric vehicles the lighting is necessarily electrical, it is surprising what a large proportion of commercial vehicles still adhere to acetylene. This is the more remarkable when one considers the almost universal application of electric lighting to pleasure cars and the success which has attended the adaptation of a combined generator and magneto to such an unsprung vehicle as a motor cycle and side-car, compared with the springing on cars of all sorts. The convenience of electric lighting ought to make greater headway than it has done on this class of vehicle. Perhaps it is expense that is standing in the way, for compared with acetylene, the initial outlay may well be a deterrent. Many of the vehicles are equipped with electric starting apparatus and also electric lighting, but the large display of acetylene lamps in the accessories section alone is sufficient indication of the field of development for electric lighting. An electric lighting and starting set costs approximately £65, for a 30-cwt. chassis, and perhaps where only the convenience of a driver is concerned, some firms will not go to that expense. There are many exhibits of electric lighting outfits, including C. A. Vandervell & Company, Brolt, Ltd., and Lucas, Ltd.

Contracts and Stable Industrial Conditions.

How closely the problem of unemployment and the possibility of obtaining almost immediate amelioration in the present serious situation is interwoven with the plea for a definite period of industrial stability to facilitate the acceptance and carrying out of large contracts in every industry in the country, was revealed at a conference held under the auspices of the Industrial League and Council to study this particular question at the residence of Mr. Hugo Hirst, chairman and managing director of the General Electric Company, "Fox Hill," Earley, near Reading. Among those who took part in the conference were Mr. G. H. Roberts, M.P.; Mr. Reg. McKenna; Major-General Sir Newton Moore, M.P.; Mr. E. W. Petter (Vickers-Petters, Ltd.), Mr. D. Gilmour (Scottish Miners), Mr. E. Manville, M.P.: Mr. John Baker (Iron and Steel Trades Confederation), Mr. J. D. Boving (Boving & Company, Ltd.), Mr. Clatworthy (Cardiff), Mr. G. Dallas (Workers Union), Mr. M. Railing, Dr. A. Railing and Mr. J. Y. Fletcher (General Electric Company), Mr. P. Rosling (W. T. Henley's Telegraph Works Company), Mr. C. Wilson (Osram-G.E.C. Lamp Works), &c.

Discussion was opened by Mr. E. W. Petter, who dealt with the position of affairs from the employers' point of view and referred to the disastrous effect of the unrest in industry for the past two years. Large employers who had ventured to state fixed prices in contracts found, when the contracts had been completed, they had lost thousands of pounds in the transaction. They could not afford to go on doing that. Instability and loss of contracts were culminating in unemployment, and the time had arrived when workers and employers should see whether they could not find a solution. If they could only agree to stability for a fixed period, approximately 12 months, he had no hesitation in saying the outcome would be that the wave of unemployment would be obviated, industry would speedily recover and absorb the whole of the unemployed in the land, the cost of living would be materially decreased, and at the end of the year the workers, providing they stuck conscientiously to their work, would find they would be able to maintain not only their present rate of pay, but its relative value would be enhanced.

There was unanimity of opinion as to the absolute need for stability, the only debatable point being as to the best means which could be adopted to attain that end. It was also generally agreed that workers would be given a larger share in the management of the industry in which they were engaged and a proportionate participation in any increased profits derived as a result of the united efforts made. These conferences of employers and employed, as organised by the Industrial League and Council, are regarded as a useful feature and the delegates urged the necessity of such conferences being extended to every part of the country.

At the opening meeting of the present session of the West of Scotland Branch of the Association of Mining Electrical Engineers on Saturday, Mr. Frank Anslow dealt with present-day electrical problems in mining. The success of the complete electrification of collieries pointed to its extended adoption in favourable circumstances. Complete electrification might not always be economical, but under circumstances requiring the replacement of winding or ventilating plant or the layout of a new pit, the case was a good one. One recent development might, under suitable conditions, help to increase output and minimise the cost of hauling underground. The Home Office had sanctioned the use of electric accumulator tractors underground. At present eight tractors were in commission in an iron ore mine, and it was anticipated that with 12 tractors 2,000 tons of iron ore per day would be dealt with. Upkeep so far had not been a costly item, and from the experience gained it did not appear likely that it would be. One tractor replaced six ponies, so that even with their comparatively high first cost there would be no doubt as to their economy. The system seemed sufficiently attractive to claim the consideration of mine managers, particularly those who might be remodelling their underground arrangements or planning new ones.

The Cause, Suspicion—The Remedy, Propaganda.

Mr. H. E. Blain was in pessi-optimistic mood at the Batti-Wallah Society's first luncheon of the winter session on Monday last, when he gave a general talk on the present industrial outlook, and his opening remarks were certainly of a doleful character. "Dangerous days—nationally, commercially, personally," he described them. War weariness, the Russian business (or lack of it), the problems of reconstruction, high wages, high prices, the sense of irritation, and finally the mutual suspicion with which employer and employee faced each other, were all reviewed.

Mr. Blain, who, on the underground system, has charge of 20,000 employees, is entitled to speak on these subjects. He sees labour struggling—labour discontented with its share in the products of industry—labour trying perhaps to get more and do less. In his mind, however, propaganda is the panacea for industrial ills. Propaganda—blessed word—propaganda as active and forceful as that which is now filling the minds of labour with wild notions, must be undertaken by the Government and by the captains of industry. An earnest of its success is the fact that labour leaders—once rank and file and unconscious of anything beyond—realised the meaning of the word Responsibility, and knew that power could only bring with it duties and responsibilities of the gravest kind. The work of the Whitley Committees and Industrial Councils was proving an immense help, but there must be education, education, education!

Altogether a most timely contribution to the suggestions of the moment and one which Mr. Blain himself is doing his best to act upon.

Legal Intelligence.

Excess Profits Appeal.

Last week Mr. Justice Rowlatt heard an appeal by Messrs. J. P. Hall & Company against an assessment to Excess Profits for the period January to June, 1916. The company entered into a contract with Douglas & Grant in March, 1914, for the supply to them of 55 electric motors, with control gear, delivery to be made between July 1, 1914, and Sept. 30, 1915. Appellants sub-contracted with Allen West & Company, and deliveries were to be made to the works of Douglas & Grant and to Rosyth Dockyard. The resultant profit to appellants would be about £1,000. Owing to the war deliveries were delayed, and the profits were credited in the periods in which the deliveries were made. The company claimed that the profits should be allocated to the standard period for the six months ended June, 1914, and not to the accounting periods in which delivery took place. They said the profit resulted from a pre-war contract, and came in the period ended June 30, 1914. The Inland Revenue Commissioners claimed that the profit was attributable to the several accounting periods in which the contract was performed.

Mr. Justice Rowlatt expressed the view that if appellants had been accustomed to allocate their profits to particular years in a certain way they were entitled to continue that practice. A true statement of the accounts for the period ending June 30, 1914, would have to include that profit, but the principle must be applied consistently, and if receipts had been brought in applicable to contracts closed in the previous periods those must go out. He referred the case back to the Commissioners for the account to be adjusted.

Breach of Factory Regulations.

Plymouth Corporation were fined £5 last week for failing to observe the Home Office Regulations for the use of electricity in Factories and Workshops. The particular breach was in regard to the switchboard arrangements at the Electricity Works.

Mr. J. Owners, H.M. Inspector of Factories prosecuted and described the switchboard at the Prince Rock station, where an accident recently occurred to a man named Prout. He said the live part of the apparatus was divided into an upper and an lower cubicle, and through it there passed a high tension a.c. current of 2,000 volts. The code laid down regulations for work on a switchboard or when it was cleaned. Prout, a semi skilled workman, had been engaged in electrical work for the Corporation for five years, and he was told to clean out the upper cubicle of the switchboard. Having put on either one or two gloves, Prout placed a chair on a table and stood on it to reach the apparatus, which he knew to be live. He began to wipe the insulators with a duster, and rested his right hand against the framing of the cubicle. In stretching his arm right in to reach the innermost insulator, his upper arm which was not covered by the glove, apparently came in contact with the "'bus bars." He received a shock which rendered him unconscious, and in this condition he was found on the floor. Both his arms were seriously hurt, and he had been unable to work since. Those in charge of the station recognised that the operation was dangerous, so they had provided gloves to protect the men. The Corporation had not provided the equipment which would enable the apparatus to be made dead, and had not shut off the power during cleaning.

Prout, having given evidence, was cross-examined by the Town Clerk (Mr. Fittall), who implied that witness ought to have done his dusting with a wiper on the end of a stick. Prout said he had never been provided with a stick, although he sometimes used one of his own. Moreover, the cleaning could not be done properly, and to use a stick would be to invite accidents.

Mr. G. Scott Ram, H.M. electrical inspector of factories, admitted in cross-examination, that the only way to comply with the regulations was to install additional apparratus at considerable expense, or close down the station for about half an hour. That was done in Coventry, where the station was six times the size of that at Plymouth. The gloves constituted no real protection in dealing with high-tension current. There were switchboards which could be cleaned with absolute safety, but the one in question was not safe. The operation Prout had to carry out was liable to cause a serious accident even if a stick were used; it might liberate the whole power of the station, cause an explosion, and create great heat, which would probably blind and scorch a man at the door of the cubicle. Standing on a chair placed on a table was another source of danger, as the chair might slip. The practice in most big stations was to have duplicate apparatus, so that the supply need not be cut off.

For the defence, Mr. E. G. Okell, borough electrical engineer, said that he had always thought that men carrying out the standing instructions implicitly would be in no particular danger. The present precautions had been sufficient to prevent any accident for the 20 years the machines had been in use, and it would be inconvenient to consumers requiring a continuous supply of current if the power had to be shut off periodically. There were extensions in progress, however, by which the regulations would be complied with, but the scheme had been hung up by the war.

In inflicting a fine of £5, the Chairman said that the Bench considered that a technical offence had been committed, although the man had failed to use the protection provided for him.

Postmaster-General v. Blackpool & Fleetwood Tramroad Company.

On Monday the Court of Appeal (the Master of the Rolls and Lords Justices Atkin and Younger) heard an appeal by the company from a Divisional Court (Lords Justices Warrington and Scrutton), reversing a decision of the county court judge at Blackpool. The plaintiff sought to recover £16. 18s., the agreed expenses incurred in making certain alterations or repairs to telegraph lines which were alleged to have been injuriously affected by the working of the company's electric tramway. The company's tramroad had been constructed under their private Act of 1896, and its working was required to be in accordance with the Board of Trade regulations, made under sec. 66 (3) of the Act. In 1914 the Postmaster-General laid a lead cable containing telegraph wires which at a certain point were within 7 ft. of the company's electric lines. No notice was given to the company before the cable was laid either as to the position or the manner in which it was intended to be used. On June 14, 1916, plaintiff's cable broke down at Bispham, and upon taking up the lead piping it was found to have been injuriously affected by electrolytic corrosion due to leakage of electric current from the tramroad. The company was notified that a claim would be made for the cost of repairing. After the corrosion had been discovered the company invited the Postmaster-General to bond his cable to their track so as to prevent any further electrolytic corrosion. The cable was so bonded, and electrolytic corrosion either ceased or was diminished as far as possible. The company in the construction and working of their tramroad had complied with the regulations of the Board of Trade. The claim of the Postmaster-General was based on certain sub-sections of the Company's Act of 1896, and (alternatively) on sec. 8 of the Telegraph Act, 1878, which was incorporated in the company's Act. The County Court judge held that sub-sections 1 and 2 of the 1896 Act must be read together, and as the Postmaster-General had not proved that the company had not constructed or worked their undertaking in all respects according to the best means within their power, and with due regard to the telegraph cable, or that they had not used every precaution to prevent the cable from being injuriously affected, judgment must be given for the company.

On appeal to the Divisional Court it was held that defendants were liable under sub-sec. 2 of sec. 65 for having by their working injuriously affected plaintiff's cables,

After legal arguments, the appeal was dismissed. The Master of the Rolls said that sec. 65 (2) was independent of sub-sec. 1. If it were to be shown that the cable was injuriously affected in the position in which it was by the working of the tramway it would be no answer to show that the Postmaster-General was guilty of unreasonable lack of care or skill in selecting the place for laying the cable. If it could be shown that the construction and working of the tramway did not injuriously affect the cable, but that it was so affected by the act of the Postmaster-General, then sub-sec. 2 might not apply. There was some evidence before the County Court Judge that it was acting with reasonable care to put the telegraph cable so near a tramway; on the other hand, there was evidence which might have qualified that view considerably. The evidence that the company had complied with all the Board of Trade regulations was doubtful, as the evidence of the manager was that it was "apparently" not safe to place the cable within 7 ft. of the tramway. But to deal with the question there must be a finding of fact whether the Postmaster-General was negligent or not. If the point had been raised in the County Court and the learned judge had been asked to find the facts upon it, and had failed to do so, the Court might have sent the case back to him to make that finding. In the absence of that finding, it was not competent for the Court to entertain the appeal.

Commercial Topics.

Aliens and Mining Shares.

An Order in Council has revoked the Defence of the Realm Regulation 30 B B, which prohibited the sale of copper, lead, tin, tungsten and zinc mines, or shares in them, to aliens. Mines or mining shares in this country or abroad may now be sold to aliens.

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Cingalese Electrical Developments.

There is a good deal of undeveloped water power in Ceylon, but plans are being prepared for the utilisation of these resources and also for the conversion of some of the railway lines to electric traction. There is, therefore, every hope that there will soon be a good demand for electrical plant in Ceylon. The services of the electrical adviser to the Indian Government (Mr. J. W. Meares) have been lent to Ceylon for the purposes of the investigation, and as he has recommended the adoption of the British standard frequency of 50 cycles it is probable that the Ceylon Public Works Department will place their contracts in Great Britain.

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New Factories in Niagara District.

In order to impress upon representatives of British and American manufacturers contemplating the erection of branch factories in Canada the special facilities of the Niagara district, the Niagara District Industrial Organisation recently held a Congress in Ontario. The delegates were shown the local power and transportation facilities, and visits were made to the power plants at Niagara Falls, and to the works on the Chippawa-Queenston Power Canal and the New Welland Ship Canal, now under construction. The district is rapidly becoming an industrial centre, and many new factories are being erected. A publicity campaign has been undertaken and descriptive pamphlets issued by the Hydro-Electric Power Commission of Ontario and the municipalities in order to show the great facilities for cheap electric power in the district.

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Indian Trading Conditions.

In an interesting Paper on our trade with India, which was read before the Royal Society of Arts on the 15th inst., Mr. T. Ainscough, H.M. Senior Trade Commissioner in India, pointed out that the position gained by Japan and the United States in Indian trade was due to the disabilities experienced by British producers owing to the war. The important difference was that while Japanese trade had fallen away very considerably since it had been possible to secure goods from this country, that of the United States had made its greatest strides since the Armistice, and now was second only to our own. Her success had been largely due to her ability to quote firm prices, and give hard and fast deliveries, especially in respect of steel and steel products, while British makers were unable to do so owing to the constant rise of price in materials and to a succession of labour troubles. Mr. Ainscough thinks that American competition, particularly in iron, steel, machinery, tools, hardware, electrical supplies and motor vehicles, will continue to be severe, and may grow in intensity. Our manufacturers and distributors must, therefore, provide equally suitable goods at a lower price. Another important change the war had brought about was the rapid advance of Indian industrialism, and British firms should carefully watch developments.

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Credits for Overseas Trade.

From the return of credits granted during the quarter ended Sept. 30 under the Overseas Trade (Credits and Insurance) Act of 1920, we learn that the actual payments made amounted to £27,395. 4s. 11d. for exports to Roumania and Czecho Slovokia. During the same period applications were sanctioned amounting to £68,773. 15s. 3d. Future returns would be more interesting if some particulars were given of the actual branches of industry affected.

As drawn up the scheme has certain drawbacks, and it will need revision if the facilities which it was intended to afford are to be taken advantage of. It is needless to point out the paramount importance of every effort being made to foster the export trade of the country, but the present scheme is not of much assistance, except to wealthy firms. The Federation of British Industries, which is in communication with the Board of Trade on the subject, point out that the fundamental principle of the Treasury advancing 80 per cent. (for a period up to three years) of the cost price of the goods to be supplied leaves 20 per cent. to be advanced by the bankers of the manufacturing firm wishing to export. Bankers are exceedingly reluctant to advance this amount even to old and favoured clients. The scheme, to be of any practical use, should (according to the F. B. I.) provide for advances to approved firms of 100 per cent. of the cost value. Even if the bankers provide the 20 per cent., the exporter is still forbidden to cover this risk by insurance, and it is difficult to see why| the exporter should run the risk of making no profit, but also the further risk of losing 20 per cent. of the net value he puts into the work. The exporter is not necessarily a financial expert, and provided that he can find such experts who, by insurance, will assume for him this 20 per cent. risk, it reduces the Government liability by this amount, leaving the exporter with the more legitimate risk of making no profit at all. The Federation, therefore, urge the Board of Trade to allow the exporter to cover himself by insurance, and also that in cases of transactions with Governments great elasticity should be allowed with regard to the nature of the collateral security which H. M. Government insists upon. As a matter of fact, we think the Federation is wrong on the question of insurance, for firms can cover their risk in this way, but the other points made careful consideration.

Electricity Supply.

Hove Corporation has been authorised to increase the maximum charge for electrical energy from 8d. to 9d. per unit.

Blackburn Guardians are applying for sanction to spend £1,426 in installing the electric lighting at their Infirmary.

Birkenhead Corporation objects to inclusion in the Mersey and W. Lancashire electricity area, and has applied for time until March 31 to prepare their own scheme.

Greenock Law & Finance Committee recommend the Corporation to increase the salary of the burgh electrical engineer, Mr. F. H. Whysall, from £1,000 to £1,100 per annum.

So great is the demand for electrical energy in Stockport that the Corporation has been compelled to refuse the application of Disley Rural Council for a supply of electricity in the district.

Doncaster Corporation has applied for the loan of £10,493 for h.t. mains, transformer motor station, &c., for the supply of electric current to the dwellings on the Carr House Estate.

Queenborough Council, owing to the Sheerness & District Electric Power & Traction Company having applied for power to increase their charges, have decided to consider the question of a municipal supply.

The sanction of the Electricity Commissioners to the extension of the generating station at Chamber Hall has been received by Bury Town Council.

An application for sanction to borrow £5,000 for house services has been made by Burnley Electricity Committee. Permission to a further loan of £12,445 for extensions has been received.

Basingstoke Council have asked adjacent local authorities (including Aldershot Council) to join them in asking the Electricity Commissioners to constitute an electricity area.

Golborne Urban Council have asked for terms for supplying electric current for public lighting from the Lancashire Electric Power Company, the Lancashire United Company, and R. Evans & Company.

The Truro Council has instructed a committee to report on the offer by the Cornwall Electric Power Company to supply electricity to the City. The cost for mains extensions is put at £6,750.

The Electricity Commissioners have authorised a maximum charge of 1s. a unit for electricity in Cromer, and the members of the Council are vigorously protesting against the introduction of a minimum charge of 15s. in the winter and 10s. in the summer.

The estimated cost of the scheme for linking up the electricity undertakings of East and West Ham, Ilford and Barking is £19,712, and East Ham Corporation has applied for sanction to borrow this sum.

The equivalent of 91,707 30-watt lamps is at present connected to the mains at Gillingham, compared with 83,721 in 1919. The charges for electrical energy for lighting and power have been increased as from the 29th ult.

On the recommendation of a committee Stratford-on-Avon Council has decided not to take over the local electricity undertaking for £10,000. A sum of £30,000 would require to be expended on renewals, and then they would be faced with a deficit on the working.

Councillor H. Lupton has been appointed chairman of the Joint Council for the Electric Supply Industry for Area No. 2 (Yorkshire, N. Derbyshire, N. Notts, and Lincoln), and Mr. W. Redmayne, of the E.P.E.A., is deputy chairman.

By arrangement with the Westminster City Council the Charing Cross, West End and City Electricity Company have recently replaced the arc lamps in the streets supplied by them with two 750 watt gas-filled lamps, erected on a twin swan neck mounted on the existing posts at a height of 25 ft. above the road level. The result of the change is a great improvement in the illumination of the road surface.

The Ilkley Urban Council finds itself compelled to extend the electricity works at a cost of £18,500. The present plant has a capacity of 200 kw., and the Council has recently purchased for £6,000 plant of 170 kw. from the Disposal Board, but extensions of buildings, mains, &c., are necessary, and application has been made to the Electricity Commissioners for sanction to borrow £12,500.

The revenue of Portsmouth Electric Lighting Department for the year ended March 31 was £91,685 (compared with £60,103 in previous year) and working expenses were £68,623 (£52,951), leaving gross profit £23,062 (£7,152), to which was added £3,566 received for sale of obsolete boilers. Instalments of loans required £10,803 and interest on loans £7,776, and on bank balances £2,295, leaving £2,187 net profit (against a deficit of £12,824). Total maximum demand was 3,000 kw. Units generated were 5,241,772 and sold 4,178,312.

Acting on the advice of Mr. C. H. Wordingham Buxton Urban Council has cancelled its previous application to borrow£15,775 for new plant and has decided to make a fresh application to borrow £21,000 for two 200 kw. gas-driven generating sets (£12,000), one 100 kw. gas-driven set (£3,500), and with piping, switchboard extensions, &c., a total of £21,000. A revised scale of charges for lighting and power has been drawn up and will come into operation as soon as the sanction of the Electricity Commissioners has been received.

The Nottingham Electricity Committee is proceeding with commendable promptitude with the arrangements for the erection of the new power station near Clifton Colliery. The Town Clerk has been asked to inquire from the Derbyshire and Notts Electric Power Company whether they require a supply of energy in bulk and to what extent. The consulting engineer (Mr. J. H. Rider) has been instructed to complete his detailed plans so that tenders for the plant can be obtained without delay. In the event of the power company requiring a supply of energy it will be necessary to proceed with the second and third sections of the Corporation's scheme.

The first meeting of the No. 6 Area DISTRICT JOINT INDUSTRIAL BOARD FOR ELECTRICITY SUPPLY was held last week at Bristol. The chair was taken by Mr. H. Faraday Proctor at the request of both the employers and the staff members. The Constitution of the District Joint Boards as circulated by the National Joint Board was approved, and the following officers were appointed for the ensuing year:—Chairman, Ald. A. A. Sennington (Bristol Electrical Committee); Vice-Chairman, Mr. A. J. Ostler (E.P.E.A.); Treasurer, Mr. F. J. Elliott (E.P.E.A.); Joint Hon. Secretaries, Mr. R. Glass (employers) and Mr. F. J. Elliott (staff members side).

The accounts of BRISTOL ELECTRICITY DEPARTMENT, which were submitted to the Council last week, show increase £229,524 (compared with £169,313 in previous year), working expenses £166,589 (£122,226), and gross profit and other credits £63,162 (£47,405). Interest and stock dividends required £20,825 (£19,243), debt redemption £31,462, and the net profit was £10,874 (compared with a loss of £3,416). Working expenses were equal to 1.357d. (1.099d.) per unit sold, redemption 0.258d. (0.285d.) and interest 0.172d. (0.176d.) Units generated were 34,851,637 and sold 29,039,680 (26,269,745). Maximum coincidental load was 13,288 k.v.a. (10,884 k.v.a.), and load factor 27.1 (30.5) per cent. Motors, heating and cooking apparatus connected aggregate 29,470 H.P. (26,733 H.P.).

The LIVERPOOL Corporation Tramways Electric Power and Lighting Committee held the last meeting of the year on Friday, when Ald. F. Smith gave a resumé of the progress made. During 1919, the units supplied for lighting, power and traction purposes were 74,609,074, an increase of 2,000,000 units over 1918. This year's output had increased very satisfactorily, for in the first eight months ended August the number of units supplied was 10,000,000 more than in the corresponding period last year, an increase of about 21 per cent. The capital expenditure up to the end of 1919 amounted to £2,374,017, and the revenue for the year was over £629,000. The average price paid for fuel in 1914 was 10s. 4d., but for the past quarter it has been 40s. per ton. Wages had also increased from 120 to 150 per cent., and the same increase would apply to most materials purchased during the year. The net surplus for 1919 was £81,836, out of which a contribution of £50,000 was made to the rates and the balance allocated to renewals fund. They were now barely paying their way, and the strictest economy must be exercised, compatible with efficiency.

Electric Traction.

WIGAN Corporation tramways department has decided to abolish women's labour.

Disabled ex-service men are to be allowed to ride free on the HALIFAX Corporation tramcars.

Work on the conversion of the L.C.C. TRAMWAYS from West Indian Docks to Terrace-road, Hackney, was commenced on Wednesday. The line will be equipped on the overhead trolley system.

The receipt of the LIVERPOOL Corporation tramways for the first nine months of 1920 were £1,073,495, compared with £858,218 in the corresponding period of 1919, an increase of £215,277, and the number of passengers had increased by 10,749,329.

Owing to the COAL STRIKE the TRAMWAYS SERVICES in several districts have been restricted. At Liverpool the service has been cut down by 25 per cent., and in Manchester, Bury and other areas in the North and the Midlands the services have also been reduced.

MIDDLESBROUGH Tramways Committee is making arrangements to take over the Teeside tramway system, and when the purchase money has been paid to the local tramways company, steps will be taken to associate the councils of Stockton and Thornaby in the joint management and control of the lines.

A STRANGE CHARGE OF PROFITEERING came before the Brighton Profiteering Committee on Monday. It related to the special fare of one shilling charged on the Corporation tramways on the occasion of the local race meetings. The Committee found that the subject was not covered by the Profiteering Act, but a resolution was passed to the effect that the charge was considered excessive.

An inquest was held on Monday on Mrs. McClelland, who was killed in the ACCIDENT ON THE DISTRICT RAILWAY at Wimbledon on Thursday last, when the train ran into the buffers, and brought down part of the station roof. The jury returned a verdict of accidental death, with a rider that the train was going a little too fast, owing to the driver having committed a slight error in judgment.

In the report of the Ministry of Transport on RAILWAY ACCIDENTS in 1919 it is pointed out that "a system of automatic train control is the remedy to prevent failure of enginemen to obey signals." The advisability of adopting a system of control has still to be authoritatively dealt with. Seven of the cases under review would, it appears, have been prevented with such a system in force. Other lessons to be derived from the year's experience are the bearing which incorrect or ill-expressed messages—telephone, verbal and telegraphic—may have in causing misunderstanding and liability to danger, and the inferiority of a visual indication for reminding signalmen compared with a direct control over instruments or signal levers.

Imperial and Foreign Notes.

Among the Government works projected in MAURITIUS are the provision of additional railway rolling stock and the electrification of some of the lines.

The TASMANIAN PARLIAMENT has ratified an agreement between the Government and Launceston Corporation for the erection of an electric line for transmitting 3,000 H.P. to the city from the Great Lake hydro-electric works. The Launceston Corporation is purchasing this power from the Government for £5. 7s. per horse-power.

The Government of NEW BRUNSWICK has decided to develop the water power of the Province, and an immediate start will be made with the Musquash and Shogemoc Rivers. Plans are being prepared by the New Brunswick Electric Water Powers Commission. Up to the present only 18,080 H.P. has been developed, but it is estimated that the undeveloped water power is over 300,000 H.P.

It is reported that Mr. J. A. Dawson, formerly teacher of electrical engineering at the Ballarat School of Mines, and Mr. V. Nightingall, an electrical engineer of Melbourne, have devised a system of LOCATING METALS UNDERGROUND, which it is believed will eliminate haphazard and unprofitable mining work. An electric current producing a certain sound is transmitted through the earth's crust, and by means of special telephone receivers and visual indicators a surveyor picks up this note, his ear detecting and interpreting any variations which may occur as indicating the presence, or otherwise, of any lode or metalliferous deposit, either near the surface or at considerable depths. A successful trial is said to have been made at the Indoorospilly Silverhead Mines. A Company, with the name of Electrical Mine Surveys Pty., Ltd., has been established at 339, Collins-street, Melbourne, to exploit the system.

According to the Consular Report on the trade of the TANGIER district there are openings for British electrical plant and accessories, hardware, ironmongery, &c.

It is reported that Herr Kocher, the Chinese representative of the Siemens-Schuckert Elektricitätswerke, of Berlin, has secured a contract to supply machinery for a COLLIERY, near HANGCHOW, North China.

A company has been formed in STOCKHOLM for developing an invention for the utilisation of WIND-GENERATED MOTIVE POWER. The idea is said to be "that the wind motor pumps water into high receptacles, whence the water streams out, propelling turbines which generate electricity."

Tenders from the Montevideo Telephone Company and the Western Electric Company (America) were recently secured by the Uruguayan Government for an UNDERGROUND SYSTEM OF TELEPHONE LINES, but, as the law dealing with the subject specifies that three tenders must be received, the tenders were not opened and it was decided that a fresh invitation of tenders should be issued.

The Swiss Auer Company, of Zurich, has made an agreement with the German electric lamp combine, formed by the A.E.G., Siemens and Osram companies, by which the Swiss company, which already had the sole right to manufacture Osram lamps for the home market, is granted a licence to produce also Wotan and A.E.G. lamps. The German combine also undertakes not to import into Switzerland any of these types.

In a report by the Committee for the protection of the bond and shareholders in the MEXICO TRAMWAYS, LIGHT & POWER companies it is stated that since the last report the operations of the Light and Power Company have been carried on with reasonable success, and there is a growing demand for power. The hydraulic plants have to be operated to their fullest capacity, and steps are being taken to instal a new unit at the Necaxa power house. Matters outstanding between the companies and the Government are under discussion with a view to reaching a settlement. When the tramways were handed back by the late Government no indemnity was paid for their occupation for over four years. The question of an increase in fares to compensate the company for the advance in wages; the subject of the taxation of the companies, and other matters are under discussion. The accountants' report on the financial position will be ready soon, and early in the new year the committee will be in a position to make a full report.

The question of developing water power is at present engaging the attention of the BULGARIAN CHAMBER, which is considering a Bill to regulate water syndicates. Investigations have been made as to the utilisation of the waters of the Rivers Topolnitza, Kritchim, Louda Yana, Strema, Eli Dere, Tchai, Toundja, Vinkos and Sutlika, and the Board of Trade "Journal" states the results show that the water resources of Bulgaria will make it possible to exploit water power of more than 1,000,000 H.P. Railways and industries will consume only 130,000 H.P. to 150,000 H.P., and the remaining energy will be available for agricultural production and lighting. An extensive irrigation scheme is also projected, including the irrigation of the plain of Deli-Ormana by means of electrically driven pumps. The undertakings to be taken in hand will include the construction of about 17 barrage reservoirs and the building of electric power stations, and also canal systems in the Plains of Thrace, Stara Zagora, Yambol and Sliven in Southern Bulgaria, and in Northern Bulgaria on the lower courses of the Rivers Isker, Vid, Ocem, Rositza, Yantra, &c., as well as in the Plains of Kustendil, Radomir, Doupnitza and Nevropol. The execution of these enterprises can be undertaken either by the State, or by syndicates by means of loans, the repayment of which will be affected by instalments paid by the Water Syndicates. A Supreme Water Council has been established at the Ministry of Agriculture and State Property to provide for the execution of the programme.

Tenders Invited and Accepted.

The date for the receipt of tenders by the Victorian Government Railways Dept. for a 5-ton electric portal crane, with luffing jib (contract 29090) has been extended to Dec. 1.

Doncaster Corporation invite tenders for the supply and erection of a 750 kw. rotary converter and l.t. switchgear. Specifications from the engineer (Mr. S. R. Windle) and tenders to the Town Clerk (Mr. R. A. H. Tovey) by Nov. 2.

Bradford Corporation require tenders by 10 a.m. Oct. 28 for two natural-draught, chimney-type cooling towers, pipe-work, troughing, valves, &c. (Contract R. 160). Specifications, forms of tender, &c., from Mr. Thomas Roles, Electricity Offices Town Hall, Bradford.

Manchester Electricity Committee invite tenders for supply and erection of high and low-pressure steam pipe work, &c. Specifications from the secretary of the electricity department (Mr. F. E. Hughes), and tenders to the chairman of the committee by Nov. 8.

The Victorian Railway Commissioners require tenders by Jan. 19 for the supply and erection or, alternatively, the supply and delivery only of an electric furnace for their Newport workshops (contract 33,419). Specifications may be seen at the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W.

The Deputy Postmaster-General, Melbourne, will receive tenders unti 3 p.m. Nov. 23, for the supply of telephones and telephone and switchboard parts (Contract No. 1650) for the Australian Commonwealth Postmaster-General's Department. Specifications from the High Commissioner, Australia House, Strand, London, W.C 2.

London County Council require tenders by 4 p.m., Oct. 25, for the supply and maintenance of 125 bodies for electric tramcars, 125 maximum traction bogie trucks, and 125 electrical car equipments, with assembly of bodies, trucks, electrical equipments, &c., into complete tramcars. Specifications, &c., from the Clerk of the Council, Spring Gardens, S.W.1.

The Commercial Secretary, H.M. Embassy, Rome, notifies that he has been asked for the names of British firms open to tender for one or two Electric Gantry Cranes, to discharge meat and lard from vessels. Load to be lifted on single end of chain, 1·5 metric tons, and total lifting height, 22 metres. Further particulars from the Dept. of Overseas Trade, 35, Old Queen-street, S.W.1.

Doncaster Council has accepted the tender of A. Reyrolle & Company, at £5,410, for switchgear.

Dartford Urban Council has accepted the tender of W. Bayliss for wiring 28 houses, at £7 per house.

Bankruptcies and Liquidations.

Claims against British Electrical Accessories, Ltd., are to be sent by Nov. 30 to Mr. W. A. Judge, 72, Market-street, Bradford.

A receiving order has been made against Harrison & Son, electrical engineers, 93, Princes-street, London-road, Southend-on-Sea.

A receiving order has been made against Foster Skinner & Company, electric fittings dealers, 6, South Castle-street, Liverpool.

A meeting of creditors of the Masham & District Electric Supply Company, Ltd., will be held at the Town Hall, Masham, on Oct. 27.

Mr. G. A. Johnson has been appointed liquidator of E. Coates & Company, Ltd., mechanical and electrical engineers, Craven House, Kingsway, W.C.

Commercial Electrical Accessories, Ltd., is being wound up voluntarily and Mr. N. Bell, 78 & 79, Wool Exchange, Coleman-street, London, E.C. 2, has been appointed liquidator.

The estates of Albert Mann & Company, electricians, 124 and 326, Main-street, Maryhill, Glasgow, and of Albert Mann, sole partner, have been sequestrated. Grounds of debt must be lodged by Feb. 9 with Mr. W. S. Colville, 55, W. Regent-street, Glasgow.

Educational.

A public appeal is being made for a sum of £500,000 to aid the University of Birmingham in wiping off a debt and to new and urgent demands on its resources.

The Education Committee of the London County Council recommend that a building grant be made for the erection of the new University of London premises. The grant is subject to satisfactory arrangements being made between the Government and the Council of King's College for the reinstatement of King's College on the proposed Bloomsbury site, and in the event of the University of London accepting the site in question that adequate grants are made by the Government for the erection of administrative buildings on the new site. The Council's contribution will not exceed one-third of the contribution made by the Government in respect of expenditure not exceeding £1,000,000.

The Chancellor of the Exchequer (Mr. A. Chamberlain) makes the welcome announcement that the Government propose next year to increase by half a million sterling the Grant in aid of University Education. The grant this year is £1,000,000, with an additional £500,000 to assist the universities and colleges in wiping out debts due to circumstances arising out of the war. Unless he was prevented by overwhelming financial reasons, he had undertaken to grant £1,500,000 for a term of years. He also hoped to be able to do something in the way of a special non-recurring grant to enable the federated universities' scheme of pensions to be adapted to the cases of older professors and teachers who had served before the pension scheme was in existence.

Institution Notes.

A re-union concert of the London Electrical Engineers Old Comrades' Association will be held at the Bridge House Hotel, London Bridge, on Saturday, Nov. 20, at 7 p.m. Admission by membership card obtainable from the hon. sec., Mr. F. Frankling, 108, Heathwood-gardens, Charlton, S.E. 7.

The third annual re-union dinner of the Ex-British Westinghouse Association will take place in the Holborn Restaurant on Friday, March 18, at 6.30 p.m. Invitations to members will be sent in due course. Inquiries should be addressed to the Hon. Secretary (Mr. L. S. Richardson), 14, Sydney-road, Richmond, Surrey.

The National Joint Industrial Council of the Tramways Industry has entered upon its second year under somewhat inauspicious circumstances, as it finds itself faced with a demand for a further all-round increase in wages of 12s. a week. At the meeting last week Mr. W. G. Squires, of the London County Council Tramways Committee, was re-elected chairman. The joint secretaries reported on the standardisation of tramway employees' wages throughout the country, and during the ensuing discussion the employees' representatives put for- a demand for a further increase of 12s. per week, at the same time intimating that what they meant by standardisation was an increase in wages. The employers declined to proceed with the question of standardisation, in view of the demand for increased wages. The employees' representatives then "requisitioned" a meeting at the Ministry of Labour for the 26th inst., to consider the wages demand. Increases in war wages were given on March 31 last, followed shortly afterwards by an increase of basic wages. It is understood that the nine District Councils will be consulted at an early date on the new development.

Miscellaneous.

Summer Time will end officially at 3 a.m. on Monday next.

The will of the late Prof. John Perry has been proved, and the value of the estate has been returned at £10,343.

The death is announced of Mr. Alex. Cameron, a former superintendent of the Eastern Extension, Australasia & China Telegraph Company.

The Labour Co-partnership Congress will take place on the 26th, 27th and 28th inst., at the Royal Society of Arts, John-street, Adelphi, W.C. 2.

The death occurred on Saturday of Mr. J. W. Gatehouse, for many years public analyst and electric lighting inspector to Bath Corporation. Mr. Gatehouse, who retired in May, 1919, was 79 years.

On Saturday last some 4,000 subscribers and 200 junction lines were cut off from the old Central Exchange and attached to the new Central Telephone Exchange in Liverpool.

We regret to record the death at Falmouth of Mr. C. J. Bowen Cooke, C.B.E., the chief mechanical engineer of the L. & N. W Railway Company, at Crewe. Mr. Cooke, who was in his 62nd year, was only ill for a short time and he only went to Falmouth for a rest.

The death is also announced of Sir John McLaren, head of Messrs. J. & H. McLaren, engineers, of Leeds. Deceased, who was 71 years, was chairman of several engineering associations, and was recognised as an authority on matters pertaining to the industry.

Owing to the Coal Strike emergency orders have been issued under the Defence of the Realm Act restricting the use of coal in factories and business premises to 50 per cent. of the weekly average consumed in the four weeks preceding Oct. 16, and also reducing the public lighting, &c. The Lighting, Heating and Power Order prohibits the use of sky-signs, illuminated advertisements and lights used in and about premises for advertising or display. There must be no illumination of windows, the inside light must be for the actual conduct of trade, and lights must be extinguished when shops are closed.

Personal and Appointments.

The Mayor Elect of Windsor is Mr. R. G. Rawkins, manager and secretary of the Notting Hill Electric Lighting Company, Ltd.

Canterbury Council has increased the salary of the chief electrical engineer (Mr. C. A. Blaschek) from £575 to £640 a year.

The Mayor-elect of Stafford is Councillor R. E. Meade, the former borough electrical engineer.

Mr. F. M. Sheedy, superintendent engineer of the operation department of the Newcastle-upon-Tyne Electric Supply Company, who is transferring to the power department, has been presented with a gold watch by his colleagues. Mr. W. R. Rogers, district engineer, Gateshead, made the presentation.

Mr. James Caldwell, M.Inst.C.E., deputy chairman of Industrials, Ltd., and technical director of several electric welding concerns, has retired from the firm of James E. Sayers & Caldwell, consulting engineers, and his address will be 14/16, Cockspur-street, and Parliament Mansions, Victoria-street, London, S.W. 1.

Mr. Herbert Tetlow, chief assistant engineer to the Coatbridge and Airdrie electric Supply Company, has been appointed electrical engineer and manager of the Bacup Corporation electricity department at a salary of £450 per annum, plus 5 per cent. bonus on net profits. There were originally 62 applicants.

Business Items, &c.

The Detroit Engine Company (Mr. Geo. Spicer) has removed to Market-place, Brentford. Telegrams: Spinimane Brentford. Telephone: Ealing 2020.

The Enterprise Mfg. Company, Ltd., Gun-street Electric Works, Bishopsgate, have been appointed the London agents for Messrs. Lowke & Sons, for switchboards from ½ kw. to 10 kw.

Spencer John Tucker and Richard Lloyd Bateson, trading as Tucker & Bateson, electrical engineers, &c., 55, Berners-street, London, W., have dissolved partnership.

Arthur Benjamin Butterworth and John A. Robinson, electrical engineers, 20, Bold-street, Southport, have dissolved partnership. Debts by Mr. Butterworth.

The name of the Central & South American Telegraph Company has been changed to "All America Cables, Inc." The London address, 34/36, Broad-street House, New Broad-street, E.C., remains unaltered.

Walter John Head and John Darcy Steele (trading as the Electric Lamp Replacement Company), 85, Fleet-street, London, E.C.4, have dissolved partnership. Debts by Mr. Head, who continues the business.

Joseph Horton and Geo. Hutton McMiller (trading as the Shire Arc Welding Company), 36, Peas Hill-rise, Nottingham, have dissolved partnership. Debts by Mr. McMiller.

John Howard Hopkins and Chas. Alban Hale (trading as the Electrical Maintenance Company), 140, Wardour-street, London, W., have dissolved partnership. Debts by Mr. Hopkins, who continues.

We are informed that Mr. Arthur Kent has resigned his position of Cable Works' Manager to the Hackbridge Cable Company, Ltd., and that in future all communications should be sent to him at The Hollies, Belmont-road, Wallington, Surrey. Telephone, Sutton 996.

Robert Marshall Chitham and Harry Jenner (trading as Jenner, Chitham & Company) electrical engineers, 11, Red Lion-square, London, W.C. 2, have dissolved partnership. Debts by Mr. Jenner, who continues the business. A sum of £200,000 has been already promised.

We learn that Mr. G. Watson, M.Inst.C.E., M.I.Mech.E., has ceased to represent the New Destructor Company, Ltd., and that he is carrying on his practice as a civil and mechanical engineer at the same address as before—viz., Walter House, Bedford-street, Strand, London, W.C. 2.

The partnership between Fredk. Ernest Youett, Fredk. Reed, Fredk. Hy. Wells Moore and Hy. Thos. Moores (trading as Youett, Reed & Company), electrical and mechanical engineers, 89a, Godiva-street, Coventry, has been dissolved. Debts by Messrs. Youett, Moore and Moores, who continue the business as F. E. Youett & Company.

The manufacturers of the "Elba" accumulators for lighting and ignition are Messrs Jones & Pordes (not Jones & Pardoe, as stated in our last issue), 8, Crawford-passage, Farringdon-road, E.C.1. The firm have appointed the Elco Mfg. Company, Colston Yard, Colston street, Bristol, as their sole selling agents for the sale of their "Elba" cells in the West and South West of England.

The partnership between Sir Guildford Lindsay Molesworth, Henry Bridges Molesworth and Walter Henderson Molesworth, carrying on business as Molesworth & Molesworth, civil engineers, at 32, Broadway, Westminster, S.W. 1, has been dissolved as regards Sir Guildford L. Molesworth. Debts by Messrs. H. B. & W. H. Molesworth, who continue the business.

We are able to announce that Mr. L. E. Little, founder and managing director of the Northern Ball Bearings, Ltd., has recently joined forces with the well-known firm of Ransome & Marles Bearing Company, Ltd., and is at present engaged in introducing several new features in ball bearing design into the most influential quarters in Great Britain. Mr. Little's headquarters are at the London office of the company, 64, Mortimer-street, Great Portland-street, W. 1, and those interested in the efficiency of the bearings they employ should get into touch with him.

Catalogues, Price Lists, &c.

In their revised catalogue of Diesel Oil Engines, Messrs. Hick, Hargreaves & Company, Ltd., Bolton, give a concise but clear description of their engines, with particulars of methods of construction, illustrations of certain types of engine, &c. The firm have an excellent reputation as steam engine builders and the new list which has been extended now includes engines ranging from 50 b.h.p to 1,020 b.h.p.

In an illustrated list issued by the Automatic and Electric Furnaces, Ltd., some technical details are given of their "Flat" Electric Furnace, which has been designed by them. This is an entirely new design, which embodies all the principles of the Wild Barfield furnace, with the added refinement of the excess temperature cut out, making electric furnaces safe in the hands of inexperienced workers. The "Flat" furnace is made in six standard sizes, and the dimensions, cost and output figures are included, together with particulars of the excess temperature cut-out, pryometers and thermo-couples.

The Sun Electrical Company have recently issued lists No. 315 and 317 relating to the "Sunco" Electric Fires, together with a Dealer Folder and a striking showcard. The latter is well printed in colours and measures 18 in. × 15 in., and will form an effective advertisement of the fires. For the 1920-21 season the Company have introduced a number of attractive new models, and the literature issued by them should help the contractor and retailer to increase sales by popularising Sunco Electric Fires. Already the Company have been able to place a fair amount of business through retailers. Copies of the lists will be sent to readers.

Patent Record.

SPECIFICATIONS PUBLISHED

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919 Specifications.

149,427 Tucker & Co. & Tucker. Process of and apparatus for assembling electric switches and accessories. (13/5/19.)

149,433 Round. Thermionic receiving-devices for wireless telegraphy and telephony. (13/5/19.)

149,434 Round. Apparatus for wireless telegraphy and telephony. (13/5/19.)

149,435 Round. Receiving systems for wireless telegraphy and telephony. (13/5/19.

149,459 Thomas & Roderick. Mechanical coupling for electric conductors. (22/5/19.

149,461 Graham, Rickets & Sanftleben. Signalling systems with special reference) to telephonic circuits. (23/5/19.)

149,466 B. T.-H. Co. (G. E. Co.) Use of electron discharge devices in signalling systems. (28/5/19.)

Relates to a wireless transmission system having means for varying the potential impressed upon the plate circuit of an electron discharge device in order to modulate the continuous waves generated in which the variable potential is impressed upon the plate circuits of two electron discharge devices, the two plate circuits being oppositely connected with respect to the source of potential.

149,467 Relay Automatic Telephone Co., Bryant & Inman. Electro-magnets or relays. (28/5/19.)

149,472 Krebbs. Devices for attachment of electric conductors to insulators. (29/5/19.)

149,482 Railing & Nobbs. Electric heating apparatus. (5/6/19.)

149,485 Hymas. Dynamo-electric generators for use in lighting cycles or like vehicles. (6/6/19.)

149,506 Siemens Bros. & Co. & Petithory. Electric cut-outs. (14/7/19.)

149,532 Hollingworth. Electro-magnetic wave signalling systems. (5/9/19.)

149.564 Sproates. Reflectors for electric light fittings. (28/11/19.)

149,713 Johnston. High-tension insulators. (14/3/19.)

149,736 Cook. Means for covering or coating electric conductors, wire, and the like with liquid or plastic materials. (14/5/19.)

149,739 Scholes & Claremont. Tool for electric cable stripping. (15/5/19.)

149,756 Richter. Three and multi-conductor plugs. (16/5/19.)

149,799 Igranic Electric Co. & Wright. Coil-winding mechanism. (29/5/19.)

149,800 Relay Automatic Telephone Co., Bryant, Johnson & Ward. Telephone systems. (30/5/19.)

149,801 Chantler. Insulators for overhead transmission lines, such as telegraph and telephone line wires. (31/5/19.)

149,816 Relay Automatic Telephone Co. & Johnson. Automatic telephone systems. (13/6/19.) (Addition to 112,650)

149,820 Igranic Electric Co. & Wright. Electrical coils. (18/6/19.)

149,822 Fletcher. Switch and fuse contacts. (19/6/19.)

149,824 Stoddart. Attachment for the mouthpieces of telephone transmitters. (26/6/19.)

149,826 Murray. Radio-navigational apparatus and the like. (4/7/19.)

149,827 Murray, Robinson & Crowther. Radio-navigational apparatus and the like. (4/7/19.) (Cognate application, 32,812/19.)

149,841 Lorkin, Daglish & Swift. Welding electrode holders. (21/8/19.)

149,858 Western Electric Co. (Western Electric Co.) Electric signalling systems, especially applicable to combined telegraph and telephone systems. (3/10/19.)

149,859 Kleinschmidt. Method of and apparatus for operating a printing telegraph. (6/10/19.)

149,861 Lindstrom & Allmanna Svenska Elektriska Aktiebolaget. Dynamo-electric generators, motors and the like. (9/10/19.)

149,875 Brunot & Chateau. Dynamo-electric generator sets. (20/11/19.)

1920 Specifications.

144,612 Trittle. Electric motor control. (6/6/19.)

149,893 August. Electric muffle furnaces. (18/10/19.) (Divided application on 146.673.)

149,903 Larsen. Electrically-operated time-controlled switches. (12/5/20.)

1920 Specifications.

137,540 Booth Electric Furnace Co. Electric furnace doors. (4/3/18.)

138.602 American Bosch Magneto Corporation. Housings for mechanical interrupters of electric-ignition apparatus. (7/2/19.)

140.105 Mancha Storage Battery Locomotive Co. Storage battery locomotives. (31/8/18.) (Divided application on 132.234.)

149.581 Vidal & Kettelwell. Magnetic chucks. (20/1/20.)

149.584 Igranic Electric Co. (Cutler-Hammer Mfg. Co.) Electric switches. (28/1/20.)

149.587 Harman & Le Bas. Dynamo-electric machines. (2/7/19.) (Divided application on 141,116.)

149.605 B. T.-H. Co. (G. E. Co.) Manufacture of incandescent electric lamps. (9/5/17.) (Divided application on 147.955.)

149.607 Tucker, Tucker & Co. Jig for assembling electric switch parts. (13/5/19.) (Divided application on 149,427.)

149,608 Tucker, Tucker & Co. Jig for assembling electric switch parts. (13/5/19.) (Divided application on 149,427.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of communicators of inventions.*

April 26, 1920.

11.488 Blair & Heatlie. Application of electricity to the heating of hot bulb internal combustion engines for starting, &c.

11.493 Celli. Portable electric vacuum cleaners. (24/4/19. Italy.)

11.519 Siemens Schuckertwerke. Conversion of electric currents. (7/2/17, Germany.)

11.560 Murray. Electric welding apparatus. (2/5/19. U.S.)

April 27. 1920.

11.590 Baden-Powell. Electrical method of reproducing distant scenes visually.

11.616 Automatic Telephone Mfg. Co. & Archer. Electrical connectors for electric heating, &c., appliances.

11.617 Automatic Telephone Mfg. Co. & G[illegible]. Telephone systems.

11.618 Automatic Telephone Mfg. Co. C[illegible]

11.638 Western Electric Co. Harmonic generator or regenerator. (28/4/19, U.S.)

11.665 Fuller. Portable electric lamps.

11.667 Morris-Airey, Dougald & Crowther. Wireless telephony and telegraphy.

April 28, 1920.

11.[illegible] [illegible] & L[illegible]. Electric side [illegible]

11.735 Barker. Wireless telegraph systems of arc gap type.

11.[illegible] R[illegible] & Co. & S[illegible]-T[illegible]. Means of [illegible] electrodes in vacuum tubes, &c.

11.[illegible] [illegible] Heater, Ltd., & K[illegible]. Automatic circuit breaker.

11.[illegible] [illegible]. E[illegible] apparatus. (26/5/19. France.)

11.[illegible] [illegible]

11.819 B.T.-H. Co. & Young. Magneto-electric machines.

April [illegible], 1920.

11.[illegible] [illegible]. Conduits for electrical conductors.

11.[illegible] [illegible]. [illegible] switches.

11.[illegible] [illegible], Ltd., & Hunt. Electric machines adapted for synchronous working.

11.888 Welch. Electrical indicators for signal, &c., lamps.

11,894 Western Electric Co. Machine switching telephone exchange systems. (14/9/17, U.S.)
11.895 Sullivan & Joseph. Electrical condensers.
11.903 Ajax, Ltd., Sell & Cooper. Electrical apparatus.
11.904 Eastern Telegraph Co. & Davies. Duplex and multiplex telegraphy.
11.930 Damey. Electric fly switches.
11.934 Electrolytic Zinc Co. Recovery of zinc by electrolysis. (24/12/19, Australia.)
11.935 & 11,936 Villarboito & Gallo. Electric switches. (29/4/19, Italy.)
11,941 Gordon-Hall. Electric generators.
11,945 Newland. Carbon holder for arc lamps.

April 30, 1920.

11.952 Imbery. Resistance elements for electric muffle furnaces, &c.
11.957 Shuttleworth. Holders or fittings for electric, &c., lamps.
11,976 Davies. Utilisation of tidal power for driving dynamos, &c.
11.998 Perrem. Preventing oxidation of electrical, &c., apparatus.
12.006 Booth. Electric lamp holders.
12,015 Bucknell. Combined electric switch and terminal.
12,022 Nolan. Electric immersion heaters.
12,028 Thermos Akt.-Ges. Electric heating resistances. (16/1/15, Germany.)
12.029 Thermos Akt.-Ges. Electric heating appliances. (5/12/14, Germany.)
12,043 Ponchain. Method of preventing loss of zinc in electric battery.
12,053 Western Electric Co. Telephone systems. (21/5/19, U.S.)
12,064 Hayward & Kluymans. Resistance materials.

Companies' Reports, &c.

The directors of the Indo-European Telegraph Company, Ltd., have declared an interim dividend for the half-year ended June 30, at the rate of 5 per cent. per annum, payable 1st prox.

The directors of the Anglo-American Telegraph Company, Ltd., announce an interim dividend for the quarter ended Sept. 30 of 15s. per cent. on the ordinary, and of £1 10s. per cent. on the preferred stock.

The directors of the Oriental Telephone and Electric Company, Ltd., have declared the following interim dividends :—3 per cent. on the 6 per cent. cumulative preference shares for the current year and 4 per cent. on the ordinary shares.

For the year ended June 30 the profit made by the Norwich Electric Tramways Company was £10,864, and with £167 brought forward, the total available was £11,031. The directors recommend that £714 be written off cost of turbo-generator, the balance of £10,317 being placed to reserve.

The directors of the Oldham, Ashton & Hyde Tramways, Ltd., announce that the arbitration respecting the decision of local authorities to purchase the undertaking has resulted in the purchase of the same for £142,174. There will be a surplus available for both classes of shareholders after repayment of the capital.

At the annual meeting of Stothert & Pitt, Ltd., last week, a final dividend of 7½ per cent. was declared, making, with the interim dividend of 5 per cent. a total for the year of 12½ per cent. The chairman (Mr. Walter Pitt, M.I.C.E.) stated that for a long time they constructed plant for steel works under a working agreement with Wellman Seaver & Head, Ltd., but that agreement had been determined. They had lately arranged with one of the leading American manufacturers of that class of plant which would enable them to manufacture to the very latest practice. They had a large number of orders on hand, and there were indications all over the world of a considerable revival of harbour and port construction.

The annual report of W. H. Dorman & Company, Ltd., for the year ended July 31, states that the net profit, after providing for working expenses, excess profits duty, &c., is £72,980, and with amount brought forward the available total is £100,356. The fixed dividend on the 8 per cent. cumulative participating preference shares to June 1 has been paid, and the directors recommend payment of the dividend on the cumulative participating preference shares up to July 31, with an additional 1 per cent. dividend thereon in respect of the year; also a dividend on the ordinary shares at the rate of 12 per cent. per annum. The dividends will be paid on December 1, together with a further four months' dividend which will then be due on the cumulative participating preference shares in order that the dividends on the ordinary shares may coincide in future with the dates on which the preference dividends are paid. After these dividends are paid a larger balance is carried forward than was brought in. The wave transmission tools, with which the company is associated, have, been practically demonstrated during the last few weeks, and are being put on the market.

At the meeting last week it was announced that the new works, which would be completed early in 1921, would constitute one of the most modern engineering shops in the world. The building is of ferro-concrete and steel, and consists of 12 spacious bays each 400 ft. long by 35 ft. wide. The plant will consist of precision tools of the latest type and be electrically driven throughout. Every bay has its electric equipment, and the whole are united by an electrically-driven travelling crane in a service bay running diagonally to the other bays.

Mr. J. G. B. Stone presided over the meeting of the Electric Supply Corporation, Ltd., and stated that the gross revenue for 1919 increased by £8,707, but the net revenue was £358 more than in 1918. During the year they had perhaps their worst experience in the matter of increased costs and stationary receipts. Those factors had had a very serious effect on all but the largest undertakings in the country. With regard to some of the older undertakings their provisional orders allowed high maximum rates and all large undertakings had a large revenue from power supply, and the rates for power supply being practically unrestricted, they could be adjusted from time to time, and thus secure a fair margin of profit. Last year he referred to the fact that they had agreements with local authorities which in most cases prevented the company from taking advantage of the Statutory Undertakings (Temporary Increase of Charges) Act, but during 1919 the board were able to enter into revised agreements in all but three of their undertakings, and they had therefore got over that difficulty. The position was much better as they now received a considerable addition to their pre-war rates in all their undertakings. It would, however, be necessary to obtain still further advances, and steps were being taken with that object. The Ministry of Transport were apparently looking with a more favourable eye on the claims of the electric supply industry, and they were no longer debarred from making application for increased rates under the Electric Lighting Acts. The rates fixed under such procedure did not involve any curtailment of their dividend, and it was their intention to take advantage of that method in due course. He hoped it would be found that during 1919 they "touched the bottom," and that they would once more show the continued improvement that was their experience in pre-war years. There was no doubt that the demand for electric supply was very much greater than ever it was, in spite of the high cost of installation, and now that they had a fair prospect of getting adequate rates for the electricity they supplied they might hope for a steady improvement in their position.

Mr. A. W. Maconochie, who presided over the first ordinary general meeting of the Agricultural & General Engineers, Ltd., on Friday, was able to give a very satisfactory account of the progress made by the company. He stated that, notwithstanding the great difficulties of trading at present, with industrial unrest at home and high prices, also the fact that, mainly owing to the exchange question, the Continental markets, at any rate as their firms knew them in pre-war days, were shut against them, they had accomplished much in fusing the various interests, works equipment and methods. The initial difficulties of harmonising and co-ordinating the operations of such a great association of firms and organising the production of the whole team on economic and efficient lines took time. To further strengthen their manufacturing circle, they had negotiated the association of nine other firms, whose specialities would make the range of their products more complete. All were well known in their particular branches of engineering work, and they had joined on satisfactory terms. The result of those additions to their strength was that they were able still further to specialise on certain main products at particular works, and were relieved from difficulties in obtaining supplies of material or essential parts of products for the supply of which they had previously to depend on outside sources. They would now be able to concentrate the main agricultural implement business at Bedford under the roof of Messrs. J. & F. Howard. A large proportion of the oil engines would be made at the Stamford works of Messrs. Blackstone & Company, the steam road rollers at Messrs. Aveling & Porter's, the motor road rollers at Messrs. Barford & Perkins, &c. With modern equipment, labour-saving devices, and with plenty of room for work under better conditions, they would attain greater success if only labour would settle steadily down and give of its best. They did not object to good wages—nay, under present-day conditions they were a necessity—but they wanted a good day's work for a good day's pay, and no objection raised when they put in new plant and machinery so as to increase production, and at a cost which would enable them to see their manufactures at prices which customers could pay. They proposed to pay a dividend at the rate of 486 per cent. per annum, tax free.

Presiding over the 77th ordinary general meeting of the Direct United States Cable Company, Ltd., on Tuesday, Sir James Pender, Bart., said that they had to consider the offer of the Government for the purchase of the company's cable, the properties at Ballinskelligs, Harbour Grace and Rye Beach, their equipment at the stations and the stock of cable which appeared in the balance-sheet at £42,415, but which was actually worth nearly three times that figure. He referred to the circumstances that had resulted in the termination of the 99 years' lease granted to the Western Union Company, and stated that the directors had endeavoured to charter the c.s. "Faraday" to repair their cable. The Admiralty controlled the movement of all vessels, but shortly afterwards the Western Union Company, who had one of their own cables interrupted, also approached the Admiralty, who gave instructions that the Western Union Company were to have the first use of the vessel, and that work upon the Direct United States cable was not to be undertaken until the Western Union cable had been repaired. Owing to the Admiralty directions, the ship was unable to repair the Direct United cable during 1918, although it did complete the repair of the Western Union cable, and its charter involved their company in an expenditure of £77,000, with no result. Taking advantage of these circumstances, the Western Union Company determined their lease. Litigation ensued, and an appeal against the decision was pending, but it would be withdrawn if the resolution for the sale of the cable to the Government were passed. An offer had been made by the Government for the purchase of the company's cable, &c., at an increased offer of £570,000. They had been in communication with the Treasury as to the manner in which the purchase consideration was to be satisfied. They had not come to a definite arrangement, but it was agreed that they should have issued to them Government bonds that would ensure their receiving £570,000 in about two years' time, with interest at 6½ per cent. per annum in the meantime. If the offer were accepted, the company would be able eventually to return to the shareholders at least £6 a share, and to remit to them a half-yearly dividend at the rate of about 4 per cent. per annum. The purchase consideration was £570,000, and of that amount £20,000 was, by arrangement with the Government, to be set aside as compensation for loss of office by the directors, which, of course, included Mr. Miles, who was director and manager, and the staff. The directors regarded the offer as a reasonable one in all the circumstances.

The resolution approving the sale to the Government was unanimously adopted.

New Companies.

ALAN EVANS, LTD. (170,512).—Private company. Reg. Sept. 29. Capital £1,000 in £1 shares. To carry on the business of electrical and automobile and general engineers, manufacturers of and dealers in motor cars. &c. Directors are: H. E. Watts, C. S. Watts (and secretary), A. V. Evans. Reg. office: Grafton Motor Works, Norwood-road, Cheltenham.

BELL ELECTRICAL COMPANY (NORTHERN), LTD. (170,706).—Private company. Reg. Oct. 8. Capital £12,000 in £1 shares (2,000 deferred). To take over the business of electricians and electrical and motor engineers at Halifax, and to adopt an agreement with B. Bell. Reg. office: Palatine-chambers, Market-street, Halifax.

BIRMINGHAM & STAFFORDSHIRE ELECTRICAL COMPANY, LTD. (170,662.)—Private company, reg. Oct. 6, capital £3,000 in £1 shares (1,000 founders), to carry on the business of electricians, mechanical engineers, &c. Reg. office, P.O. Buildings, Samuel-street, Bloxwich.

B.M.C., LTD. (170,661.)—Private company, reg. Oct. 6, capital £1,000 in £1 shares, to carry on the business of electricians, motor and mechanical engineers, &c. First directors not named. Reg. office, Arcadia Works, Grant-road, Croydon.

CHARNOCK & COMPANY, LTD. (170,407).—Private company. Reg. Sept. 24. Capital £10,000 in £1 shares. To adopt an agreement with Kate Charnock for the acquisition of the business of an automobile electrical and mechanical engineer and transport contractor, carried on by her as "Charnock & Company." Directors: J. R. Charnock (permanent chairman), and Mrs. Kate Charnock. Reg. office: Harehills Garage, Foundry-lane, Leeds.

PUNCHES, DIES & TOOLS (BOOTLE), LTD. (170,625.)—Private company, reg. Oct. 4, capital £3,000 in £1 shares, to carry on the business of engineers, founders, smiths, machinists, electricians, manufacturers of machinery, tools, &c. Secretary, A. Ellison. Reg. office, 23, Well-lane, Bootle, Lancs.

TILLOTSONS, LTD. (170,397).—Private company. Reg. Sept. 24. Capital £3,000 in £1 shares. To take over the business carried on as "Tillotson Brothers," and to carry on the business of electrical, sanitary and hot-water engineers, manufacturers of electrical and mechanical instruments &c. Directors: S. G. Tillotson and C. T. Turner (permanent), R. N. Flint, and H. Campbell. Reg. office: 52, Kennington Park-road, S.E.11.

WILLIAM HEYWOOD & SON, LTD. (170,810).—Private company. Reg. Oct. 13. Capital £10,000 in £1 shares. To take over the business of ironfounders and general engineers carried on by William Heywood & Son, and to carry on the business of electricians, electrical, mechanical and general engineers, &c. First directors are: W. Heywood (chairman) L. Heywood (and secretary), W. Tattersall and H. Lowe. Reg. office: Milton-street, Royton.

Prices of Metals, Chemicals, &c.

TUESDAY, Oct. 19.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£102 0 0	—	£4 0 0
Electro Wirebars...	..	£106 0 0	—	£7 0 0
H.C. wire basis......	per lb.	1s. $3\frac{3}{16}$d.	—	$\frac{13}{16}$d.
Sheet	,,	1s. $5\frac{3}{16}$d.	—	$\frac{7}{16}$d.
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. $8\frac{3}{16}$d.	—	$\frac{13}{16}$d.
Brass 60/40—				
Rod, basis	,,	0s $10\frac{3}{8}$d.	—	$\frac{1}{4}$d.
Sheet, basis	,,	1s. $4\frac{1}{2}$d.	—	$\frac{1}{4}$d.
Wire, basis	,,	1s. $3\frac{7}{8}$d.	—	$\frac{1}{4}$d.
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£51 0 0	—	—
Lead Pig—				
English	,,	£36 5 0	£0 10 0	—
Foreign or Colonial	,,	35 5 0	£0 12 6	—
Tin—Ingot	,,	239 0 0	—	£25 0 0
Wire, basis	per lb.	0 3 $1\frac{1}{2}$	—	$3\frac{1}{2}$d.

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £17 15s.

,, (Roll Brimstone).—Per ton £17 15s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £39 10s.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 2d.

Sodium Chlorate.—Per lb. $5\frac{1}{4}$d.

Rubber.—Para fine, 1s. 6d.: plantation 1st latex, 1s. $6\frac{1}{2}$d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company, Ltd.

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Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 23, 1880.)

EDINBURGH.—The electric light is to be tried immediately in the Museum of Science and Art.

CAMBRIDGE.—Lord Raleigh will, during this term, lecture on Galvanic Electricity and Electro-Magnetism in the Cavendish Laboratory, and Mr. Glazebrook will give an elementary course in Electricity and Magnetism.

HORSE RACING AND THE TELEGRAPHZ.—Upwards of six thousand five hundred telegrams were disposed of at Newmarket on the day of the Cesarewitch. This, we believe, is one of the heaviest day's business on record at any race meeting.

EDISON'S PATENTS.—It is said that in the course of the last 11 years Edison has taken out 233 patents. He has no less than 35 patents relating to automatic telegraphs, eight to duplex and quadruplex, 38 to telegraph printing, and eight more to trifling emendations of the Morse alphabet in one way and another.

PROFESSOR GRAHAM BELL.—During his recent visit to Paris to receive the Volta prize, Professor Bell performed some successful experiments with the Photophone, using electric light instead of that of the sun. We hope that Professor Bell will explain and illustrate his discovery before our own Society of Telegraph Engineers during the forthcoming session.

INDUCTION AND INSULATION.—Mr. E. F. Phillips, of Providence, has patented a method which he, of course, hopes will supersede the older methods of covering conductors. Heretofore, he argues, insulated conductors have had a metallic sheath of foil wound spirally to carry away inductive circuits. He would put the foil on straight, and by this means he maintains that it is less liable to injury as the foil is bent and handled.

Arrangements for the Week.

FRIDAY, October 22nd (to-day).

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's-gate, St. James's Park, London, S.W. Presidential Address by Capt. H. Riall Sankey.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, Westminster, London, S.W. Lecturette on "Impulse Turbines," by Mr. A. H. Fitt.

SATURDAY, October 23rd.

BIRMINGHAM AND DISTRICT ELECTRIC CLUB.

6.30 p.m. At the Grand Hotel, Colmore-row, Birmingham. Tenth Annual Ladies' Night.

MONDAY. October 25th.

FARADAY SOCIETY AND THE PHYSICAL SOCIETY OF LONDON.

2.30 and *8 p.m.* At the Institution of Mechanical Engineers, Storey's gate, St. James' Park, London, S.W. 1. General discussion on "The Physics and Chemistry of Colloids and their Bearing on Industrial Questions."

WEDNESDAY, October 27th.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.

8 p.m. At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Address on "Some Notes on Foundries and Production," by the Rt. Hon. Lord Weir of Eastwood, P.C.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics."—"The Air Conference"; "Mail Transport"; and "Screw Propellers," by M. A. S. Riach.

"The Cabinet Maker."—"Practical Polishing"; "Helpful Criticism of Retailers' Advertisements"; and "Electric Lighting of Shop Windows."

"The Chemical Age."—Special Review of Canada's growing Chemical Industry: Lord Moulton's Presidential Address to Dyers and Colourists; and "Profiteering in Soda."

"Farm and Home."—"The Meaning of the Dairy Show" (special); "Refrigeration of Dairy Produce"; and "Keeping the Horse in Good Condition."

"The Fruit-Grower."—"Worcester Commercial Fruit Show" (illustrated); "The Kent Show Programme"; and "Is Fair Trading fair Dealing?"

"Gardening Illustrated."—"Bulbs for Early Forcing"; "Chrysanthemums Treatment under Glass"; and "Ripening and Keeping Grapes."

"The Gas World."—"Laying on Gas to a Garden Village in South Wales"; Special Report of the Ninth Annual Conference of the British Commercial Gas Association; and "The Metropolitan Gas References on Testing Gas for Calorific Value."

"Hardware Trade Journal."—"Selling at a Profit"; "A New Type of Recuperative Furnace"; and "The Sale of Firearms."

"Ways and Means."—"Trade Prospects: The Effect of Political Unrest Abroad on British Industries," by E. Bagnall Bull; "The Socialist Machine," by the Editor; "Co-partnership in the Match Manufacturing Industry," by H. Cooper.

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Notes.

The Variable Clause Once More.

One of the most sensational items in this week's news is the announcement that the Allgemeine Elektricitäts Gesellschaft have secured from a British company an order for the supply of electrical plant to the value of £150,000. It is naturally a matter of great regret that this country should lose such an important contract at the present time, but we believe that this failure to secure the work is mainly due to the effect of the variable price clause which now appears in British tenders, and to the inability of our manufacturers to guarantee delivery within a reasonable time. We have recently referred to this subject and to the necessity for firm quotations by electrical manufacturers if proper progress is to be made. Difficult as it must be to quote definite prices in the present unsettled conditions, we sincerely hope that the Federation of British Industries and the B.E.A.M.A. will explore the situation fully, and see if some remedy cannot be promptly devised to meet a situation which is rapidly becoming worse.

Particulars of the Contract.

We learn that the contract secured by the A.E.G. was for the supply of rolling mill equipment to the Partington Steel & Iron Company, Ltd., of Irlam, near Manchester. The equipment will consist of two 1,400 kw. generators, driven by gas engines, and a 3,000 h.p. slow-speed mill motor direct-coupled to a reversing rolling mill, while between the generator and motor will be the usual Ilgner set. Tenders were invited from leading British firms, and from the A.E.G. The latter quoted fixed prices, but in accordance with accustomed practice the British firms, who are unable to buy their steel at fixed prices, submitted contract prices with an "adjustment" clause. The price quoted by one British firm was from £3,500 to £4,000 lower than that of the A.E.G., but the former was, of course, subject to the adjustment clause. If, however, the purchasers had split the contract, and ordered the generators from one firm and the motors from another, the aggregate would not have exceeded the German price, apart from the adjustment clause. Moreover, it is doubtful whether the German specification is as good as those of the British firms, and we may well have similar doubts about the material and the workmanship. We have given these particulars of the contract to show manufacturers and workers what a grave injury is being done to the electrical industry and to the country as a whole by the present unstable state of affairs. Both sides cannot but lose heavily by such a policy, but the workers are likely to suffer even more than the manufacturers, unless industrial conditions are stabilised and we therefore earnestly appeal to both sides to consider the question closely in all its bearings in order that an effective remedy may be provided without delay.

The Coal Dispute.

As we go to press it is stated that the coal dispute is practically settled, though exactly on what terms is not disclosed. But whether or not this is the case and whatever the terms of agreement are, it is certain that short as so far the stoppage has been the damage done to the industry of the country will take a considerable time to repair. How true this is may be gathered by considering the steps which has been taken in many cities to conserve the stocks of coal by limiting the supply of electrical energy in accordance with Government instructions. Such limitation has not only imposed loss on the supply undertakings themselves, but has meant similar loss combined with unemployment and disorganisation to their consumers. This is, of course, inevitable under the circumstances, but it is a pity that the blow could not have been mitigated by a little more care in drawing the Lighting, Heating and Power (Emergency) Order. 1920.

The Restriction of Electricity Supply.

As is well known under this Order the electrical energy used in factories during the strike must not exceed 50 per cent. of that normally consumed, though exceptions are allowed. The local authority is responsible for seeing that the provisions are kept, and where the electficity supply undertaking is municipally owned this duty has, in most cases, been imposed on the electricity department. But the Order is capable of many interpretations. In Manchester, for instance, factories are closing three days a week, while a similar policy is being followed in Birmingham, Leeds and Hull. Trams and street lighting are being restricted in Newcastle, where four of the waste heat stations of the electric supply company have had to close down. Such Draconian methods must, however, press more hardly on some than on others, and we, therefore, hope that as long as fuel is adequately conserved, Clause 4 of the Order, which allows the 50 per cent. limit to be exceeded under certain conditions will be liberally administered and that the supply will be available at all times for those who require it, provided these restrictions as to consumption are not evaded. While the strike has brought with it considerable disorganisation there is no need to add to this by bureaucratic action. Nevertheless, it may be added that in such circumstances the supply of lighting is more important than that of power, and we hope therefore that every undertaking will use its best endeavours to maintain a supply for this purpose as long as possible.

Trades Unionism and Trades Union Leaders.

It was said of his late Majesty King Charles II. that while he never said a foolish thing he never did a wise one. Something very like this is equally true of many trades union leaders. For while men like Mr. Thomas and Mr. Brace counsel peace, sanity and increased production as the only ways of bringing about industrial prosperity, they also organise and carry through strikes which, whatever else they do, most certainly prevent such desirable conditions being realised. Curiously enough there is a reverse to this picture. For we have firebrands like Mr. Robert Williams breathing threatenings and slaughter and, at the same time, preventing a stoppage of work which would bring suffering and distress on the country generally without benefiting his followers one iota. The reason for this state of affairs is not hard to find. The more important trades unions are increasingly coming to be governed by the vocal and less balanced among their members, and policies are inaugurated and actions done which have not the support of the general body of the members.

Ignorance of the Issues.

This is well-illustrated by the present coal dispute. A ballot was taken on two questions, one of which appealed to that altruism, which is more or less present in everyone. As soon as negotiations were begun this was dropped, and discussions were continued on a straight wages claim. A second ballot was taken on a matter about which there is not unnaturally a good deal of disagreement, even by moderate men, and when this showed the Government offer to be generally unacceptable, the first ballot was used as a mandate for calling a strike. In other words, because a miner objected to his wages being based on the output of the whole of the coal mines of the country instead of on his own particular contribution to that output he was therefore represented as being in favour of a strike to enforce a claim for a 2s. per day increase in wages. It is not very logical; and it is not, therefore, surprising that the strike is unpopular among the rank and file and that those who are able to keep their heads are asking why they stopped work. We have every sympathy with their dilemma, though it may be pointed out that the fault is theirs. If there is to be that stability which is now so necessary in every industry, the moderates, the sensible and the wise must exclude the hotheads from the control of their unions. If they do not the country will continue to suffer as it is now suffering, but the trades unions will suffer in an even greater degree.

Faults on Large Power Systems.

Hand in hand with the growth of our power supply systems has very rightly gone the study of the phenomena which takes place when many thousand horse-power are being generated and transmitted, and of the means that should be taken to reduce what may easily be the disastrous effect of a short-circuit or bad fault on such systems to a minimum. As is well known, the usual methods adopted for ensuring this condition are some form of automatic isolation or sectionalisation, and the introduction of a reactance into the circuits so as to limit the surges which may occur to such a level as will prevent them having any dangerous effect on the machines or network. Simple though the problem may appear in its essential form, actual faults are sometimes accompanied by curious manifestations which well repay study by giving us a wider knowledge of the cycle of events that occur, and by pointing a way to an ultimate solution of the various problems involved. The subject is one of both practical and theoretical interest, and lends itself to mathematical treatment. It is not, therefore, surprising that it is a matter to which Dr. C. P. Steinmetz has recently been giving close attention.

A Lesson from America.

We are, in fact, indebted to a series of accidents which recently occurred on the system of the Commonwealth Edison Company for a study of electrical instability by Mr. R. F. Schuchardt and Dr. Steinmetz which greatly adds to our knowledge of the subject by showing us how much there is we do not know. The actual occurrences which gave rise to the phenomena are few and simple. It appears that with a number of generating stations connected in parallel on a load of about 200,000 kw. at 25 cycles, two short-circuits occurred close to the 'bus bars of one of the stations, with the result that the voltage dropped far below the point where a synchronous load could stay in phase. This was followed by a violent hunting of the units for about a quarter of an hour before stability was restored. This hunting appears to have been due to the sudden alteration in the load causing the generators to drop out of synchronism. Then, as the governor gear re-assumed control, the various generators reached synchronism at different times, with the result that they interfered with each other, until the interconnecting feeders were cut out and matters gradually settled down.

The Importance of Feeder Reactance.

In considering the occurrences which follow such a mishap, Dr. Steinmetz points out that, without reactances in the feeders the voltage after a short-circuit would rise slowly, and that, therefore, all synchronous apparatus would probably fall out of step, while there is also considerable strain on the circuit-breakers. Under these conditions, a feeder reactance would have the useful effect of reducing the short-circuit current to be handled by the circuit-breakers and by preventing the terminal voltage from falling below about half its normal value would allow operations which depend on the machinery remaining in synchronism to be safely performed. This is important where fractions of a second are of value, especially as small variations in the governing of the machines may otherwise cause them to fall out of synchronism when trouble occurs. It therefore appears that if there is sufficient reactance to prevent the generator voltage fallfng below half its normal value the machines will probably remain in synchronism, and that serious hunting will be prevented. Without going to this length in practice, however, it is probable that a great deal can be done by arranging the interconnection of the stations, so that any fault causes the least possible disturbance to the system as a whole. Now that we are extending our networks, we hope that America will be able to provide other studies and examples of this kind from which we can learn useful practical lessons without it being necessary to endure such unpleasant effects as those we have just recounted.

Water Power Development in Scotland.

The increasing price and scarcity of coal are compelling local authorities and others supplying electrical energy to turn their attention to the possibility of developing any water-power that may be available in their neighbourhood. With this aim in view, several hydro-electric schemes are being projected in Scotland and Wales, and the Electricity Commissioners are being urged to give financial help and technical advice in carrying out the surveys. The Commissioners are, however, fully occupied with the reorganisation of electricity supply in the industrial and more populous areas; and they have no money for these purposes. Under these circumstances, the Banffshire County Council has taken a very courageous step. It has decided, in conjunction with the other local authorities concerned, to engage an engineer to make a complete survey of the four rivers in the county in order to ascertain the amount of power available, and the probable cost of developing it. It is further interesting to note in connection with our remarks on rural electricity supply last week, that while the county is mainly agricultural, it is considered that if hydro-electric works were established new industries would be attracted, some of the power could be used for agricultural and domestic purposes, and that it would mean greatly increased prosperity for the whole county, not the least on the score of economy in coal. We feel sure this would be the case. For such enterprise as this we have the highest praise, and we commend the foresight of the County Council, and of its convener, Dr. George C. Grant, and we recommend them to appoint a sub-committee to visit Mr. Kerr and hear what he can tell them. In view of this natural desire to develop local water falls, we hope that the Water-power Committee of the Board of Trade will not delay with its final report. The development of electricity supply in some districts is already slow enough without any Government Department binding what progress there is with red tape.

Whitley Councils and the Electricity Supply Industry.

We are glad to be able to announce that complete success has attended the adoption of the Whitley scheme in the electricity supply industry. There is now a District Industrial Council for every area in the country, and over the whole a National Council which satisfactorily covers all sectional interests. Further, the whole machinery is working smoothly. Nevertheless as might be expected with a thing so startling in its newness there is among the conservative minds in the industry a slight feeling of distrust, or at least, of suspension of judgment as to the ability of these bodies to do what is required of them. To such a recent utterance by Mr. J. A. R. Marriott, M.P., on Whitley Councils, in "The Fortnightly Review," may be interesting and, possibly, reassuring. He describes them as "the latest and not the least hopeful experiment in Government by committees," and goes on to say, "They have been devised to meet the needs of a new stage in industrial evolution. It has been realised—in sane quarters too tardily—that those who contribute to the work of production or distribution by the labour of their hands are not, therefore, necessarily devoid of brains, still less of human feelings and interests. The manual workers of this country are to-day not concerned simply and solely with questions of wages and hours, these matters are doubtless primary, but there are others; the conditions of employment; the environment and regulation of the workshop; the allocation of work; fines, meal-times; opportunities for rest and recreation, and so forth. More than this, the better educated employees believe that they can contribute valuable ideas as to the actual work of production, if not of distribution. They declare that under-production is as much the result of unskilful management as of unwilling labour. Be these things as they may, Whitley Councils are the outcome and manifestation of a desire to bring together round the Council table the representatives of capital, of management and of manual labour. The members are not delegates of the proletariat, but representatives of all classes whose energies are commonly engaged in industrial and commercial undertakings." These are views, which, as everyone knows, we have always supported, but we especially commend them to readers of The Electrician at a time when unfortunate and widespread industrial disagreements are tending to force sanity into the background and making even the most moderate express a desire for the employment of "methods of barbarism."

Electricity Supply, Whitley Councils and Finance.

The question of finance is as ever-present in the conduct of Whitley Councils as in that of all other organisations. It is obvious that these Councils cannot be run without expense, but the matter is to some extent simplified by the fact that each side pays its own individual expenses and contributes equally to the common costs of administration. So far, therefore, as the Trades Union side is concerned these bodies have merely to draw on their union funds. But there are no such funds available on the employers' side. In the electricity supply industry the present arrangements are that the expenses of the National Council are paid by the four representative Associations of the undertakings, while the expenses of the District Councils have to be met by contributions from the undertakings in the respective areas. This is an unsatisfactory arrangement, for it means that it is a matter of luck whether sufficient money is forthcoming. There are some District Councils, for instance, where the constituent members are very small undertakings, so small that they can barely scrape together sufficient to pay for stationery, printing, postage and such like running expenses. There are, on the other hand, areas which include rich undertakings where the District Council can not only afford to meet all their running expenses, but can pay their Chairman £500 a year, their joint Secretaries £200 a year each and the special committee-men fees for attendance and still have a good balance. It is obvious, therefore, that some adjustment must be made especially as the work of all District Councils is very much alike, and is fundamentally of equal importance. Moreover, inefficiency in any one section militates against the usefulness of the whole body, so it is a matter of general interest that each section should be properly equipped financially. We hope arrangements to this end will be made without delay.

Technical Education in South Wales.

In an address which he delivered before the Western Centre of the Institution of Electrical Engineers last week Principal C. Cole, of the Cardiff Technical College, gave an encouraging account of the present state of technical education in that city. He said there were something like 8,000 students or 4 per cent. of the population, and so keen were the pupils that they were hoping to change a number of the classes from the evening to the day time, and so, as far as possible, prevent the burning of the candle at both ends. We are glad to learn that in putting this scheme into force he has had the support of the employers, and we agree with him that their co-operation in this matter shows them to be both self-sacrificing and far seeing. We hope that the example thus given by Cardiff will be followed in other cities, for what is now wanted in engineering is a system of education carried out in the most generous way on lines best fitted to our national characteristics. The new Education Act is likely to be a great assistance in this respect, and we agree with Principal Cole that matters might still further be improved by the introduction of some scheme of co-operation between the various educational institutions which would prevent overlapping and needless expenditure.

Students and the Institution.

The duties of that body of electrical engineers, conveniently known as "students," to the Institution and of the Institution to the students are subjects which are worth a little consideration at the present time. This we are glad to see they received in an address delivered by Mr. E. T. G. Donovan at the inauguration of the Students' Section of the South-Midland Centre of the Institution of Electrical Engineers. Perhaps this is not very evident, on first studying this address, as it deals mainly with what the students' section is doing in disseminating sound technical knowledge and giving an opportunity for the expression of views in the most concise way to help the junior to get on. But as the junior of to-day is the senior of to-morrow, so the development of those qualities of push and go in the present will tend to the benefit not only of the Institution, but of the industry as a whole in the future. It has been said that as the twig is bent so is the tree inclined, and if the student nowadays takes every oppportunity of expressing his views both in formal and informal discussion he will brighten his own knowledge and that of others by a buffing process which will provide his intellect with a permanent polish. It should be added that Mr. Donovan is a student himself, and is therefore in a good position to benefit by his own advice.

The Investigation of Contact Resistance.

A week or two ago we called attention to what we described as a by-way in switchgear design. Another example of this class of research is to be found in an investigation which has recently been undertaken in Germany into the contact resistance between copper surfaces with a view to formulating rules for the proper design of parts where such contact occurs. It is found that the current carrying capacity of a contact is limited by the temperature rise, since at high temperatures the losses rapidly increase from oxidation, while above a certain critical current very high temperatures are rapidly attained which destroy the springs and make overhauling of the gear necessary. The contact resistance is also found to be almost independent of the contact surface, but, as might be expected, it varies inversely as the pressure, while between this pressure and the current passing a simple relation can be obtained to give a "critical drop" which, if exceeded, shows that the contacts are dirty or the springs are in bad condition. It is also interesting to notice that if two lengths of 'bus bar are clamped together the contact resistance of the join must be added to the copper resistance though the effect is mitigated by an increase in the section, and it is therefore possible to design the join to give the same total resistance as a solid bar of the same dimensions. This may all seem very trifling, but attention to matters such as these may often be the means of preventing breakdowns of greater or less importance.

Standardisation of Batteries.

We have several times taken up the attitude that in a growing industry like the electrical industry it is a mistake to standardise either apparatus or methods too soon. For by so doing an obstacle is placed in the way of future developments, if the conditions brought about by those developments do not coincide with those required by the standard apparatus. There are, of course, even in the electrical industry, exceptions to this rule, and among them may be placed the primary and secondary battery. The technical alterations that have been made in these equipments since the very earliest days are few, and even the improvements in these technical details and in the methods of manufacture have now become crystallised. We are therefore pleased to learn that an investigation into this question has recently been undertaken by Dr. E. B. Rosa at the Bureau of Standards, Washington, with a view to establishing standard methods of testing, though it is hoped that a further outcome will be the publication of a complete set of specifications. The need of such work and the benefit accruing to the public from it is evident when it is stated that over 5,000,000 dollars worth of primary and secondary batteries are sold in the United States every year.

German Social Legislation.

In pre-war years Germany had a fairly good record in regard to social legislation, and, in view of its present industrial and economic difficulties, the character of some new legislative proposals which are to be considered by the Reichstag therefore deserve passing notice. One Bill will provide for insurance against unemployment. Hitherto this has been mainly under municipal control, but the system worked irregularly. In future, unemployment insurance, like sickness, accident and other forms of social insurance, will be controlled by the Federal Authorities. Employers and employees will pay equal premiums, and the State and municipalities will also contribute. Unemployed persons will receive the full ordinary wage of their trade, though for not longer than 13 weeks in one year. Agricultural labourers and domestic servants are excluded, but, in addition to industrial manual workers, sailors, actors, orchestra musicians, apothecaries' assistants, teachers and officials in State or municipal employment will benefit, and the Insurance Bureau will be linked to the already existing organisation for this purpose.

German Manufacturing Difficulties.

The suggestion that the market is shortly to be flooded with German goods may be justified in some industries, but it looks as if the machinery trade were pretty safe. For, speaking at the recent annual meeting of the German Machinery Manufacturers in Cologne, Mr. Becker exhibited considerable pessimism. In spite of the reduction in prices, he said that the German industry was unable to compete successfully with foreign machinery makers, the result being a steady falling off and cancellation of orders from abroad. Manufacturing for stock could not be continued much longer, and no improvement in the general situation could be hoped for unless the industry devoted its attention to standardisation and generally recognised that recurring wages claims, the capital levy and decreasing production were exercising a strangulating effect that, if not checked, would lead to dissolution. The cynical will say that these pronouncements were intended for foreign consumption, nevertheless they contain a lesson which is of general application, that it should be read, marked, learned and inwardly digested before it is too late.

One Remedy for the Paper Shortage.

Readers of The Electrician may have heard that there is a shortage of paper, and that, therefore, for their own sakes, they should do all they can to reduce their consumption of this commodity. There have in fact, been appeals from the Government to the public that this should be done. But neither the information nor the appeal seems to have permeated through to the Ministry of Labour. For a correspondent to the "Manchester Guardian" complains that he has received five identical circulars in five large separate envelopes, and he also adds that the only explanation that he can give of this phenomenon is that, as the circulars came from a Labour Exchange, it must be a subtle attempt to provide employment for someone. We think, however, that there may be another explanation. Some soft-hearted official has heard there is a lack of paper in the complainant's office, and has adopted this method of relieving the shortage. It is an attempt to do good by stealth which has failed. We hope the official is now blushing to find it fame.

The University of London.

An important contribution towards the solution of the problem of housing the University of London has been made by the Senate, who have now conditionally accepted the Bloomsbury site recently offered by the Government; and it is therefore possible to understand and appreciate the position of the various parties interested in this subject. Though the decision was not unanimous the resolution was carried by such a substantial majority that we think the graduates and other well wishers of the University would be wise to accept the situation and support the Senate in their efforts to ensure that the new home shall be dignified and worthy in every way of what an Imperial University should be. It must be remembered, however, that, though the Bloomsbury site has been accepted in principle, there are several important conditions attached to the acceptance, and the Government may find it impossible to accept them all.

Conditions of Acceptance.

The enumeration of these reservations will make the final solution of the problem easier, as we shall be able to see which are essential and which are matters for further negotiation. The first, and perhaps the most important, condition, is that the buildings to be erected on the new site shall be on the same basis as regards maintenance, rates, &c., as those laid down in the Treasury Minutes of 1899, and that the grant made for these purposes shall not be reckoned as a portion of the grants to universities for educational purposes. This is an important matter and the Senate rightly insist upon the performance of the obligations entered into by the Government in 1899. We cannot, however, imagine that the Government will refuse to accept this condition, as otherwise, the University would be deprived of a large annual sum which would greatly handicap the Senate in their schemes for developing their new home.

The Bloomsbury Site.

The second and fourth provisions of the Senate are also quite reasonable and we think that no serious objection can be made to them. They insist that the allocation of the Bloomsbury site between the various buildings to be erected thereon shall be at their sole discretion; and that the new headquarters buildings shall afford not less than 50 per cent greater floor space than is now allocated to the separate use of the University at South Kensington. The work of the University has grown so much in recent years that the present accommodation is insufficient, and, as we anticipate greater developments in future, it is only prudent to make suitable provision for expansion.

The Position of King's College.

The third and fifth provisions of the Senate which relate to the King's College are, it seems to us, matters for negotiation. There is a feeling abroad that the Government wish to obtain hold of the site in the Strand at once, while there is no immediate urgency about resuming possession of the Imperial Institute. Consequently the Senate lay down that the University shall retain, and that King's College shall remain in, full possession of their present sites and buildings under the conditions by which they are now held until the new buildings at Bloomsbury are ready for occupation and are free from debt; and also that the terms of the removal of King's College shall be a matter of subsequent negotiation between the Government on the one hand and the Council of the College and the Senate of the University on the other hand. We think the Senate have acted wisely in separating the question of the removal of the University headquarters from the controversy about the King's College site. It would be foolish to remove from South Kensington until the new home is ready at Bloomsbury, and, also, until there is a reasonable prospect of occupying it without embarassing financial conditions, but it would be equally imprudent to vacate King's College until alternative premises are available. This alternative accommodation can, so far as we are able to judge, only be provided by erecting new buildings at Bloomsbury, and the question of removal must, therefore, be postponed until the College can be housed on the new site. This is also, we consider, only right and proper.

The Financial Question.

It is estimated that over a million sterling will be required to provide equivalent accommodation for the headquarters of the University, and £800,000 for King's College, but the new stipulation as to 50 per cent. more floor space than what is now available at South Kensington will mean a large addition to these sums. It is, therefore, not an exaggeration to say that at least £2,500,000, and probably much more, will be required. The provision of this sum at the present time is not as easy as it was in pre-war days, and it places a serious responsibility upon the Minister of Education. However, we know Dr. Fisher to be an ardent educationist, a man of courage and resource and we hope that he will undertake the responsibility of finding the money. The questions of reorganising and finding a suitable home for the University are long overdue and we think no greater service could be rendered to the cause of university education in this country and in the Empire as a whole than to find a suitable and a final solution of them. Possibly some of the money might be raised by an appeal to the public, but this is scarcely a suitable time for such a procedure, as industrial conditions are not as favourable as they might be, and many of the other Universities and University Colleges have recently been trying to raise large sums for purposes of extension without complete success. No doubt when the buildings are provided an appeal could justly be made to the public to assist in raising the funds for scientific equipment, for research work and for the other requirements of the University.

Concentration of Colleges.

In conclusion, we would like to say that, while we think the main reservations of the Senate are prudent and business-like, we are not quite in accord with the concluding paragraph of their resolution. In accepting the offer of the Government, the Senate "assume that the offer does not incidentally involve a policy of curtailing the development of the work of those colleges and schools of the University which are not now, nor in the future will be, situated in the neighbourhood of the Bloomsbury site, and that these institutions will not receive less favourable consideration at the hands of the Government than would otherwise have been the case." This is looked upon as a pronouncement against the principle of concentration, and, if it is so, we have no hesitation in condemning it. There is no doubt that a certain amount of concentration is necessary, and a good deal of the work now done at some of the isolated schools and colleges of the University might be done more efficiently and economically in the new quarters. We desire the University to become a real university in the proper sense of the term and we are afraid that the final condition of the Senate will militate against this transformation by continuing the present geographical aggregation of its schools and teaching institutes.

Antenna Form Factors,

By A. PRESS.

Deferred potentials recently described by Lorentz have been introduced in the theory of wireless telegraphy by means of antenna systems. A conclusion drawn from such introduction is that circuits devoid of capacity effects can radiate energy. It is submitted that nothing of the sort can take place and that the cause of such error must be attributed to a wrongful interpretation *per se* of the deferred potentials. True such deferred potentials satisfy the Maxwellian equations of condition, but so do the instantaneous potentials of Maxwell. Both radically different types of functions are, therefore, particular solutional forms only.

The question has arisen in consequence how are electromagnetic waves set up by means of an antenna structure. It will be found that the latter leads to a discussion of antenna form factors. In a previous article it was intimated that the wave values are set up as a *resultant* of the space and time compounding of instantaneous potential functions of the true Maxwellian type: the one due to the distribution of impressed H_i (and therefore D_i) throughout all space in absolute time phase with the conductor current distribution i_z whose measure it is, and the other due to the value of the distributed dielectric displacement D_e, also in absolute time phase with the bodily surface charges that cause the former to exist. The above is under the condition that e_z and i_z express the voltage and current distributions in the material antenna system.

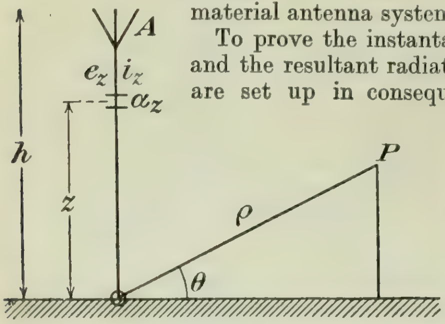

FIG. 1.

To prove the instantaneous componental and the resultant radiation conditions that are set up in consequence, a generalised form of treatment will be resorted to. Thus we will take up an antenna system symbolised by the letter A of Fig. 1. An arbitrary point P is chosen in space. The problem first will be to determine the character of the H at P due to the conduction current distribution i_z in the antenna system A, and from the differentiation with respect to time to determine the displacement component D_i due to the whole antenna system. Similarly the instantaneous type of impressed displacement at P due to the distribution of voltage e_z along the material antenna will also be symbolised by D_e. Then if it can be shown that both D_i and D_e involve phase displacements in the co-ordinates of time and space simultaneously our problem will be solved. This will follow because, for the simplest case in the theory of progressive waves,

$$\sin(at+bz)=\sin at \,.\, \cos bz+\cos at \,.\, \sin bz \quad . \quad . \quad . \quad (1)$$

The two components on the right-hand side are seen to be out of phase with respect to each other 90 deg., both with respect to time t and distance z, yet combined they give a progressive wave.

Treating the current conductive or H component first, we have that the H at P due to the element dz will be given by the definite integral

$$H_P=\int_h i_z \,.\, f(z) \,.\, dz \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

taken over the limits of the antenna height h, where $f(z)=f_z$ expresses the necessary proper relationship. In this integral function (2), however, we have the condition given that a stationary or simply harmonic distribution of current prevails. That is, we have

$$i_z=Z_i \,.\, T_i \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where it is understood both Z_i and T_i are simply harmonic functions of z and t respectively. That is, by (2) and (3) we have the definite integral

$$H_P=T_i\int_h Z_i f \,.\, dz \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

As a preliminary step for the subjoined discussion it will be necessary to bring the function Z_i from under the integral sign.

Employing the formula

$$UV=\int d(UV)=\int UdV+\int V \,.\, dU, \quad . \quad . \quad . \quad (5)$$

let

$$Z_i dz=dU \; ; \; V=f_z \; ; \; U=\int Z_i dz \ldots \quad . \quad . \quad . \quad (6)$$

Thus, since Z is sinoidal, we have

$$\frac{d}{dz}=j_z \; ; \; U=-j_z . Z_i \ldots \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

and by successive application of formula (5) we have finally

$$\int f_z Z_i dz=\left\{\left(\frac{df}{dz}-\frac{d^3f}{dz^3}+\frac{d^5f}{dz^5}-\ldots\right)-j_z\left(f-\frac{d^2f}{dz^2}+\frac{d^4f}{dz^4}-\ldots\right)\right\}Z_i \,*$$

$$(8)$$

The latter formula can be condensed by writing

$$\left.\begin{aligned}F_1&=\frac{df}{dz}-\frac{d^3f}{dz^3}+\frac{d^5f}{dz^5}-\ldots\\F_2&=f-\frac{d^2f}{dz^2}+\frac{d^4f}{dz^4}-\ldots\end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

and we have in consequence

$$\int f_z \,.\, Z_i dz=(F_1-j_zF_2)Z_i \quad . \quad . \quad . \quad . \quad . \quad (10)$$

$$H_P=[(F_1-j_zF_2)Z_i]_h \,.\, T_i \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Showing that the H_P at P involves both a cosine as well as a sine evaluation for the z functions F_1, F_2 and Z_i. In general, therefore, for a point P' removed the arbitrary distance PP' a difference in space phase and amplitude will result, though the sinoidal function T_i will remain the same for all space. In so far as the displacement D_i at P will depend on the time variation of H_P it follows with $j_{\hat{t}}$ affecting the sinoidal function T_i only we have with $\frac{d}{at}=pj_{\hat{t}}$. †

$$D_i=[(F_1-j_zF_2)Z_i]_h \,.\, j_{\hat{t}}T_i. \quad . \quad . \quad . \quad . \quad (12)$$

Turning now to the condenser effect it will be proper to assume that an elemental portion dz of the antenna system at potential e_z with respect to the earth will contribute a displacement component $dD_{\hat{e}}$, given by the relation

$$dD_e=e_z \,.\, dz \,.\, \varphi(z) \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

Thus integrating over the entire length of the conductive antenna we have a resultant component

$$D_{\hat{e}}=\int_h e_z \,.\, \varphi_z \,.\, dz. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

Again, as before, it will be necessary to postulate that e_z along the antenna is not only a sinoidal function of the time, but also of the height z from ground. In the case of an unloaded power transmission line e_z would be 90 deg. out of time and space phase with i_z. We will write, therefore, for the general case that

$$e_z=Z_e \,.\, T_e. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

When Z_e and T_e have a space and time displacement respectively with regard to Z_i and T_i.

We have, therefore, by (14)

$$D_e=T_e\int_h \varphi_z \,.\, Z_e \,.\, dz. \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

Taking now advantage of the development (8), (9) we have with

$$\left.\begin{aligned}G_1&=\frac{d\varphi}{dz}-\frac{d^3\varphi}{dz^3}+\frac{d^5\varphi}{dz^5}-\ldots\\G_2&=\varphi-\frac{d^2\varphi}{dz^2}+\frac{d^4\varphi}{dz^4}-\ldots\end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad (17)$$

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* It should be specifically understood that the operator j only operates on Z_i and not f or its derivatives.

† For this type of operator see "Treatment of Harmonics, &c.," by A. Press, Univ. of Calif. Pubs., Sept. 30, 1919.

the result that

$$D_{\hat{e}}=[(G_1-jG_2)\,.\,Z_e]_{\hat{h}}\,.\,T_{\hat{e}}. \quad . \quad . \quad . \quad . \quad (18)$$

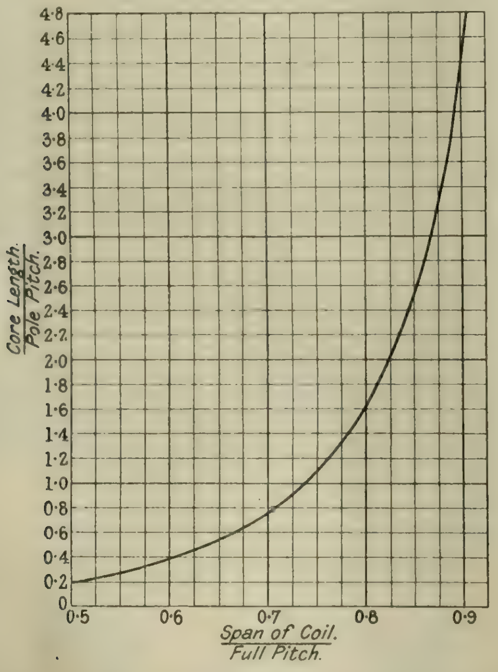
Showing that a progressive wave in view of (1) necessarily results and due to the fact that the voltage and current distribution along the antenna system are sinoidal functions, both with respect to position and to time.

It will be noted that in determining H_p above (as well as D_i) that the method pursued is quite analogous to the antenna form factor method described by Zenneck in his book on Wireless Telegraphy. However, that is only part of the story, since the electrostatic effect symbolised by D_e should also be taken into account. Thus, there are in reality two form factors: the one is magnetic (H_p or D_i), but the other is electrostatic (D_e). Together they amply express the relative merits of two dissimilar antenna systems.

Short Pitch Windings.

By HERBERT VICKERS, M.Eng.

In many types of dynamo-electric machines short pitch windings are used, but it is doubtful whether, or not, their advantages are fully appreciated. In the alternating current generator a judicious choice of the coil pitch results in the elimination of the harmonics from the E.M.F. of the machine which are present in the flux wave, and consequently tends to the production of the ideal sine wave, which is desired for so many reasons. By correct chording the losses due to the armature reaction flux may be diminished, and in induction motors crawling and other troubles may be eliminated by their use. In addition to these advantages, there is another which is equally important, viz., the great saving in copper which is effected especially in high speed machines, such as turbo-alternators and high speed induction motors. The purpose of the present investigation is to determine the pitch of the coils which will give the minimum copper weight for all values of pole pitch and core lengths. In making the calculation it is assumed that the current density is constant, and that there is room therefore to deepen the slots to accommodate the increased number of conductors required due to chording. In most cases of importance this is possible.



Curve Showing Relation between Span of Coil and Core Length and Pole Pitch for Minimum Copper Weight, Based on Constant Current Density and Constant Flux.

Let E=E.M.F. generated per phase in volts.
Z=number of conductors in series per phase.
f=frequency of supply current.
$\beta=\dfrac{\text{span of coil}}{\text{full pitch}}$. k=distribution factor × form factor.
τ=pole pitch.
a=area of conductor.
φ=flux per pole.

C.G.S. units are used throughout.

Then for a distributed winding

$$E=2\times k\times Z\times\varphi\times f\times\sin\beta\frac{\pi}{2}\times 10^{-8}\text{ volts} \quad . \quad . \quad . \quad (1)$$

From this equation

$$Z=\frac{p}{\sin\beta\frac{\pi}{2}} \quad \text{where } p=\frac{E\times 10^{8}}{2\times k\times\varphi\times f}.$$

p is constant for a given rating.

The mean length per turn with full pitch coils

$$=2(l+a\tau),$$

where l=length of core
and $a\tau$=length of overhang at one end of the coil.

In any given case the value of a may be easily found, for the inclination of the coil end to the core with diamond shaped coils is given by

$$\sin^{-1}\theta=\frac{\text{width of slot copper}+\text{clearance}}{\text{width of slot}+\text{width of tooth}}.$$

The volume of copper with full pitch coils with m phases

is thus $$=m\frac{Z'}{2}\times 2(l+a\tau)\times a,$$
$$=mZ'\times a\times(l+a\tau),$$

where Z'=number of conductors in series per phase with full-pitch coils.

The volume of copper required with fractional pitch coils

$$=mZ\times a\times(l+\beta\tau a), \qquad =\frac{mZ'}{\sin\beta\frac{\pi}{2}}\times a\times(l+a\beta\tau).$$

Since $$Z\sin\beta\frac{\pi}{2}=Z'.$$

Therefore $$\frac{\text{Volume of copper with full-pitch coils}}{\text{Volume of copper with fractional pitch coils}}$$
$$=\sin\beta\frac{\pi}{2}\times\left(\frac{l+a\tau}{l+a\beta\tau}\right).$$

It is clear that this ratio will have a maximum value for minimum weight of copper—in other words the most economical span of the coil will be that which gives the above ratio a maximum value. This span can be determined by differentiating the above expression with respect to β.

Calling this ratio A, we have

$$\frac{dA}{d\beta}=(l+a\tau)\left(\frac{\pi}{2}\cos\beta\frac{\pi}{2}\right)(l+a\beta\tau)-a\tau\left(\sin\beta\frac{\pi}{2}\right)(l+a\tau)(l+a\beta\tau)^{2},$$

for a minimum, $$\frac{dA}{d\beta}=0,$$

$$\frac{\pi}{2}\cos\beta\frac{\pi}{2}\times(l+\beta a\tau)=a\tau\sin\beta\frac{\pi}{2}.$$

Therefore $$\tan\beta\frac{\pi}{2}=\frac{\pi}{2}\left(\frac{l+a\beta\tau}{a\tau}\right),$$
$$=\beta\frac{\pi}{2}+\frac{\pi}{2}\frac{l}{a\tau}.$$

Let $\beta\frac{\pi}{2}=\theta$, than $\tan\theta=\theta+\frac{\pi}{2}\frac{l}{a\tau}.$

Its solution is shown in the following curve, which gives the most economical span of the coil for different ratios of core-length to pole-pitch.

In drawing this curve a value of a=1·4 has been taken, but in any given case its correct value can be substituted in the equation.

The Development of Thermionic Valves for Naval Uses.*

By **B. S. GOSSLING.**

In the early part of the Paper the introduction of valves for naval wireless telegraph work and some early researches thereon are described. Attention is then given to the numerical design of power valves, especially triodes, and to various small valves for use in reception. Finally, the standardisation of valves and their specification for quantity production are discussed.

At the outbreak of war, one important problem was to find a good method of continuous wave reception, Poulsen arc generators being already well developed. The valve made its first appearance as a generator of low-power oscillations, stability of the local oscillation being more important than actual strength. The two instruments first studied embodied respectively the ultraudion circuit and the De Forest "audion," and the Lieben circuit with a suitable Round valve. It was understood that in the Lieben circuit the resistance of the oscillatory circuit should be less than the product of the mutual inductance to the oscillatory capacity into the rate of change of anode current with grid voltage; but the complex internal action of the Round valve was difficult to ascertain, and to this day is not completely understood. The soft audion was also a bad valve for use in careful experiment. The author explains various modifications leading to the form of receiver shown in Fig. 1, which was ultimately adopted for the purpose of experiment.

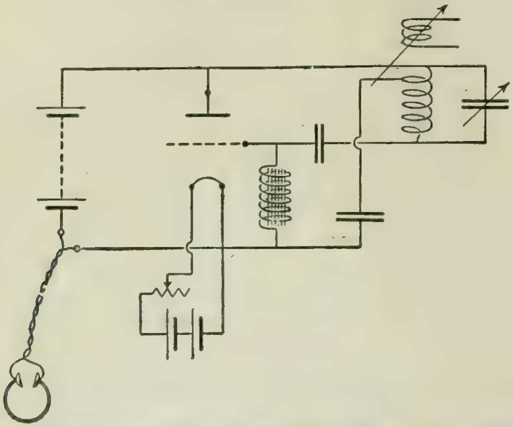


Fig. 1.—Ultraudion Receiver, Improved and Simplified; Q or R4 Valve.

Various important points in connection with the operation of such valves, apart from the primary question of the effect of the positive ions of the gas, were discovered. Valves sometimes contained too little gas, leading to serious over-running of the filament. An investigation into the amount of nitrogen gas desirable was undertaken, and the results were confirmed by similar work at the N.P.L. Work on valves was also going on under Sir J. J. Thomson at the Cavendish Laboratory, and with this work the "Vernon" was in touch. Ultimately Mr. Stead devoted all his time to the problems at Cambridge, and this added facility, together with improvements in the technical manufacture of valves, effected considerable advances.

The calculation of the grid constant imposed great difficulties. Sir J. J. Thomson eventually communicated the now familiar formula giving the proportionate effects produced at the surface of the filament by the grid and anode voltages for a cylindrical anode and a grid of parallel wires spaced round a smaller circle. This formula was as follows:—

$$m = \frac{\pi N d' \log (d/d')}{\log [1/(\pi N dg)]},$$

where d and d' are anode and grid diameters, dg the diameter of the grid wires spaced at N per centimetre. A corresponding formula, of less practical importance, has been developed for a plane anode and a plane instead of a filamentary cathode. The formula has, however, been valuable in establishing the theory of the triode valve.

The next point dealt with is the design and development of power valves handling up to ½ kw. The main formula for such valves, giving the constant m, is

$$m = \frac{\pi N d' \log (da/d')}{\log [1/(\pi N dg)]}.$$

The author works out a numerical example of design, the mean power being taken as 250 watts and the saturation current as 0·34 amperes A formula is also given to determine the safe filament temperature, from which the dimensions of the filament can be settled. The various formulæ established, in conjunction with improved methods of manufacture, notably as regards the exhausting, led to a great advance. The author explains the action of the vapour condensation pump, which superseded the Goode rotary mercury pump. Extreme rapidity of pumping in the last stages was necessary.

The development of a high vacuum receiving valve was next pursued, and the valve of this type, known as R4, ousted the soft valves, and in some cases had a life exceeding 8,000 hours (12 months) on continuous burning. The ultimate specification, covering a saturated emission current of five times the normal anode current, involved a positive ionisation current of the order of 1/1,000th of the primary electron current. Experiments on "ageing" established the fact that the greater the gas present the greater the watts extended in heating the filament, and the higher the temperature of filament required to produce a given total electron current. Various incidental difficulties, leading to subsequent deterioration, were involved in the preparation of these valves. Experiments with various forms of grids showed the influence of grid area on cement, and were in close accord with theory.

Fig. 2 is interesting as showing the voltage adjustments for given ratios of grid current to anode current for coarse and fine grids. This proportion can be reduced without affecting the screening effect of the grid measured by the value of m by using finer wires in larger number; but it is necessary to avoid undue sacrifice of mechanical strength.

In discussing the properties of "soft" and gas-filled valves, it is pointed out, as the chief point of distinction between soft and high-vacuum valves, that when the P.D. between filament and anode (or grid) exceeds a certain value, positive ions arising from the disruption of the gas molecules appear near the high potential electrode. This tends to produce a higher electrode current, and the curve connecting this with grid voltage becomes steeper; ultimately a point of discontinuity may be reached which renders the valve either inactive or very difficult to adjust. This caused much trouble in the earlier valves. The conception of the essential characteristics of the soft valve, as compared with the hard one, dates from the study of an experimental helium-filled valve sent by Prof. Horton in 1916, and subsequent valves due to Prof. Richardson; these were steady in operation, but had sharply-defined critical values. Sir J. J. Thomson, in 1916, contributed a mathematical theory of an idealised soft triode valve showing the nature of the upper limit, which depends on the quality of the gas. During 1917 difficulties were experienced with audion valves, which suffer

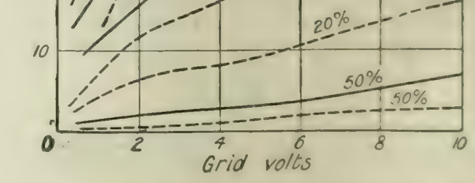


Fig. 2.—Curves showing the Voltage Adjustments for Given Ratios of Grid Current to Anode Current.

Full lines are for coarse grid, 0·04 cm. wire and 5·5 turns per cm. Broken lines are for fine grid, 0·01 cm. wire and 12 turns per cm.

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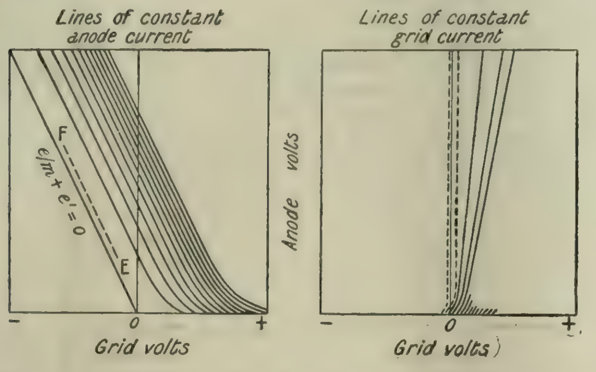
* Abstract of a Paper read before the Institution of Electrical Engineers.

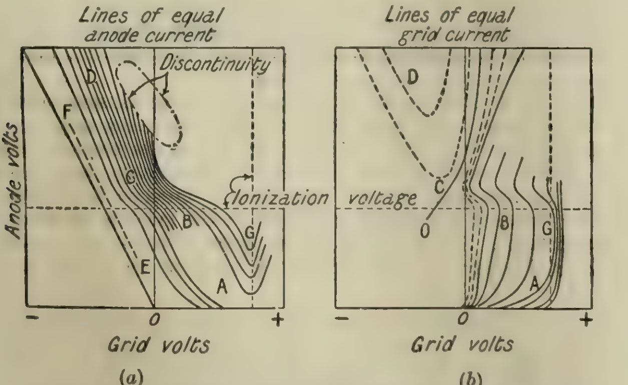
especially from discontinuity effects; in fact, the glow-point affords a guide (somewhat uncertain, however) to the degree of softness in manufacture. By adopting a cylindrical construction for the electrodes, it was found possible to use much higher gas pressures, and, by closing the anode, the general glow could be eliminated and "kinks" in the characteristic avoided. As a result of experiments, a pressure of about 0·06 mm. was adopted for the nitrogen-filled R2 valves, and the method of estimating this pressure is of considerable importance. In this method, described in the original Paper, use is made of the variation of the amount of "backlash." Curves were drawn showing the relation between pressure and anode voltage required to give a backlash of 1 micro-ampere for nitrogen, helium, hydrogen and carbon monoxide. The first R2 valves had one serious defect—*i.e.*, the nitrogen disappeared during the running, being presumably absorbed in the electrodes. Argon, an inert gas, was tried, but the filaments disintegrated too rapidly. Helium however, proved very suitable, and by no means so scarce as was imagined. For a given pressure a helium valve is much harder than a nitrogen valve. The gas is not absorbed, nor do the filaments disintegrate too rapidly. Owing to changes in the gas content of the metal parts, contamination of the helium was experienced, and special measures had to be adopted to evacuate completely prior to admitting the helium.



(*a*) (*b*)

FIG. 3 (*a*) & (*b*).—GENERAL CHARACTERISTICS OF HIGH VACUUM VALVE.

The extension of the use of valves to other receiving instruments besides the simple heterodyne made the R4 valve obsolete. Multiple valve amplifier sets were tried in 1917, and various difficulties in constructing small valves were experienced. In particular, a knowledge of the distribution of temperature along the filament, enabling the number of electrons emitted by each small section to be determined, was necessary. Ultimately it was found possible to design experimental types without trial. Fig. 5 gives results for a set of valves predetermined in this way. Many life tests were conducted, and in the case of cascade circuits valve noises were frequently discovered. Almost all filaments are noisy if the temperature is unduly raised; thoria, if present, is apt to be productive of a distinct crackling noise. In later receiving valves pure tungsten was used, and the requirements as regards noiselessness were severe. The change from thoriated to pure tungsten made no appreciable difference to the working life.



(*a*) (*b*)

FIG. 4 (*a*) & (*b*).—GENERAL CHARACTERISTICS OF SOFT VALVE.
Minute currents are shown by broken lines.

The final design of the R5 valve, the ultimate stage of development among high-vacuum receiving valves, was largely empirical; but the discrepancy between observation and calculation showed that an approach to finality was reached. In standardising these valves, the bulb and cap developed by Capt. Mullard for the Royal Air Force were adopted.

In the final section of the Paper the author deals with the specification of a standardised valve and the importance of uniformity. Observations on valves fell under two heads. First there were the current and voltage adjustment necessary to produce a specified saturation current of electrons from the filament; and, secondly, there were observations indicating the form of the characteristics in the working region when the filament had been so adjusted. Fig. 6, giving the results of a batch of 100 tests, shows how these phenomena, hitherto regarded as fickle, have been brought within reasonable bounds. Other diagrams are presented showing the nature of the anode-current/grid voltage slope, the anode-current/anode voltage slope, and the grid closeness factor. Similarly, the effect in amplifier of changes in the characteristic can be shown.

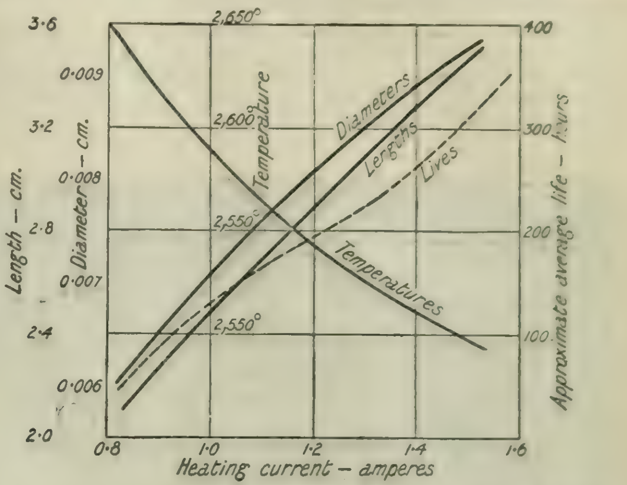


FIG. 5.—ALTERNATIVE FILAMENTS, 6-VOLT SUPPLY, 80 M.A. EMISSION.

Electrical tests selected as necessary for receiving valves included:

Filament.—An upper limit, imposed by the supply arrangements, for the current and voltage for a specified saturated electron current, and a lower limit of voltage if great uniformity is required, or valves are used with a common filament control.

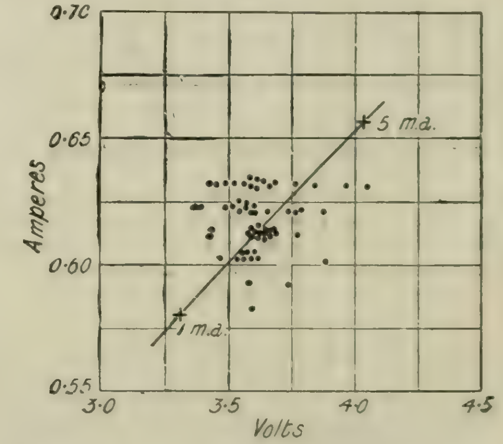


FIG. 6.—FILAMENT ADJUSTMENTS FOR 2 M.A. SATURATED EMISSION.

Characteristics.—Anode current observed at two stated grid voltages and two or three anode voltages, the differences of readings indicating the values of the characteristic slopes and of their ratio *m*. Lower limits are specified for both slopes, and for *m*, but an upper limit for the anode voltage slope only.

The value of the reverse grid current, if any, at a stated negative grid potential is taken as indicating the degree of exhaustion of the valve, and the direct grid current at the working grid potential as indicating the damping effect of the valve on the input circuit.

Life.—Sufficient information for rigid life-test clauses was not available at the time considered.

The Bleriot-Scott Single Unit Lighting Equipment.

The design and manufacture of the electrical equipment which has now become so common on motor cars are subjects in which a very little interest is taken by electrical engineers. Apart, however, from the unusual details which, owing to the special work they have to do, distinguish the generators and motors from those employed in other classes of work, the whole question is worthy of some attention seeing that it forms another way of bringing before the public the advantages of electrical apparatus for a large number of purposes.

In an article which we recently published in The Electrician, Mr. C. H. Stephenson drew attention to some of the problems which the designer of these machines has to face and laid down some general principles. These are carried out in the new "Bleriot-Scott" combined starting and lighting equipment which has been placed on the market by the Scott Electrical Company, Ltd., in conjunction with Messrs. Bleriot, Ltd., for use on light cars. As will be seen below it contains some interesting details.

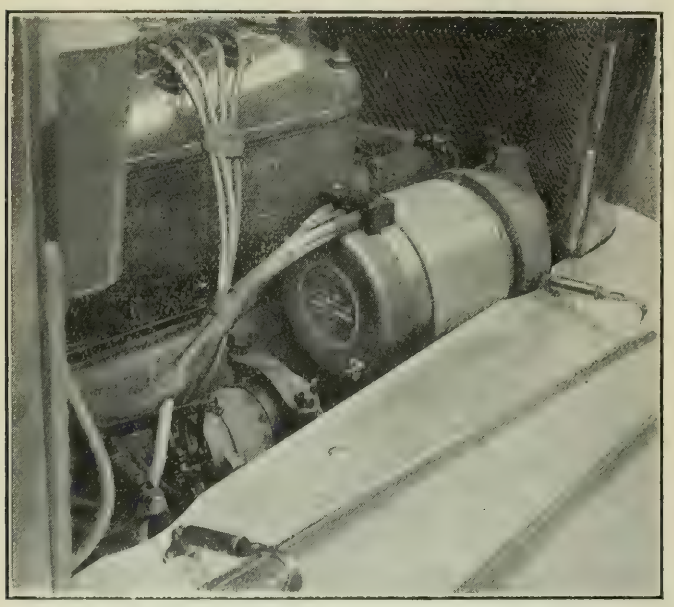


Fig. 1.—Illustration of the New Bleriot Starter fitted to a Car.

We may begin by saying that the Bleriot-Scott single-unit starting and lighting equipment is the latest development of the well-known Scott starter, which was the first single-unit system to be used in this country. The use of single-unit equipments has proved very satisfactory for light cars and offers many advantages over two-unit systems. For instance, one very serious difficulty in connection with the latter systems is the meshing of the starter pinion with the toothed ring on the engine flywheel, for which purpose a number of very ingenious arrangements have been evolved, though even the best introduce an element of uncertainty. In addition, the designer is presented with the problem of finding room for two extra machines on the chassis, each of which must be accessible. In the case of the single-unit system, on the other hand, there is only one machine and the drive is permanent. In addition, the machine can, as a general rule, be fitted alongside the engine where it is both accessible and well protected from oil and dirt. The most usual method of driving is by means of "silent chain," though there is no objection to the use of gears, should they prove more convenient. An example of an actual fitting is illustrated in Fig. 1.

The Motor-Dynamo.

The starting and lighting machine itself is compound wound, the four field poles being fitted to a tubular yoke which is ground inside and out. This yoke carries the brass end brackets in which the ball bearings are mounted. A vertical type of commutator is employed, the important feature of which is that it permits the maximum area of brush contact to be obtained for a given length of machine. The brush gear, Fig. 2, is particularly simple and allows any of the four brushes to be easily replaced.

The armature slots are of unusual shape, being tapered instead of parallel. The advantage of this construction is that a reduction of area of the cross-section at the root of the teeth where the density is greatest in the conventional design does not occur. The taper slot offers serious difficulties in winding in the case of an armature in which heavy conductors must be used, but this difficulty is overcome in the armature now being described by the use of stranded conductors, which are easily deformed so as to fill up the whole of the winding space, as will be seen from the section of part of a wound armature shown in Fig. 3. It is found that the result of this construction is to give an armature carrying the maximum amount of copper and containing the least weight of iron. It should be mentioned that the armature weight is an important consideration, as by reason of its inertia, it loads the drive during changes of speed.

Control of Output.

The control of output is one of the most difficult questions in the design of a starting and lighting equipment. For the output of the generator must be sufficient to keep the accumulator charged even when the car is used almost entirely for town work. The case of a doctor is probably the most severe that can be chosen to illustrate this because the starter is used very frequently and only short distances are covered between successive "starts." This means that unless the generator is designed to give a large output, the accumulator will become discharged and will no longer be able to operate the starter. It is, however, quite a simple matter to design the generator to give a large output, but unfortunately, it is not possible to make an accumulator of the size acceptable to motor car manufacturers, which will stand a high charging current for lengthy periods. Thus, if the output of the generator is sufficient for, say, a doctor's car, the same equipment fitted to a touring car would not be satisfactory, as the prolonged charging at a high rate would quickly destroy the accumulator

It is possible to solve the problem in several ways, some of which call for the use of more or less complex apparatus requiring, of necessity, a certain amount of attention, but it has been considered best to adopt a solution which is entirely free of any complications. The motor-dynamo has accordingly been designed so that the series winding has a demagnetising effect when the machine is operating as a generator. The output is, in this way, reduced to a maximum of approximately 12 amperes in the case of the medium-sized

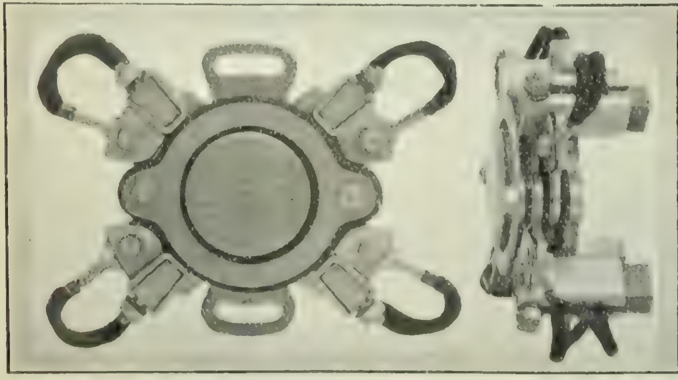


Fig. 2.—Bleriot-Scott Brush Gear.

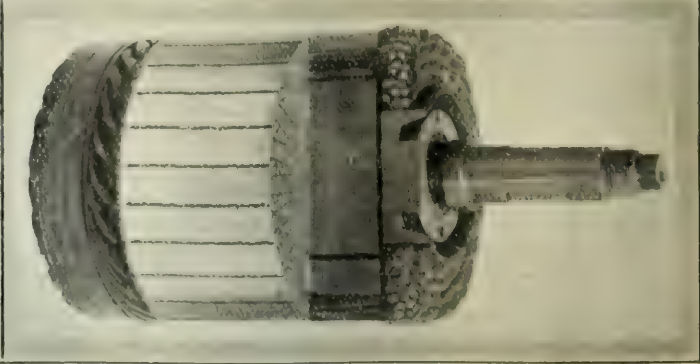


Fig. 3.—Bleriot-Scott Armature, showing Windings.

machine, and the low speed at which this output is obtained ensures, we are informed, the accumulator being kept charged even under the most severe conditions of use.

In order to safeguard the accumulator when the car is used for touring, a resistance is inserted in the generator shunt winding, so as to reduce the maximum output to 5 amperes. This current is ample to keep the accumulator in good condition and cannot possibly result in any damage being done even if continued indefinitely.

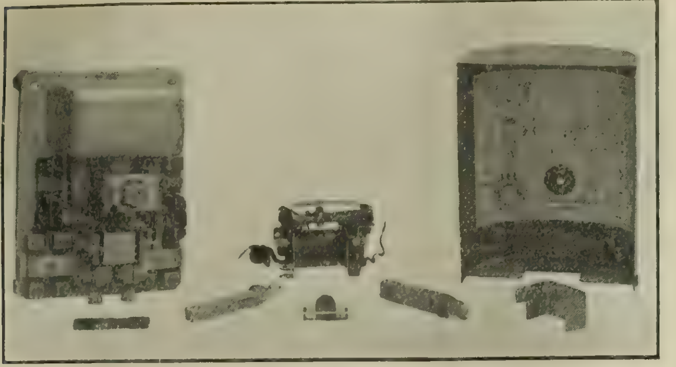


Fig. 4.—Bleriot-Scott Starting Switch and Cut-Out.

The resistance is placed at the back of the switchboard and is short-circuited by the charge switch when this is in the "full charge" position.

Starting Switch, Cut-out and Fuses.

The cut-out is illustrated in Figs. 4 and 5, and a diagram of the electrical connections is given in Fig. 6. The starting switch consists of a movable ⊓-shaped copper piece which makes contact with a pair of laminated blades. The arrangement is such that there is a rubbing action over the whole area of contact, thus keeping the surfaces clean and reducing the voltage drop to a minimum. A pair of sparking buttons is fitted so that any sparking does not pit the main contacts. These buttons are easily renewable, though switches have been in use for three years without replacement of these parts being necessary. The cut-out, which is of the well-known Bleriot "PHI" patented compensated type, is mounted on the cast aluminium base which carries the starting switch. The principle of operation of the cut-out will be understood by referring to Fig. 5. The core carries three separate windings, (*a*) the series, (*b*) the shunt, (*c*) the resistance. The resistance winding is short-circuited by the subsidiary contacts (K.K.), when the cut-out is "out." The armature is adjusted so as to close the main circuit when the generator voltage reaches 13·5. When the armature is attracted and the main circuit closed, the subsidiary contacts are opened, thus inserting the resistance in series with the shunt coil. This has two effects, (1) the cut-out shunt current is reduced, (2) the attractive force on the armature, due to the cut-out shunt current, is reduced. In this way the heat generated in the coil is diminished and compensation is made for the change of air gap in the magnetic circuit. It must be remembered that for a fixed value of the cut-out shunt current the attractive force experienced by the cut-out armature is considerably greater when the cut-out is "in" than when it is "out." This is, of course, due to the decreased air gap in the former case. If we suppose that a non-compensated type of cut-out to be so adjusted as to come "in" at, say, 13·5 volts, it will not break the circuit, even though no series current be flowing, until the voltage has fallen very greatly below 13·5. In actual use the direction of the current through the series coil exerts a demagnetising force which allows the cut-out to break the circuit before the voltage has fallen greatly below 13·5. The essential point, however, is that the value of the reverse series current necessary to make the cut-out open at 13·5 volts, is dependent on the difference between the attractive force acting on the armature in its two positions, viz., "out" and "in." The compensating winding, by reducing this difference, allows the cut-out to operate with a very small reverse current.

The main contacts are of silver and are protected from pitting by subsidiary carbon contacts. The fact that the cut-out operated with a very small reverse current reduces sparking and the provision of carbon sparking buttons absolutely protects the main silver contacts from deterioration. The fuses are arranged so as to protect the charging circuit only. The main fuse breaks the circuit in the event of a short occurring such as, for example, might be due to the cut-out being put out of adjustment. The other fuse is included in the motor-dynamo shunt field circuit, where it protects the shunt windings of the machine and cut-out, should the accumulator be removed and the car used with the "charge" switch on. The fuse wire is held in clips and, as an extra supply of wire is provided, the renewal of a fuse is a very simple matter. The carrier on which the spare fuse wires are wound is stamped with the values of the fusing currents of the wires. These values are not those at which the fuses actually blow, but refer to the rating of the fuse wires which should be purchased if an additional supply is required. Thus, in the case of a medium-sized equipment the part of the spare fuse wire carrier on which the main fuse wire is wound, is stamped 8 amperes. In purchasing an additional supply "8-ampere fuse wire" should be obtained. This wire fuses at 8 amperes when the standard gap is used, but when a shorter length is employed, as is the case here, the fusing current is, of course, higher.

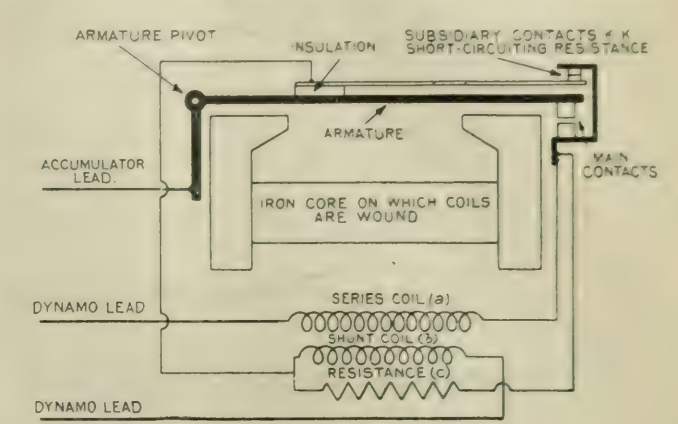


Fig. 5.—Diagram of Cut-Out.

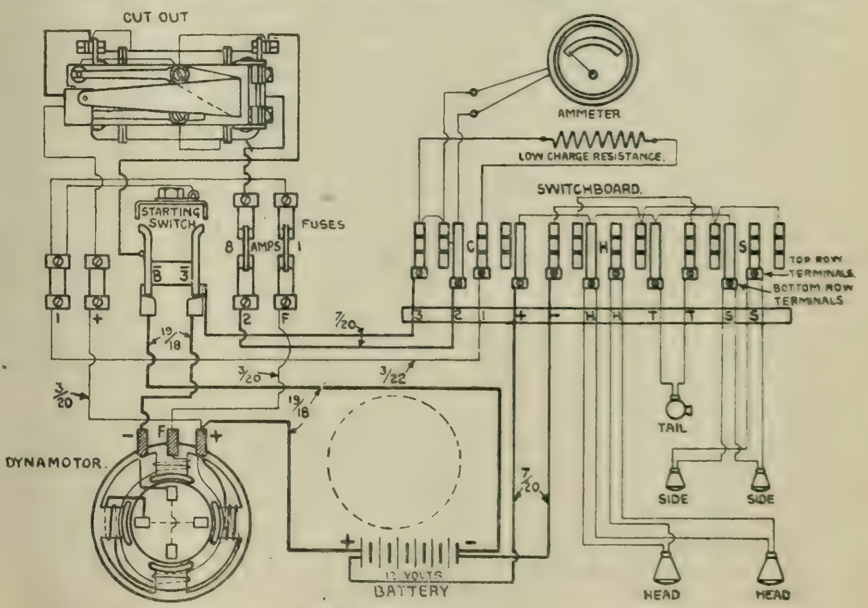


Fig. 6.—Diagram of Electrical Connections.

It has not been considered advisable to fit fuses to the lamp circuits as there is always the possibility of a short circuit occurring which would then lead to the sudden extinction of the lamps with, perhaps, serious consequences. If no fuses are used, a short circuit will only dim the lamp whose circuit is affected, leaving enough light to steer by until the car can be stopped.

The starting switch is fixed to the engine side of the dash and is operated by a rod passing through the dash and terminating on or below the instrument board, where a handle is attached. The handle is pulled to close the switch, and on being released, is returned to the "off" position by a coiled spring. The action of pulling is the most convenient and natural one and the handle may be fitted in a very accessible position. The whole of the starting switch and fittings mounted on the same base, are protected by a sheet metal cover to the interior of which a complete wiring diagram of the whole equipment is attached. This obviates the danger of the wiring diagram being lost, and ensures it always being available at a moment's notice.

Switchboard.

The switchboard contains three switches operated by push and pull knobs, marked respectively "C," "H," "S," and giving the following control. With the first knob "in" the battery is receiving its full charge. When it is "out" the battery is half charged. Of the other two knobs the first controls the head and tail lamps, and the second the side and tail lamps. In both cases the lamps are "on" when the knob is "in" and "off" when the knob is "out." An ampere-meter, indicating the charging current, is fitted. The resistance mentioned above which is used in connection with the method of control, is screwed to the inside of the aluminium casting forming the main body of the switchboard. The board is designed for flush fitting on the dash of the car and is very accessible for purposes of wiring up, a special form of wire clamp being used. The ease of wiring is a point which should appeal very strongly to car manufacturers, in that it reduces the time required which has to be spent in the erecting shops. The front of the switchboard is enamelled black and polished and the ampere-meter may be brass or nickel-plated as desired.

The equipment is made in three sizes with a full charging current of 10, 12 and 15 amperes respectively. The "cutting-in" speed with the smallest size is 1,400 revs. per min., and with the other two 1,200 revs. per min. The torque at 10 revs. per min. is 275,400 and 500 lb. respectively. The weights are 32, 40 and 48 lb. Actual test figures which we selected at random from a number of similar results show that after a two-hours' run on full load as a generator the temperature of the machine was 151°F. with an air temperature of 46°F., or a rise of 105°F., and that the insulation resistance was 2 megohms.

Olympia and British Progress in Electric Vehicles.

By **RAYMOND J. MITCHELL, A.M.I.E.E., A.M.I.Min.E.**

Some Reflections.

One's predominant impression on visiting the magnificent array of commercial vehicles displayed at Olympia was a feeling of great pride in the pluck, enterprise, and real achievement of which the show was an expression. Never previously has Olympia contained a more convincing collection of exhibits, the majority of which were of purely British origin, and never was pessimism more signally routed than by the firms, who despite the gloom that obsesses us, decided nevertheless to expend the money and work necessary to bring together a veritable galaxy of road transport machinery, including every type from the *de luxe* light delivery van to the 25-ton tractor.

It was, therefore, all the more disappointing that the electric vehicle was represented by only four firms actually staging vehicles, and this for an industry where already there are at least a dozen firms making either road vehicles or trucks! Here was a magnificent opportunity lost! Since the last Commercial Vehicle Show seven years have passed. In this time the electric vehicle has fought its way inch by inch until at last its just claims are freely admitted, and indeed advanced by many who originally were either hostile or sceptical towards the newcomer. We are on the verge of using electrical energy in a whole-hearted, generous, "don't be afraid of it" manner—even the Government is trying to help—yet the electric vehicle industry is waiting—until next year!

One compares such timidity with the relative audacity of the petrol vehicle makers, who faced by ever rising fuel costs, the effect of a huge second-hand stock of war-worn machines, and legislation which certainly doesn't *help* them, yet display such an aggressive spirit. Let us hope that *next* year *every* electric vehicle maker, whether of trucks or road vehicles, every battery maker, including all the charging plant and accessories firms—not omitting the Electric Vehicle Committee itself—will ensure that electric vehicles are the star section of the show! Not a modest minority almost submerged in the sea of competition from petrol and steam. Also! Makers of electrics and other types of vehicle should show electrics on one stand and steamers or petrol machines *not* on their electric vehicle stand! It confuses the issue to do otherwise! One cannot hunt with the hounds *and* run with the hare! It needs too much explaining!

Current Tendencies in Design.

Nothing could be more individualistic than the methods by which designers of electric vehicles have arrived at their respective layouts in the machines now available. An almost complete diversity of practice distinguishes one chassis from another, not only in general arrangement, but also in particular detail. On the whole, this is a healthy condition, from which will emerge all the sooner that reasonable degree of standardisation which is desirable in the construction of a type of machine intended eventually to be used in large numbers and generally by people not necessarily highly competent mechanically.

Transmissions of diverse types have been and are used on petrol vehicles, but not in such diverse forms as are presented on electric vehicles. Thus, to mention only one diversity, we have the contest between single, twin and even four-motor drive, yet no serious argument can prove that the best results in point of operative efficiency cannot be gained by the single motor system. In the actual means for transmitting the motor power to the road wheels there is also great variety. In the simplest system a single motor drives a countershaft by means of a "silent" chain totally enclosed, the second stage being transmitted by roller chains running over chain rings attached to the spokes of the rear wheels, the chains being quite unprotected. This is the simplest single motor transmission, and perhaps the cheapest—and *if kept perfectly clean* is also very efficient. Unprotected chains are, however, a very doubtful practice, which could be revised without undue difficulty by providing aluminium oil-tight chain cases, as is done on several petrol lorries. By this means transmission efficiency is maintained together with vastly increased chain life and silence of working under all conditions.

Other systems of transmission in current use are tabulated below:—

Make.	First Reduction.	Second Reduction.	Number of Motors.
A	helical spur gear	roller chain	Two
B	bevel gear	roller chain	One
C	silent chain	bevel gear	Two
D	spur epicyclic gear	spur internal ring	One
E	spur epicyclic gear	spur internal ring	Two

Although giving successful service in a variety of applications yet obviously there must be considerable differences in cost, weight, and transmission efficiency between these rival systems.

An attempt has indeed been made in one design of vehicle to gain extreme simplicity of transmission by gearing a motor to both rear wheels in such a manner that the motor pinion preserves its pitch relation to the rack ring with which it engages, whilst half the weight of each motor is spring borne as in tramway practice. This method is interesting but of somewhat doubtful use from the standpoint of the wear likely to be met with due to hammering between tooth flanks on the gearing.

The Design of Control Gear.

Considerable pains have been taken to simplify controllers and the gear used for operating them, whilst accessibility has been studied and duly applied. In some cases the controller is placed on the side of the vehicle and can be inspected in a moment by opening a simple latch-held door—thus also enabling any cleaning of contacts to be done with perfect convenience to the man in charge. In this connection it is interesting to note that a prominent maker has abolished electro-dynamic braking, preferring the extra simplicity so gained to the slight economy which electric braking made available. This is a step in the right direction. It is so fatally easy to make electric vehicles mechanically "pretty" and ingenious at the expense of real simplicity. One little refinement which *is* worth while—and which the writer has advocated in the past—is a provision for interlocking the controller operating handle with a latch which in turn makes it impossible to operate the vehicle when the charging plug is in circuit—a most desirable device, and one which will assuredly save a life or two in the future! At the risk of giving offence the writer would like to express a strongly held opinion that electric vehicle engineers might with advantage study more closely the refinements of design incorporated on the best examples of petrol lorry. On some electric vehicles the detail work leaves much to be desired or is even obsolete in design, particularly in such items as steering gear, brakes, and provision against the effects of wear in linkages. On the other hand, the machine shown by one of the oldest British makers was a credit to this industry, both in general design and in detail workmanship.

It is a pity that the electric vehicle should so often be turned out looking so drably utilitarian, when by a few more pounds initially spent the reverse could be achieved. Not a little psychological value attaches to paint and varnish—a dictum which makers might investigate the truth of for themselves. Externals are of great importance in this instance.

Experiments are being made with pneumatic tyres on electric vehicles and indications are already available that in certain services advantages they will give which far outweigh their extra first cost. Higher speed and reduced energy per gross ton-mile appear likely to be gained by this means—improvements of cardinal importance for a type of vehicle which is dependent on a limited supply of energy. A new comer in the field of alkaline accumulators is heralded by the presence of a complete battery for a two-ton vehicle on one stand. This accumulator, an English edition of the Swedish Funguen, has already been applied to road traction service in the country of its origin, and will naturally be watched with great interest by electric vehicle owners and engineers generally.

Correspondence.

"THE WOMAN IN THE PROGRESS DEPARTMENT."

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The letter from Lady Parsons under the above heading, which appeared in The Electrician for October 15, is a criticism of trade union procedure rather than of my article, and whilst agreeing that the term "skilled" as used by the trade unions savours somewhat of humbug, I cannot agree that "intelligent, educated girls . . . could learn almost any mechanical process in a few weeks, if properly taught."

It is agreed that modern engineering practice tends towards specialisation and that the "all-rounder" has practically ceased to exist. As a consequence, therefore, the five or seven years' apprenticeship period is no longer necessary. But it does not follow that an apprenticeship period is not necessary at all. A mechanic specialises as a turner, for instance, but because he is taught to turn a motor shaft, and he is able to do this efficiently, he is not thereby qualified to call himself a turner. He must be able to undertake any turning work which may fall to his lot, and for him to do this he must be educated in the art of turning, and so an apprenticeship period is essential.

I might be bold enough to tell my wife that, after five or six weeks coaching, I should be quite proficient in handling all the household duties, but I can see the pitying smile with which my boast would be met, and, candidly, I should not like her to take me at my word. I might, in that time, become proficient in some of the elementary duties, and might even turn out a very creditable treacle pudding, but that would not entitle me to rank with my wife as an expert on household matters.

The fact is that the women in the engineering factory have been misled by the fulsome plaudits of the popular press. They have been told so many times that "they are man's equal in all things and his superior in most" that they actually believe it, and as a consequence they do not think it necessary to endure the drudgery so necessary to gain experience and thus become proficient. They want to commence their career at least half-way up the ladder, not realising that this is wellnigh impossible, and that a start must be made at the foot.

The well-educated woman (like the well-educated man) is a minus quantity in any profession without the necessary experience, and when she (or he) enters the engineering factory much must be forgotten before anything can be learned, or, in other words, she (or he) must "be born again," in the industrial sense.

The writer has had experience of many well-educated and intelligent persons who, after spending some years in a certain profession, have decided to forsake this profession for the glamour of the engineering factory. It cannot be said, however, that their proficiency in their new sphere was more marked than that of the ordinary factory operative. Some made good—others did not, but they all had to start at the foot of the ladder, and it is the contention of the writer that the woman desirous of qualifying as a mechanic or an engineer—or for an administrative post in the engineering factory—must serve an apprenticeship, and gain her place, not by privileges, but by merit.

Dealing specifically with the woman in the Progress Department, the same remarks hold good. Lady Parsons states that "the salaries offered to women are usually too small for an educated girl to live on away from home," but the girl (educated or otherwise) who aspires to a post in the Progress Department must enter as a junior, at a junior's rate of pay. There is no room in this department for the educated girl, unless she has had practical progress experience, so here also it would seem that the woman is out to dodge the drudgery and start half-way up the ladder.

I cannot agree that I have disposed too lightly of the clerical side of the profession, and that "the highly imaginative brain of the mathematician and the brilliant genius of the inventor . . . must bow to the 'progress chaser'." Lady Parsons is evidently confusing the lowly chaser (*i.e.*, the progress apprentice) with the section leader, but apart from this, the mathematician and the inventor are rarely to be found in the progress department. It is in connection with the chasing part of the business that I contend that the woman lacks opportunity, and without this experience she cannot aspire to the higher position.

I believe that the woman (given the same opportunities) can compete with the man in the engineering factory, either in a productive or an administrative capacity, but she must be on exactly the same footing, and she must not have privileges which are denied the man. She must, however, start at the bottom, and work her way up, and she must serve her apprenticeship, for I cannot agree that the few weeks advocated by Lady Parsons is the only probationary period necessary. It is in connection with this apprenticeship, however, that I anticipate trouble, although this may possibly be overcome if the right procedure is adopted in the "all women" factories now being established.—I am, &c.,

London, Oct. 23. W. J. Hiscox.

AUTUMN TRADE PROMOTION NUMBER.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I am very much obliged to Mr. Hardie for supplying the details of the houses at Glasgow, and am sorry that I was misled into thinking he had no regular hot-water supply. I cannot help thinking that his 1-kw. immersion heater is larger than should be necessary so far as my own experience leads, and one would gather that it is used about 8 hours per day. Probably he would get much more satisfactory results by having two heaters, one of, say, 400 watts and one of 200 watts, and keeping the smaller one on all day and all night. Also I think his 3-kw. fire in the kitchen is far larger than should have been necessary.

I quite agree with Mr. Hardie that he will halve his consumption by having one fire, but so far as I have found this will probably not provide all the hot water required if he tries the experiment on the same tenants, for they will have been educated to a better supply and will resent a less perfect one.

Mr. Hardie has much over-estimated the consumption of the 2-kw. fire in the hall of the 14-room house, because, mercifully, we seldom indulge in this part of the country in two months of extreme cold, and I think the average for that particular fire during the last 4 years will not have exceeded 500 to 700 units. There are irons and a vacuum cleaner, but no immersion heating apparatus in the house in question, and I quite agree that if the domestic water supply were heated in this way, as there is a 60-gallon hot water storage, there would have to be added another 8,000 to 10,000 units annually.

I shall await Mr. Hardie's further figures with great interest, for it is only by such experiments that we can progress in the application of domestic heating, and so far as my experience goes it is almost impossible to experiment in one's own house, for it is almost the invariable rule that something special is required the moment one begins a test.—I am, &c.,

Watford, Oct. 22. M. J. E. Tilney.

THE STANDARD FREQUENCY.

TO THE EDITOR OF "THE ELECTRICIAN."

Sir: In view of your comments on 50 cycle rotary converters in your issue of 15th inst. you may be interested to learn that a 5,000 kw., 520 volt, 50 cycle rotary is in use in the Peiner Walzwerk. The supply to the rotary is taken from a gas engine station, and the direct current is supplied to steel works so that it would be difficult to imagine much harder conditions.

In your remarks you also fail to make any reference to the mercury vapour rectifier which, I think, gives an excellent method of changing from alternating to high-tension direct-current.—I am, &c.,

Charles W. Marshall.

[We did not wish to imply that a 50-cycle rotary converter could not be used, but merely to indicate its unsuitability for railway work, where it is even more essential that the equipment shall give as little trouble as possible—even less than in steel works.—Ed.]

Heating and Cooking Notes.

Novel Service Idea.

Messrs. **Troughton & Young**, electrical contractors, of Knightsbridge, are to be commended on their initiative in putting forward a concrete suggestion to hotel proprietors which should prove to be a sound advertisement of the advantages of electricity. The suggestion, which is set out in a leaflet issued by the firm, is as follows: Visitors to hotels very often require to have light articles of wearing apparel, like blouses, lace and handkerchiefs, washed and ironed, and they not unnaturally prefer to do these little jobs themselves. With the advent of the universal voltage iron many a visitor simply connects the iron to the lampholder and goes ahead in her bedroom, and provided the fuse does not blow, nothing is known of the matter by the hotel proprietor, and current is so used at lighting rates. If the fuse does blow inconvenience is caused to the other guests, and that is all. Why not, therefore, say Messrs. Troughton & Young, provide for the use of guests an electric ironing room, equipped with benches and wall-plugs and electric irons? Those visitors who so desire can still use their own universal irons. Current so used could be taken at "heating rates," and if it was not thought advisable to provide this service free, a small hourly charge could be made for the use of the ironing room. In addition to the idea being a good one it is pleasing to see that there is a firm of contractors searching for business, by making definite suggestions, and not sitting still and waiting for enquiries to drift in.

A Long-handled Adapter.

Despite the arguments which are put forward on behalf of scientifically designed shades for home lighting, there are many cases where the housewife insists on having a so-called "pretty" glass shade. In other words, a desire for artistic or pleasing effect dominates the choice of shades. Many of these glass shades are long and narrow, making it difficult to get the hand up inside the shade to insert a cocus adapter for connection to a standard lamp or other electrical device. The provision of an adapter with a stem three or four inches long would overcome this difficulty, and should find a ready sale. Fig 1 shows the idea.

A "Welco" Combination Fire and Cooking Stove.

Messrs. **Welco Patents, Ltd.**, have introduced a portable electric fire (Fig. 2), consuming 750 watts, which can be used at will either as a fire or a radiant hotplate (Fig. 3). The apparatus consists of a radiant element mounted in the centre of a dome-shaped reflector; four feet being attached to the reflector. When used as a fire the three feet form a tripod support, and similarly by placing the reflector in a horizontal position the three feet can be similarly used. To convert the apparatus from fire to hotplate is, therefore, a perfectly easy operation, which does not involve the unscrewing of any fly-nuts or releasing springs. Three finishes are offered—viz., nickel black, nickel, solid polished brass, and if so ordered the fire can be supplied with a three-heat plug to provide a certain range of regulation. The same firm have also produced an attractive toaster in oxidised silver finish, and a range of electric fires in rectangular sheet metal frames in antique copper or oxydised silver finishes. Three sizes of fire are made in each finish—*i.e.*, 750 watts, 1 kw., and 1½ kw. respectively.

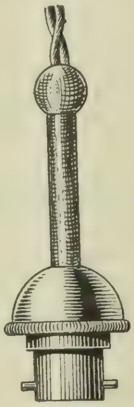


Fig. 1.—An Adapter with a Stem—A Suggestion.

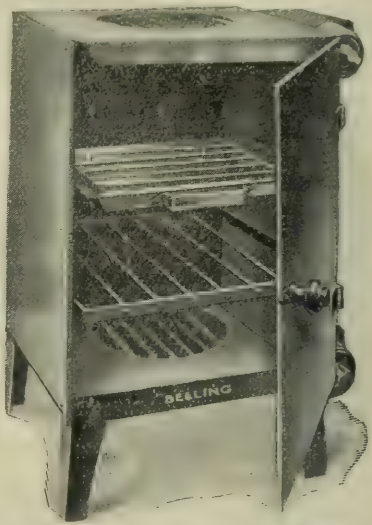


Fig. 4.—"Belling" Cooker for Small Flats.

"Belling" Flat Cooker.

There is a growing tendency to provide a cooker which will meet the requirements of the small family living in a flat or sharing a house. It is only to be expected therefore that Messrs. **Belling & Company** should add to their extensive range of apparatus a cooker suitable for this purpose. This cooker is illustrated in Fig. 4. It consists of a sheet metal oven mounted on four legs, a 1 kw. radiant element being provided at the top and bottom. Where the element is fitted the top part of the oven is open, it being intended that a saucepan or other utensil should be placed there whilst cooking is proceeding. If this is not done a reflector plate can be placed over the top of the oven. For boiling purposes it is recommended that a quick boiling self-contained kettle be used. Each element is separately controlled by a three-heat rotary snap switch, mounted on the side of the oven. The cooker is supplied finished in bright black enamel, complete with rod shelf, solid shelf, grill pan and grid at a very reasonable figure, which should make its introduction in a small family home comparatively an easy matter. A wall plug connection is all that is required, and when not in use it can be placed under a table, thus economising space.

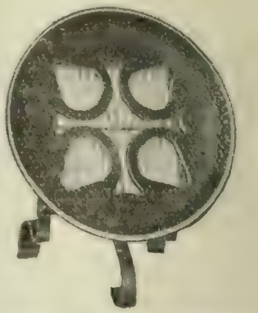


Fig. 2.—"Welco" Combination Fire.

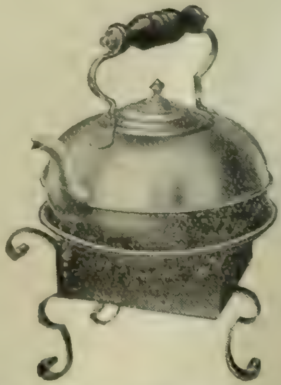


Fig. 3.—"Welco" Combination Fire in Use as a Hotplate.

The "City" Lantern.

The "City" lantern, manufactured by the General Electric Co., Ltd., was placed on the market to meet the need of a suitable lantern for use with gas-filled lamps. It was designed as the outcome of knowledge bred of long experience and it was decided that it should embody the following characteristics :—(1) A wide distribution of light ; (2) Facilities for easy adjustment and cleaning ; (3) Efficient Ventilation ; (4) Watertight and substantial construction ; (5) Handsome appearance.

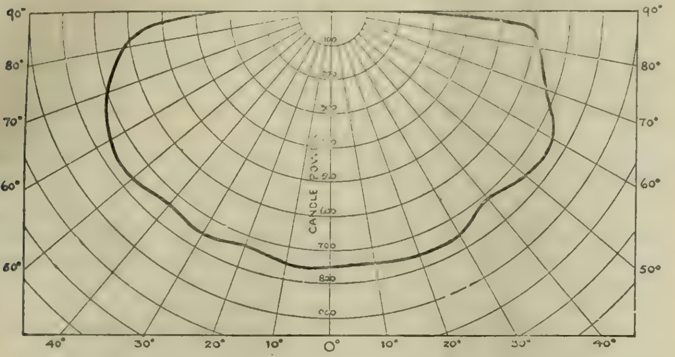


Fig. 1.—Light Distribution Curve from 200-volt, 500-watt Osram Gas-filled Lamp in G.E.C. "City" Lantern.

The first of these aims was attained by the provision of reflecting surfaces having a carefully calculated contour and the results of tests carried out by the National Physical Laboratory and reproduced in Figs. 1 and 2 demonstrate the accuracy of these calculations.

The reflecting surfaces, being of white vitreous enamel, can be readily cleaned and this work is facilitated by the possibility of lowering the glass to the extent of two safety chains. A ratchet device enables the position of the lamp to be adjusted to the correct focal position without the use of a screwdriver.

The question of ventilation in fittings for gas-filled lamps has always been a vexed one. This has been overcome in the "City" lantern by the provision of two concentric cylinders with staggered openings and baffles permitting a continuous current of air to be drawn over the lamp and at the same time preventing rain from driving into the body. Fig. 3 shows the lantern.

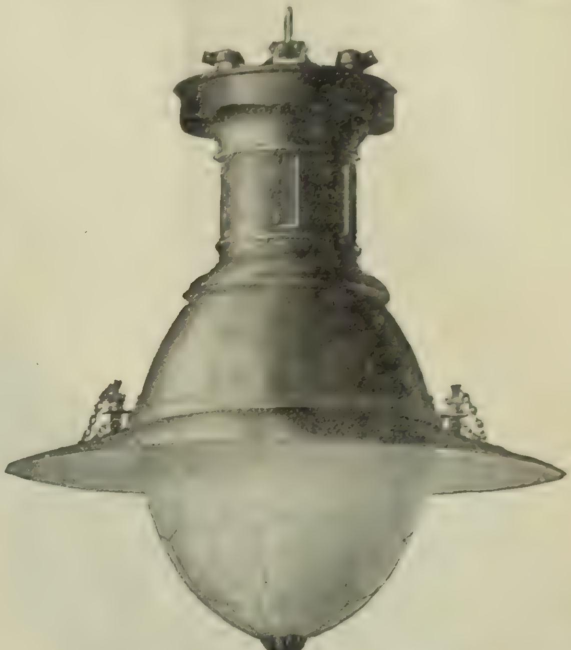


Fig. 3.—G.E.C. "City" Lantern for Street and General Outside Lighting.

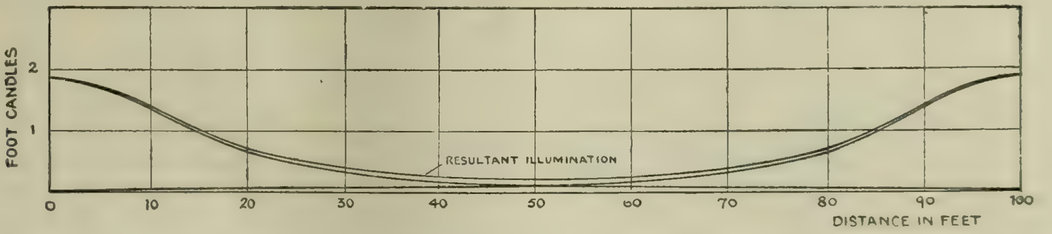
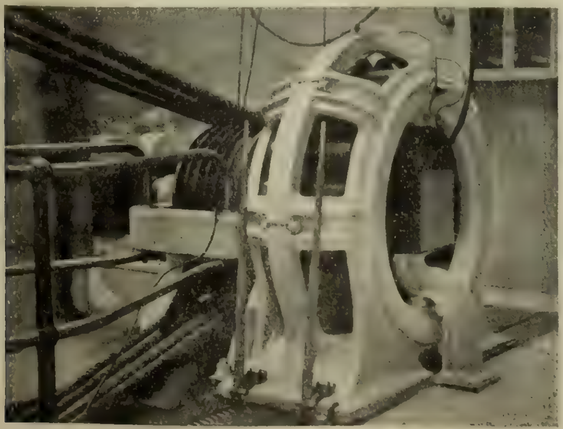


Fig. 2.—Foot-Candle Curves of Illumination Given by Two G.E.C. "City" Lanterns with 500-watt Lamps, Mounted 20 ft. Above Street Level and 100 ft. Apart.

Early Electricity Supply in Glasgow.

A week or two ago we described the new generating station at Dalmarnock, which the Glasgow Corporation have found it necessary to erect in order to supply the electrical needs of the district. But as "great oaks from little acorns spring," so 24,000 kw. turbo-alternators are the descendants of the machine, which by the kindness of Messrs. **Mavor & Coulson** we are able to illustrate herewith. It shows the first alternator used for public electric supply in Scotland. The machine is a Ferranti alternator which was made at the firm's works at Charterhouse-square and was installed in the John-street generating station in 1889 by Messrs. Mavor & Coulson, who at the time not only owned, but managed, all matters connected with the public electricity supply in Glasgow. It was disposed of to the Glasgow Corporation when the latter took the supply of electricity into their own hands.



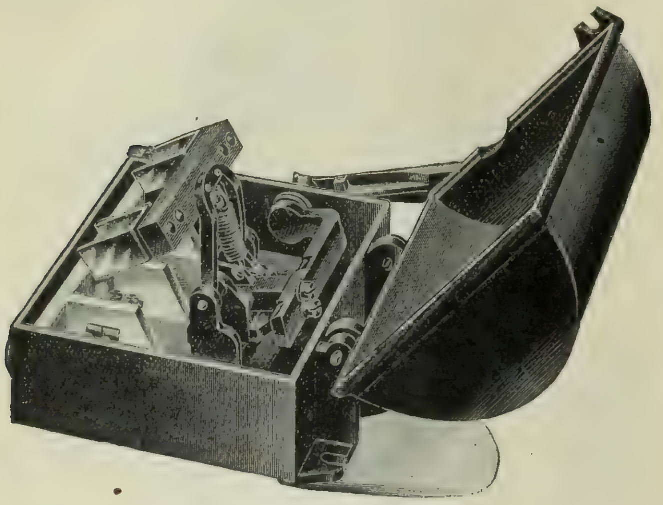
The first Alternator used for Public Electricity Supply in Scotland.

The plant illustrated consisted of two rope-driven Ferranti alternators, each of 200-kw. capacity, supplying single phase current at 2,400 volts and 120 cycles. The power to drive these alternators was developed by two Mirrlees-Watson tandem compound horizontal engines of 300 to 350 h.p., supplied with steam from two locomotive boilers each capable of evaporating 5,000 lb. of water per hour. The distribution was effected by an overhead high-tension network with transformers on the consumer's premises reducing the pressure to 100 volts.

The Australian Department of Trade and Customs has classified the following articles under the tariff items mentioned : Cable, flexible, cotton braided, containing wires, paper, rubber and cotton covered ; enamelled covered ; enamelled and cotton covered ; covered with rubber and cotton tape (item 181a), duty under General Tariff 15 per cent., duty free, under British Preferential Tariff. Steam turbines : Transformers for reducing electric current from 11,000 volts ; rotary converters, for transforming 3,000 k.w. alternating current to direct current ; and alternating and direct current switchgear, for controlling current from transformers and rotary converters of capacity referred to above, all for use in the manufacture of electrolytic zinc and by-products (item 174), 10 per cent. under General Tariff, British Goods free. Wire, nichrome, for use in the manufacture of electric heating and cooking appliances (item 404), 10 per cent. under General Tariff ; British goods free.

Apex Ironclad Switchgear.

Recently the Sun Electrical Company, Ltd., has designed and placed this switchgear upon the market. It is claimed that the construction of these switches represents an entirely new principle resulting in an exceptionally easy and simple action for both the "on" and "off" positions. Among the other advantages claimed for it are that each movement is absolutely of the quick-break type and is independent of the operator; all contacts enter or leave the switch at the same moment, reducing the possibility of arcing to a minimum. The switches are entirely fool-proof, easily operated, and it is impossible to put the switch on when the cover is open or, on the other hand, to open the cover when the switch is in the on position. The switches are double-pole and are smaller in size than any similar type on the market. The switch blades give a positive make or break contact at one and the same time, and the action, being a parallel one, the arc is evenly distributed over all four contacts.



30-ampere 500-volt Switch.

Care has been exercised in the design to ensure rapid wiring and erection, and in the case of the switch fuse, in which standard cartridge fuses are used, these can be easily replaced. There is no porcelain insulation, and the material used is practically unbreakable. It is claimed that the switch fuse is quite water-tight and not merely splash-proof, and by a slight modification it can be made suitable for use in fiery mines. In a pamphlet issued by the company, illustrated particulars are given of the design, construction and operation of the switchgear. The switches and fuses are made in three standard sizes and our illusetration shows the interior of a 30-ampere 500-volt switch.

Legal Intelligence.

The Osram Lamp Patents.

Last week Mr. Justice Eve gave judgment for the plaintiffs in the action of the Osram Lamp Works, Ltd., *v.* Maxim Lamp Works, Ltd., for default of defence. The case related to an alleged infringement of one of plaintiff's company's patents.

Patent Extension Application.

Last week the application for the extension of the patent granted to Valdemar Poulsen (No. 15,599 of 1903) came before Mr. Justice Sargant. For the applicants (Christopher Hage, of Copenhagen, the British & Overseas Engineering Syndicate, Ltd., and the Poulsen Wireless Telegraph Company, Ltd.), Mr. Trevor Watson said that since the day for the hearing notice of opposition had been put in by Mr. Frank Elwell, and the Board of Trade had also objected. He asked his lordship to give directions for the delivery by the opponents of particulars of their objections to the prolongation of the patent.

Mr. Courtney Terrel (for Mr. Elwell and the Radio Communication Company) said he would like to have some weeks to get out the particulars.

His Lordship: From what you both say, it should probably be tried on oral evidence, but I had better wait till I see the particulars of objections.

Mr. Austen Cartmell, for the Board of Trade, said the case was an extremely important one, and the law officers would be briefed to deal with it, consequently he asked that some time should be given before the hearing.

His lordship said he would give the opponents six weeks for the particulars of objections. The case will not be taken this term.

Insulating Tape Contract.

Last week Mr. Justice Bray heard an action brought by the British and Allied Electrical Company, Ltd., against the Chemical Engineering Corporation, Ltd., to set aside a contract entered into between themselves and defendants on the ground that they were induced to enter it by misrepresentation of material facts.

Mr. Croom Johnston (appearing for plaintiffs) said that fraud was not alleged. The adhesive tape was largely used in the electrical trade. Before the war the available supplies in this country were of German manufacture, and latterly American. There was undoubtedly a great shortage of it by the time the war was well advanced, and in Oct., 1918, plaintiffs, through their managing director (Mr. Pollock), got into communication with Mr. Fraser, who was connected with the defendant Company. Mr. Fraser, told him that the Company were making the tape at their factory at Southall, and that considerable quantities of it had been sold to the Admiralty and War Office. He said that it would turn out satisfactory. A sample was submitted to Mr. Pollock, and eventually in Dec., 1918, an agreement was made between the parties under which defendants were to supply to plaintiffs 50 tons of the tape at 1s. 6d. per lb., the quality to be in accordance with sample. Plaintiffs, who were commercial agents under the agreement, asked for the immediate delivery of two tons and defendants forwarded the goods direct to plaintiffs' customers. All the customers made complaints of the material which defendants replaced with other stuff.

Mr. Albert W. Pollock was called as a witness, but after a conference between the parties Mr. Croom Johnston announced that terms of settlement had been arrived at between them and he asked that a judge's order be made staying the action and ordering the pay ment of money out of court—£60 to plaintiff's executors, and £60 to the defendants.

His Lordship having assented to the course proposed, Mr. Claughton Scott (for defendants) observed that part of the trouble was caused by the absence of some secret knowledge as to how the stuff was kept adhesive.

Electricity Supply Dispute.

Mr. Justice Roche had before him, on Thursday afternoon, a claim by the Bounemouth & Poole Electricity Supply Company, Ltd., against Messrs. Hiel, Richards & Company for £297 10s. 8d. for eletric current supplied to them.

Mr. R. Goddard (for plaintiffs) said the defendant firm were doing concrete shipbuilding at Poole, and by agreement, dated Feb. 26, 1918, they agreed to take a supply of electricity from plaintiff company. The defence set up was not raised till plaintiffs were pressing for payment, The date on which the company commenced to take the supply, and for which the agreement ran was April 16, 1918, and went on till December, 1919. It was common knowledge in Poole that Hiel Richards & Company might be disposing of the business to the Gardner Shipbuilding & Engineering Company, but no application was made by anyone down to December 1919 that the Gardner Company should be substituted for defendants as consumers. Defendants sent a cheque for £27 12s. to cover what was due to the end of July, 1919, and with regard to the period ending Sept. 29, for which £190 14s. was due, they wrote. "We have apportioned this between ourselves and the Gardner Company as follows: Our proportion £60 1s. 10d., proportion payable by Gardner Company £130 2s. 2d. At the request of the Gardner Company, we have to-day forwarded them a cheque for £60 1s. 10d., made payable to you, and they have agreed to attach their cheque for their portion and forward both cheques to you. This clears the matter up." In reply to a letter from plaintiffs inquiring if defendants regarded their agreement with them as terminated, the defendants wrote: "We think it best that all accounts in future for the supply of electricity should be rendered to the Gardner Company, as we are making arrangements with them." Upon receipt of that letter plaintiffs took steps to send forms to the Gardner Company inquiring whether they wished to become consumers instead of defendants. These forms were sent in December, and were not received back from the Gardner Company until the middle of February. Meanwhile they sent in an account to Hiel, Richards & Company for the December quarter, and on Feb. 6 they got a letter from the Gardner Company stating: "We enclose herewith our cheque for £162 10s. 3d., and one from Hiel, Richards & Company for £88 17s. 7d., making a total of £251 7s. 10d., the amount of your account to Dec. 21, 1919." At that time counsel said the plaintiffs had not a consumer's account with the Gardner Company, and those two cheques were credited in their ledger to Hiel, Richards & Company.

Mr. Johnson, for defendants, said the situation was that they were clearing up at the time and occupied only a very small part of the premises for a few weeks. He contended that the two letters of defendants in December amounted, regarding them in the ordinary business sense, as a notice to discontinue the supply to them. The account had been paid down to Dec. 22.

His Lordship said the amount claimed was for the quarter ended March 29, 1920, and was regulated by the terms of the agreement between the plaintiff company and defendants. He had no doubt that notice was not given or accepted terminating that agreement, and judgment was, therefore, entered for plaintiffs for the amount claimed, with costs.

Electricity Supply.

Coventry Corporation have applied for permission to borrow money for transformers.

Sanction to a loan of £4,000 for extensions of mains has been received by Cheltenham Corporation.

The Galashiels and District Electric Supply Co. are laying a cable from Galashiels to Selkirk.

Aldershot Urban Council have received sanction to borrow £19,800, including £14,000 for additional generating plant.

Darlington Corporation has been authorised to borrow £8,200 for a new boiler at the electricity works.

Yarmouth Electricity Committee has increased the charges for electric current by 20 per cent.

Fleetwood Council has received sanction from the Electricity Commissioners to a loan of £5,000 for mains and services, and £2,000 for meters.

The Fife Electric Power Company has offered to purchase the Kirkcaldy burgh electricity undertaking, the transfer to take place on May 15 next.

A dispute as to the wages to be paid to the employees of the Colchester electricity department has been referred to the Industrial Court for Arbitration.

Aberystwyth Council has asked a committee to report upon the question of appointing an electrical engineer to make a survey of the water power available in the district.

A conference of Greater London Local Authorities Owning Electricity Works has been called for Nov. 17 in order to consider the question of the reorganisation of electricity supply in the area. The Town Clerk of Hammersmith is Secretary of the Conference.

The Minister of Transport has extended by one year the times limited by the Bradford-on-Avon Electric Lighting Order for making the transfer authorised by the order and the Rickmansworth and Chorley Wood Electric Lighting Order for laying mains. &c.

Whitehaven Rural District Council are applying to the Electricity Commissioners for a Special Order to enable them to provide and distribute electrical energy for all purposes within the parishes of Distington, Parton, Moresby, &c., in the Council's area.

The Electricity Commissioners have sanctioned the borrowing of £656,000 by Bolton Corporation in connection with the extensions at the electricity works. The Electricity Committee propose to apply for authority to borrow £100,000 for three years' prospective expenditure on mains and sub-stations.

The income of the Norwich Electricity Department for the year ended March 31 was £114,221, compared with £80,186 in previous year. Working expenses were £71,322 (£49,190), and after providing £5,799 for capital charges, and transferring £5,000 to depreciation fund, there remained a surplus of £29,641, which was carried forward.

One result of the amalgamation of Edinburgh and Leith is that a uniform scale of charges (the Edinburgh scale) for electrical energy will be introduced for the united area on Nov. 2. At present 5d. per unit is charged for lighting in Leith, and 3d. for power, but in Edinburgh the rates are only 4½d. and 1⅞d. respectively.

In order to encourage the use of electricity for domestic purposes the Westminster Electric Supply Corporation have issued, with their accounts for the Michaelmas quarter, an invitation to their consumers to visit the company's demonstration rooms any day from the 18th inst. until Nov. 1, when a special electric washing machine will be shown in operation, together with electric ironing machines, electric cooking stoves and other appliances. We hope full advantage will be taken of this invitation.

The effect on coal consumption of installing modern turbo-generators of large output is clearly shown by the results which have been obtained at the new Dalmarnock station of Glasgow Corporation. Tests show a reduction to 1·62 lbs. of coal per unit generated has been obtained, representing a saving of nearly 1½ lbs. of coal on every unit. This saving will total up to nearly 100,000 tons of coal per annum, representing a saving of £195,000 with coal at 40s. a ton.

The formal starting of a new 12,000 kw. Parsons turbo-generator at at the Valley-road electricity works, Bradford, took place on Saturday. The order for the new set was given three years ago ; the normal capacity of the station has only been 14,000 kw. but the maximum load last winter was over 22,000 kw., Another turbo-generator of the same size is awaiting delivery, and the Electricity Commissioners have intimated that they are prepared to sanction the installation of a still further set. The ceremony of starting up was performed by Mr. Wilfred Turner, Chairman of the Electricity Committee. On behalf of the contractors, a silver cigar-box was presented to Mr. Turner, a silver rose bowl to Mrs. Turner, and a silver key to Mr. Longley, the deputy-chairman of the Committee, who opened a canteen for the staff.

The utilisation of the water power resources of Banffshire was considered at a conference of local authorities last week, The chairman (Dr. Geo. C. Grant) said that the Water Power Commission had confined their report to the West and Midlands of Scotland, and the North-East of Scotland was not surveyed. The County Council appointed a Special Committee to deal with the matter. From a communication from the Electricity Commissioners it was clear that if they were to get anything in that part of the country they would have to do it themselves. The Commissioners stated that the demand for electrical energy was so great in the populous districts that the rural districts would have to be left alone. The Commissioners said they could not survey that part of the country, and if the County Council wished that done they should appoint an engineer of their own to do the work. A firm of London engineers estimated the cost of the work at about £300. The meeting unanimously agreed to take steps for the appointment of an engineer to advise the County Council on the water power available in the county for the generation of electric power at the earliest moment.

Norwich Electricity Committee is considering a recommendation of the City electrical engineer (Mr. F. M. Long) to erect new electricity works at a cost of £502,000. The average annual increase in the consumption of electricity is 10 per cent., and as this may be higher in future Mr. Long proposes to erect a new power station on land between the Crown Point sidings on the G.E.R. and the river opposite Trowse Eye. The site would give an adequate supply of water for condensing purposes and railway facilities. Mr. J. H. Rider, consulting engineer, has confirmed Mr. Long's view that no further plant should be put down at the present works, as the station lay-out does not permit of economical working. Mr. Rider's estimate of the cost of a 10,000 kw. plant is £428,000, and for 20,000 kw. £636,000. Including a bridge over the railway, trunk mains and converting plant, the total cost of the first section would be £502,000. The Committee recommend the adoption of the scheme, and hope to get a suspension of sinking fund payments until the new works become remunerative. The present works will be operated for a few years for generating current, but afterwards will be used as a sub-station.

Finchley Urban Council has authorised the Electricity Committee to proceed with a scheme for the extension of the generating plant at the Squire-lane Station at an estimated cost of £60,000. Explaining the scheme, the Chairman (Councillor Syrett) stated it was difficult to get plant at present, and orders should be placed at once. The capacity of their present plant was 1,400 kw., and included one 700-kw., and two 250-kw. steam sets, and a 200-kw. oil-driven unit. In addition there were at the sub-station two 200- and one 100-kw. oil plants. It was felt that the oil engines were far too unreliable, and it was for that reason they were purchased out of revenue and not capital. They had done good service at the sub-station, and had assisted during the war to turn out the electrical current required for munition purposes, but it would not be safe to reckon them as part of the generating capacity of the station. It was not safe to reckon on a generating capacity of more than 1,000 kw., and the maximum load last winter was 1,200 kw. It was agreed that the extension of the generating plant was the best and most economical thing for the Council. They estimated that they would save £6,000 a year by putting in their own plant and not taking a supply in bulk.

The revised scale of charges for electricity was adopted by Sheffield Corporation last week, though there was much criticism of the incidence of the revised tariff. Councillor Balfour pointed out that the effect would be to place a large burden on the power consumer ; it was a question of increasing the cost of production in Sheffield, and might cause great unemployment. He also asked if the committee had considered that large power consumers must be in a position to compare their power costs in the city and other towns. The Lord Mayor, chairman of the special committee, replied that there was a big divergence of opinion as to what charges should be made, and the figures could not be sufficiently adjusted by the committee in the time they had at their disposal to justify them in making an entire change in the principle of charges. The committee felt it was impossible to come to any definite decision at the moment, but that it must be gone into further, and expert information, probably from outside, must be called in to advise them on the proper scale of charges for the department. Unless something was done the department would have a deficit of £160,000 when the accounts were made up next March. Even if a very much larger sum was put upon the lighting and the tramways it would make very little difference this half-year to the power consumer.

Progress with the formation of the West of England Electricity Authority is very slow, mainly owing to the critical and somewhat parochial attitude taken up by Bath Corporation. It appears that the Ministry of Transport is prepared to proceed with the erection of the proposed transmission lines between Beachley, Forest of Dean, Gloucester, and the Stroud Valley, at an estimated cost of £365,000, provided resolutions are adopted by the local authorities in the district confirming the resolutions passed at the Conference which decided to submit a scheme for the establishment of a joint authority. The consent of the Ministry to the construction of the lines would be conditional on the early establishment of a joint authority, and as the power of the Ministry to acquire Beachley station is doubtful, the Office of Works are prepared to continue to work it until the joint authority is constituted and able to purchase the station and transmission lines. This would have to take place within two years from the constitution of the authority. The price to be paid for the station is about £170,000.

The Bath Electric Lighting Committee recommend the Council not to adopt the form of resolution submitted by Mr. Faraday Proctor, being of opinion that it is desirable to wait until the Electricity Commissioners have held their local inquiry, at which the whole position, including the degree of liability which will be assumed by the local authorities included in the proposed scheme, will be more clearly defined.

The gross capital expended on the Gravesend and Northfleet Electricity undertaking at March 31 last was £107,206, of which £54,133 had been paid off. Last year's profit was £6,879, but after providing for interest (£2,297), capital repayment (£4,761) appropriating £680 for discounts and bad debts, and crediting £23 dividends on investments the deficit was £836. In explanation of this loss it is pointed out that fuel, labour and stores have increased enormously in cost, and it is impossible to adjust charges to meet increased costs until some months after they had been increased. The maximum load was more than 50 per cent. above that of 1914, and the output in units had considerably more than doubled during the same period, while the machinery had to be taxed to its utmost capacity, and it was impossible to close down for essential overhauls. New plant on order had been delayed by various causes and the electricity Commissioners were asking the Corporation to undertake further extensions which would make Gravesend an important factor in the schemes for cheaper supply. It is understood that these extensions will involve capital expenditure, but at the same time when they realised the importance of an adequate and cheap supply of electricity for all purposes, it was hoped the public would support the Electricity Commissioners in their efforts, secure in the knowledge that the very best electrical engineers and financiers of the present day were directing the policy of the Government.

All the public gas lamps are to be adapted for electric lighting, wherever possible.

The inquiry held last week by Col. Ekin, an inspector of the Ministry of Transport, into the application of the Chelmsford Electric Supply Corporation for authority to increase the charges for electrical energy disclosed some of the present difficulties of small supply undertakings. The managing director of the Company (Mr. K. A. Scott Moncrieff) stated that their original charges were 6½d. per unit, with ½d. discount if paid within a month; at the beginning of 1919 the charge was increased to 8d., and in November, 1919, to 9½d., and they now wanted to increase the figure to 1s. 0½d., with ½d. discount, each consumer to take or pay for 15 units in the winter, and 10 units in the summer quarters. The average profit for the three years preceding the war was £2,720. In 1919 there was a debit balance of £759 and the estimated debit balance for 1920 was £1,392. Including depreciation, the losses were respectively £6,652 and £7,656. The price of coal had gone up from 17s. 6d. in 1914 to 46s. 10d. 4,069 tons were used in 1919, and it was estimated that 3,430 would be required in 1920, the difference being accounted for by the marked improvement in the quality of the coal now received, and the repairs to plant which had made for efficiency. The loss on the undertaking was met out of the profits of other undertakings of the Company, and investments. The total net profit on the whole of their undertakings in 1919 was about £2,000, on a capital of £300,000, and the shareholders had had no dividend for four years. Mr. Moncrieff also stated that the Board of Trade had refused a previous application for a minimum charge, but the Company wished to revert to the old practice. The principal objection was to the minimum charge, and it was stated that many shopkeepers did not use a single unit in the Summer.

The question of the Reorganisation of Electricity Supply and the Development of Water Power in North Wales was considered by the Carnarvonshire County Council last week. At a recent conference of representatives of North Wales County Councils and electricity suppliers it was decided to oppose the proposal of the Electricity Commissioners to include portions of Cheshire, Salop and Cardiganshire in North Wales area, unless guarantees were given to safeguard local requirements. Mr. H. J. Jack, managing director of the Aluminium Corporation, attended, and pointed out that the conference had not dealt with the subject with adequate respect. The Commissioners recognised that there must be a district within which the current produced could be sold, and for that reason North Wales, an agricultural district, was attached to an industrial district. His company had spent two millions on their scheme, and to develop the water-power of the district to the full would require a further expenditure of three millions. The estimates of consumption in five North Wales counties ran to about 30 million units per annum, while there would be 130 million units available with fuller development of power, and he assured the Council that no electricity authority would send its current one yard further than was necessary. His company has constructed huge dams which would be there for practically all time, and thus North Wales had in them a huge national asset. He was prepared with a scheme which would cost nearly five million pounds. He proposed to construct lines in such areas as Carnarvon and supply them with electricity in bulk within four months of that day at 2d. a unit, and there could be an agreement that it must be sold locally at no more than 6d. for lighting and 3d. for heating and cooking. He hoped to supply Colwyn Bay in eight months and Bangor in four, and he intended taking the line to Wrexham, Crewe, Nantwich and Middlewich. It might be possible to establish factories with electrically-driven machinery and so develop local industries.

The Reconstruction and Parliamentary Committee has been asked to consider and report to the Council on the subject.

Personal and Appointments.

Mr. Edwin Deller, LL.D., has been appointed Academic Registrar of the University of London.

Mr. R. R. Beal, of the American Federal Telegraph Company, has arrived in this country from Denmark, where he has been discussing questions relating to improvements in wireless telegraphy with M. Valdemar Poulsen. Mr. Beal has recently been engaged on the construction of the large wireless station at Bordeaux.

The Blackburn Branch of the National Association of Local Government Officers has presented Mr. T. Wallwork, mains superintendent, and one of the founders of the Association, with a gold albert, and Mrs. Wallwork with a gold wristlet watch in recognition of his services to the Branch. The presentations were made by the Borough Electrical Engineer, Mr. P. P. Wheelwright.

Electric Traction.

The Maidstone tramway accounts for the year ended March 31 show revenue £2,010, gross profit £4,173, and after providing £4,315 for capital charges, the net deficit was £142.

The threatened strike of Glasgow tramway employees has been averted and the men have accepted the offer of the Corporation to grant an increase of 4s. per week and 2s. for women. The revised scale will remain in force until June next.

Col. Pringle, who has recently inspected the track of the Llandudno electric tramway, has suggested certain improvements, including the relaying of the line in Gloddaeth-avenue, and the Council has now called upon the company to execute the work as soon as possible.

If the demand for another increase of 12s. a week in the wages of tramwaymen be conceded it will seriously affect all tramway undertakings, and it is estimated that if the full demand be granted less than 25 per cent. of municipal tramways will be able to continue working without calling upon the local rates.

At the meeting of the National Industrial Council for the Tramway Industry on Tuesday the application was submitted. The companies' representatives refused to consider it and retired from the Council. On the suggestion of the Municipal representatives certain inquiries will be made, and the meeting stands adjourned until Nov. 12.

The East Ham Tramways accounts for the year ended March 31 show revenue £95,235 (compared with £84,848 in previous year), and operating costs £104,386 (£85,691), the result (after providing for repayment of principal and interest) being a deficit of £21,355 (£11,174). Passengers carried were 19,192,452 (17,068,833), and car-miles run 1,386,777 (1,379,511). Operating costs per car-mile were 18·06d. (14·91d.)

The accounts of the Birkenhead Tramways Department for the year ended March 20 show revenue £148,179 (compared with £114,974 in previous year), and working expenses £100,476 (£69,249). Stamp duty, &c., required £74 (£39), interest £19,799 (£19,049), and sinking fund £11,725 (£10,138), and the net profit was £16,105 (£16,500). Total revenue was 27·89d. (22·44d) per car-mile, and working expenses, including power, were18·91d. (13·51d.). Passengers carried were 22,836,034 (2,394,837), and car-miles run 1,275,022 (1,229,610). The motor 'buses, the first of which were put into operation in February, 1919, show revenue £8,010, and gross profit, after paying working expenses, of £2,119.

The London County Council have appointed Mr. P. J. Crouch, general manager of the Metropolitan Carriage & Wagon Company, to act with the general manager of the tramways (Mr. A. L. C. Fell) as assessor of the designs for new tramcars.

The Highways Committee has sanctioned certain items of expenditure on maintenance and repairs, including the following:—Articles for maintenance, &c., £205,394; purchase of metals, £6,133; rewinding of armatures, £4,970; purchase of creosoted wood paving blocks, £50,000 and 9,550 tons of granite setts, £42,250; and supply of conductor rails, £50,425. For certain renewals of track in Harrow-road an expenditure on maintenance account not exceeding £23,500 has been sanctioned. The poles for the tramways in Burdett-road, Grove-road, &c., and the new tramway in Well-street will be provided and installed by Clough, Smith & Company, as an extra upon their present contract, at a cost not exceeding £16,500.

Institution Notes.

Owing to the strike and the fact that a large number of their members are engaged in the mining industry, the annual meeting of the Association of Mining Electrical Engineers, which was to have been held at Cardiff on the 29th inst., has been postponed.

At the annual meeting of the Western Centre of the Institution of Electrical Engineers, held on the 18th inst., Mr. C. T. Allen was presented with a set of silver plate and a stop-watch and Mr. A. J. Ostler with a set of silver plate, in recognition of their services.

The one-hundred-and-second session of the Institution of Civil Engineers will be opened on Tuesday, Nov. 2, at 5.30 p.m., when Mr. John Alex. Brodie, president, will deliver an address, and will present awards made by the Council for papers dealt with during the past session.

A joint meeting, organised by the Faraday Society and the Sheffield Section of the Institute of Metals, will be held in the Mappin Hall of the Department of Applied Science of the University of Sheffield, on Nov. 19, to discuss papers dealing with various aspects of Electroplating. Those desirous of taking part should communicate with the Local Honorary Secretary of the Faraday Society, Dr. F. C. Thomson, at the University.

At the meeting of the Sheffield Wireless Society, on Friday last, the address of the President, Mr. H. E. Yerbury, M.Inst.C.E., M.I.E.E., dealt with the subject of internal atomic energy, the Einstein theory, the structure and potentialities of matter, electric waves, &c. At the conclusion of the address some interesting experiments were conducted and subsequently there was a general discussion.

We are informed by the Secretary of the British Section of the Société des Ingénieurs Civils de France that arrangements have been made of four or possibly six meetings to be held during the forthcoming session. The first of these will take place on Tuesday, November 9th at the Royal Society of Arts, John Street, Adelphi, when M. Edouard Gruner, President of the Society, will read a Paper.

We have also received an account in French, of the proceedings of the opening meeting of the Section held on November 24, 1919, of which an account has already been given in The Electrician and of the excursion to the devastated areas of Northern France, which took place in June of this year.

Imperial and Foreign Notes.

According to Sir Adam Beck, Chairman of the Ontario Hydro-Electric Power Commission, it should be possible to develop some 4,500,000 H.P for Canadian use along the waterways between SAULTE STE. MARIE and MONTREAL, representing the same annual value as 90,000,000 tons of coal.

H.M. Senior Trade Commissioner in Canada and Newfoundland report that a Montreal company desire quotations and date of earliest delivery for four 1,200 h.p. synchronous motors (240 R.P.H., 6,600 volts, 3.phase, 60 cycles) with rheostats and auto transformer. It is understood that if United Kingdom manufacturers can give delivery within six months there is every possibility of the order being given; also, that it is not so much a matter of price, as the assurance of delivery. The name of the company can be obtained from the department of Overseas Trade, 35, Old Queen-street, S.W. 1.

We are informed that in the PATENT INFRINGEMENT SUIT of the Dubilier Condenser Company against the Wireless Specialty Apparatus Company the District Judge for the Southern District of New York held on the 4th inst. that certain claims, 2, 3, 4, 5, 7, 8, 9, 12, 14 and 15 of Patent No. 1,229,914, and claims 1, 8, 12, 16 and 17 of Patent No. 1,229,914 were valid, and that the Wireless Company had infringed the patents. The fourth claim of Patent No. 1,229,915 was invalid, being anticipated by the prior use of the subject matter. The case covers mica condensers, especially the h.t. type in which brush discharge is eliminated and efficiency greatly increased.

The Commercial Secretary to H. M. Embassy at Tokyo (Mr. Hugh Horne) reports that the IMPERIAL JAPANESE RAILWAY DEPARTMENT is going to introduce in the present session of the Diet a Bill for the organisation of a semi-official electric power company, with a capital of 100,000,000 Yen supplying 250,000 H.P. for working trains on suburban railways. They propose to build a power house on the Shinano-gawa. Extensions of the electric railways running out of Tokyo which will link many important centres with the capital have been planned by the Railway Department. It is proposed to run an electric line from Ryogoku to Chiba and from Kichijeji to Hachioji. Another extension under consideration is that of the present Tokyo-Yokohama electric line to Odawara and Yokosuka, and a new electric line out of Uyeno Station to Takasaki is also planned. The authorities expect to have the 5-mile section between Hachioji and Kokubunji in operation before the end of the year. The Ryogoku-Chiba line will be attended to after Manseibashi and Ryogoku have been connected.

Business Items, &c.

The FOREIGN SAMPLES EXHIBITION, which is organised by the Department of Overseas Trade, has been removed to commodious premises at 7-11, Old Bailey, London, E.C. 4.

On November 10th the offices of the Electrical Power Engineers Association will be removed to 102, St. George's-square, London, S.W.1. Tel. No.: Victoria 9424.

Messrs. Jones & Pordes have appointed Messrs. Rickard, Wright & Dean, Ltd, 17, Neal-street, Bradford, as sole selling agents for their "Elba" dry cells for Central Yorkshire.

Messrs. Sir Isaac Pitman & Sons, Ltd., publishers of technical and other books are removing to Pitman House, Parker-street, Kingsway, London, W.C.2. Telephone: Gerrard 856; Telegrams: Ipandsons Westcent, London.

Arthur Herbert Walker and John Francis Taylor, electrical and mechanical engineers, have dissolved partnership. Debts by Mr. J. F. Walker, who continues the business at his premises in Dock-street, Middlesbrough.

The British Chamber of Commerce for Switzerland has begun work and has taken convenient premises at 20, Rittergasse, Basle. The permanent secretary-general is Mr. Alex. Richardson, and there is a branch office at Place St. Francois, Lausanne, in charge of Mr. Maurice Galland.

Several new designs of "MAGNET" ELECTRIC FIRES have been put on the market this season by the General Electric Company, and in a neat booklet, together with a loose leaflet issued by the company, illustrated particulars and details of these fires are given. We hope to give further particulars of these in an early issue.

Messrs. Gross, Son & Robertshaw, have been appointed sole selling agents for Wild-Barfield electric furnaces for the counties of Northumberland, Durham, Cumberland and Yorkshire. In addition to their office in Newcastle, Messrs. Gross have opened a branch office at 41, Great George-street, Leeds, where a demonstration furnace is in course of erection. Messrs. Macbeth Bros. & Company, Ltd., of Bombay and Calcutta, have taken over the sole selling rights for India where these plants are already in operation.

An amalgamation of the interests of the English Electric Supplies, Ltd., and the lamp and supplies department of Messrs. Siemens Brothers & Company, Ltd., has been arranged, and from the 1st Nov. the business will be carried on under the title of the English Electric & Siemens Supplies, Ltd., whose registered office is Brook House, 191 & 192, Tottenham Court-road, London, W. 1. The supplies department, with showrooms and stores, at 38 & 39, Upper Thames-street, London, E.C. 2, will be retained, and all orders and business in connection therewith will be dealt with from that address, as heretofore. The Company will retain the same staff, both in London and the branch offices, and will carry on the business of both companies on the same lines as formerly, with the addition of new electrical devices to be placed on the market shortly.

Miscellaneous.

The death occurred last week of Sir CORNELIUS N. DALTON, K.C.M.G., late Comptroller-General of Patents.

A course of five LECTURES ON ADVERTISING will be given by Capt. Oliver Minns, at the L.C.C. Commerical Evenings Institute, Stillness-road, Brockley Rise, S.E. 23, on Monday evenings, and will commence on Nov. 8.

Although the use of foreign magnetos was allowed in the recent AIR MINISTRY COMPETITIONS for Aeroplanes and Seaplanes (Amphibious) the whole of the eight prizes awarded were won by machines fitted with British magnetos.

A FATAL ACCIDENT occured at the Lister Drive powerstation of Liverpool Corporation on Wednesday last. A boiler scaler named Charles Mathers became entangled in a revolving shaft at the station and was killed. At the inquest a verdict of accidental death was returned.

It is announced in the daily press that on Feb. 1 next attempts are to be made to establish communication between wireless amateurs in America and in this country. The arrangements are in the hands of Mr. Phillip R. Cursey, to whom all communications should be addressed at 12, Henrietta-street, London, W.C. 2.

In an editorial note on Electricity in Housing Schemes, which appeared in last week's issue, we stated that a meal for six persons could be cooked for 5·67 units. The Jackson Electric Stove Company draw our attention to the fact that this should be 3·27 units. We hasten to make the alteration, as this is not the kind of propaganda that we care to have anything to do with at the present time.

The new ELECTRIC ROLLING MILLS at the Grange Lane Works of Messrs. Hemming & Company were opened on Monday by Mr. Wild, chairman of Sheffield Steel Products, Ltd., The mills are specially designed for rolling high-speed steel rods, &c., used in the cold drawing department of the firm, and consist of one train of three stands of 12 in. three high rolls and one 8 in. train comprising six stands. The mills, which have been completed in about six months, were designed by Mr. J. W. Walker, a director of the firm.

Notwithstanding the present industrial unrest the latest enterprise of the Glasgow Corporation in the way of exhibitions—that of the SHIPBUILDING, ENGINEERING and ELECTRICAL—will open in the Kelvin Hall of industries on the 8th prox. It is the first exhibition of its kind held in Scotland and it will be the biggest that has taken place. Every inch of available space in the huge Kelvin Hall has been let, the exhibits comprising all type of material coming within the scope of the Exhibition. The various stalls have been erected and workmen are busily engaged getting the exhibits into position. The Exhibition will run for a month.

The Annual Installation Meeting of the KELVIN LODGE was held at Mark Mason's Hall, London, on Friday last, when Mr. Henry Porter-Cox was installed as reigning master. The members and visitors afterwards dined in the Connaught Rooms, among those present being Mr. Edward Manville, M.P., who is a Grand Junior Deacon of England, Mr. E. J. Reid, Assistant Grant Supt. of Works, and Mr. P. P. Kipping, Past Assistant Grand Supt. of Works, and other gentlemen holding positions of rank in the masonic world. Reference was made by Mr. Porter-Cox to the magnificent way in which the Kelvin Lodge had supported the Masonic Charities since its consecration in 1914. Mr. Rentell proposed and Mr. W. M. Aitken, reigning Master of the Telephone Lodge, responded to the toast of "The Visitors."

The SELECT COMMITTEE ON TELEPHONE CHARGES has resumed its sittings and evidence has been taken from members of Chambers of Commerce and business houses. Mr. J. Walker Clark, of the National Chamber of Trade, said his members preferred a message rate, a small charge for installation and, say, £5 rental, with a charge of 1d. per call, or, alternatively, a charge of, say, £12 per annum for one instrument and 1,000 calls, without extra charge. A large number of people in a small way of business were without telephones, because of the difficulty and cost of installation. Hull had the only existing municipal service, and they considered the Hull method of charging by providing a measured rate and a flat rate helped to popularise the service and increase the number of telephone users. On Tuesday Col. H. Laws Webb gave evidence on behalf of the Federation of British Industries.

Nothing has tended to prove more conclusively than the events of recent months—even the Coal Strike, the need for the development of EDUCATION IN INDUSTRY. It is a factor which the Industrial League and Council has recognised for some time, although it is only of late that it has been generally accepted as a phase of primary importance. "When we stop learning we stop living—we are really dead," said Mr. W. J. Deeley, B.A., in his lecture on this subject, on Sunday, before the members of the Yorkshire (Leeds) Centre of the Industrial League and Council at their Week-End Conference. He said that records should be kept by the foreman and points concerning each worker should be jotted down so that, when opportunity of promotion came, no deserving worker should be overlooked. It often transpired that the workmen who had not trained minds might yet be classed as educated minds. He knew of a cobbler who was not a reader, but was one of the best educated men he knew. He entered into continual debate with visitors, and would bring his mental powers to bear on the questions brought up. This method, together with books read to him at times, had developed his mental faculties. In our subconscious minds lie enormous powers never tapped. In industry we might improve out of all recognition, if the powers of the subconscious mind were utilised. The lecture was followed by an interesting discussion. This was the second week-end conference of employers and employed that the Leeds Branch of the Industrial League and Council has organised. In addition to the lecture by Mr. Deeley, the session on Saturday afternoon was occupied by a consideration of "The Work of the Building Trades' Parliament," on which an address was given by Mr. Malcolm Sparkes.

We learn that a movement has been inaugurated to provide a Memorial to Mr. W. Duddell, C.B.E., F.R.S., who died in November, 1917. As our readers are aware, Mr. Duddell devoted himself for many years to the study of alternating currents and his work necessitated the design and development of several instruments, including the Oscillograph, which he introduced in 1898. The present knowledge of the theoretical side of alternators, switchgear, surges in cables and telephonic phenomena is largely due to the use of the Duddell Oscillograph. His paper, read before the Institution of Electrical Engineers in 1900 "On Rapid Variations of Current through the Direct Current Arc," was of fundamental importance, and the musical arc in the hands of Poulsen became a most valuable means of producing continuous waves for telegraphic purposes. Later he turned his attention to wireless telegraphy and during the war devoted much time to the solution of scientific problems which the war brought into prominence, and it is probable that excessive work so undertaken was responsible for his premature death. The following are the Members of the Memorial Committee:—Sir W. Bragg (Chairman), Sir H. Darwin, Sir R. T. Glazebrook, Dr. R. Knox, Prof. T. Mather, Mr. Roger T. Smith and Mr. Robt. S. Whipple.

It is proposed that the Memorial should take the form of a medal to be awarded periodically by the Council of the Physical Society to those who have advanced physical knowledge by the invention or design of scientific instruments, or of materials used in their construction. If sufficient funds are available after paying for the cost of the dies and providing for the cost of striking the medals, it is proposed to form a fund to be devoted to the foundation of Scholarships or Prizes to be awarded to students of the Physical Society. Subscriptions to the Hon. Sec., Mr. R. S. Whipple, 15, Creighton-avenue, Muswell-hill, N.10.

Imports.—The following are official values of electrical machinery, material and apparatus imported into this country (*a*) during September, 1920, and (*b*) the aggregate figures from Jan. 1 to Sept. 30, with increase or decrease compared with corresponding periods of 1919:—

Electrical machinery, (*a*) £117,602 (increase £50,967), (*b*) £848,600 (increase £355,366); telegraph and telephone cables other than submarine, (*a*) nil, (*b*) £50 (increase £50); telegraph and telephone apparatus, (*a*) £24,486 (decrease £8,664), (*b*) £123,519 (decrease £89,609); other electrical wires and cables, rubber insulated, (*a*) £3,342 (increase £3,272), (*b*) £23,560 (increase £19,065); with other insulations, (*a*) £14,426 (increase £12,857), (*b*) £85,992 (increase £73,581); carbons, (*a*) £10,574 (increase £4,772), (*b*) £95,940 (increase £70,974); glow lamps, (*a*) £10,857 (increase £10,745), (*b*) £40,072 (decrease £173,550); arc lamps and electric searchlights, (*a*) £254 (increase £254), (*b*) £4,014 (increase £3,983); parts of arc lamps and searchlights (other than carbons), (*a*) £776 (decrease £4,241), (*b*) £10,228 (decrease £47,786); batteries, (*a*) £10,796 (increase £6,474), (*b*) £60,454 (increase £25,846); meters and measuring instruments, (*a*) £11,300 (increase £7,650), (*b*) £60,750 (increase £31,201); switchboards, (*a*) £212 (increase £212), (*b*) £1,345 (increase £202); electrical goods and apparatus unenumerated, (*a*) £92,958 (increase £55,056), (*b*) £550,930 (increase £220,921). Total of electrical machinery, material and apparatus other than uninsulated wire, (*a*) £298,382 (increase £138,626), (*b*) £1,913,950 (increase £588,749).

Exports.—The exports of electrical machinery, material, &c., (*a*) during September, 1920, and (*b*) from Jan. 1 to Sept. 30, with increase or decrease compared with corresponding periods of 1919, were as follows:

Electrical machinery, (*a*) £1,089 (increase £222), (*b*) £7,621 (decrease £796); including railway and tramway motors, (*a*) £30 (increase £17), (*b*) £162 (decrease £204); other generators and motors (*a*) £671 (increase £142), (*b*) £4,461 (increase £736); and electrical machinery unenumerated, (*a*) £388 (increase £63), (*b*) £2,998 (decrease £1,328); telegraph and telephone cables, submarine (*a*) £72,992 (increase £48,612), (*b*) £1,224,625 (increase £776,934); other than submarine, (*a*) £48,389 (decrease £16,401), (*b*) £703,400 (increase £387,127); telegraph and telephone apparatus, (*a*) £75,576 (increase £45,527), (*b*) £852,062 (increase £572,662); other electrical wires and cables, rubber insulated, (*a*) £164,837 (increase £90,630, (*b*) £1,237,132 (increase £683,471); with other insulation, (*a*) £161,618 (increase £52,658), (*b*) £1,535, 984 (increase £857,030), carbons, (*a*) £8,084 (increase £7,365), (*b*) £80,158 (increase £83,313); glow lamps, (*a*) £33,937 (increase £19,654), (*b*) £193,602 (increase £81,585); arc lamps and searchlights, (*a*) £2,050 (increase £2,050), (*b*) £15,405 (increase £8,481); parts of arc lamps and searchlights (other than carbons), (*a*) £2,356 (increase £2,334), (*b*) £10,398 (increase £2,568); batteries, (*a*) £66,441 (increase £49,456), (*b*) £399,191 (increase £73 576); meters and measuring instruments, (*a*) £38,415 (increase 9,057), (*b*) £294,072 (increase £116,158); switchboards, (*a*) £12,960 (increase £6,844), (*b*) £74,857 (increase £36,982); electrical goods and apparatus unenumerated, (*a*) £200,582 (increase £114,867), (*b*) £1,366,347 (increase £525,308). Total of electrical machinery material and apparatus, other than uninsulated wire, (*a*) £1,145,191 (increase £492,334), (*b*) £9,603,279 (increase £4,544,719).

Bankruptcies and Liquidations.

James Skinner, trading as Foster, Skinner & Company, electric fittings dealer, 6, South Castle-street, Liverpool, has been adjudicated bankrupt. First meeting of creditors on Nov. 4 at 11, Dale-street, and public examination on Nov. 29 at the Court House, Victoria street.

A meeting will be held at 6, Old Jewry, London, E.C.2, on Nov. 24 to receive an account of the winding up of Insulation and Metal Fitments Ltd.

Tenders Invited.

Turton Urban Council require tenders by Nov. 10 for overhead lines and underground cables. Specification from the Electrical Superintendent, Bromley Cross, near Bolton.

Ecclesall Bierlow Guardians require tenders by November 10th for the electric lighting of hospital and infirmary blocks. Particulars from the Clerk, Union Offices, The Edge, Sheffield.

Doncaster Corporation invite tenders for the supply and erection of a 750 kw. rotary converter and l.t. switchgear. Specifications from the engineer (Mr. S. R. Windle) and tenders to the Town Clerk (Mr. R. A. H. Tovey) by Nov. 2.

The date for the receipt by the Crown Agents for the Colonies, on behalf of the Government of the Uganda Protectorate for a concession of a portion of the Ripon Falls of the Nile for the generation of electric power has been extended from Dec. 20 to Feb. 19.

Tenders are required by Nov. 19 for the supply and erection of motors, transformers, &c., to operate eight pumps at the dry docks at Kattendyck (Belgium). Specification can be seen at the Dept. of Overseas Trade, Westminster, S.W.1.

The Deputy Postmaster-General, Brisbane, requires tenders by Dec. 15 for the supply of cable (schedule 513) for the Australian Commonwealth Postmaster-General's Dept. Specifications can be seen at the Department of Overseas Trade, Westminster, S.W.1.

Manchester Electricity Committee invite tenders for supply and erection of high and low-pressure steam pipe work, &c. Specifications from the secretary of the electricity department (Mr. F. E. Hughes), and tenders to the chairman of the committee by Nov. 8.

The Electricity Committee also want tenders by November 22nd for supply and erection of motor-generators, battery boosters, switchgear, &c., at Barton power station. Specifications from Mr. F. E. Hughes, Town Hall, Manchester.

Catalogues, Price Lists, &c.

Messrs. Crompton & Company, Chelmsford, have issued leaflet No. C1 which gives particulars and prices of two types, D.B.O. and D.B.I., of their small d.c. motors. The leaflet gives a general specification, with dimensions, outputs, &c. The company report a phenomenal demand for this type and size ($\frac{1}{2}$, $\frac{3}{4}$ and 1 h.p.) of machine at present. Copies of the Company's lists dealing with motors of larger sizes, both a.c. and d.c., will be forwarded on request.

The new catalogue of Messrs. Landis & Gyr, Ltd., Hampton Hill, is a neat publication and should prove useful to all who are interested in their electricity meters. Conveniently divided into sections, it is well printed and bound, and it can be carried in the pocket. Section A is devoted to meters for single and polyphase circuits, and contain a description of the design and construction of the various standard types of "Elgee" meters, with particulars of capacities, method of connection, diagrams, and other technical details. In the next section d.c. meters are treated in a similar manner, while a third section is devoted to special tariff and prepayment meters as well as m.d. indicators, contact clocks, current limiters and other recording instruments. The fourth section is on induction-type watt-meters for single and three-phase circuits, and the final section relates to time switches and limiters, remote control switches and contact clocks. The various illustrations, diagrams and technical data are very clear and concise.

The desirability of efficient lighting in workshops was never more urgent than to-day, when the industrial watchwords are "Production and Efficiency." Good lighting enables more and better work to be done in a given time; it safeguards the health and eyesight of workers, minimises the risk of accidents and creates a cheerful atmosphere. Statistics show that when inefficient lighting gives place to modern methods the spoilages are reduced by anything up to 70 per cent. The development of the Osram gas-filled lamp and recent advances in illuminating engineering prove that "rule of thumb" methods of lighting are highly inefficient, and in this connection it may be affirmed that any installation planned more than six years ago should be reviewed in the light of modern knowledge. Particular value, therefore, attaches to the issue of a new Industrial and Street Lighting Fittings and Accessories Catalogue (Section F.1) by the G.E.C., which is replete with illuminating engineering data, illustrations, particulars and prices of fittings, &c.

In the first (Industrial Lighting) section are found fittings suitable for lighting workshops, stores and offices, together with technical data and instructions regarding their installation and use. The fittings include extensive, intensive and angle-type steel reflectors for local lighting, semi-indirect ceiling fittings for high and low ceilings, indirect fittings, hand lamps, bulkhead fittings, &c. In the second (street lighting) section are a large number of lanterns for street lighting with Osram gas-filled lamps, together with artistic standards, time switches and accessories. Of the lanterns the "City" and "Metropolitan" are deserving of mention; they are specially suitable for lighting main thoroughfares, and both have been widely used for public lighting. Full specifications are given in the catalogue. Several of the lanterns are particularly suitable for illuminating yards, sidings, railway stations, docks, &c., and also large buildings, such as hotels, theatres, offices, &c. Information on lighting problems, as well as schemes for any purpose, will be worked out by the G.E.C. Illuminating Engineering Department for the assistance of engineers, contractors and others.

Patent Record.

SPECIFICATIONS PUBLISHED

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1916 Specifications.

150,357 B.T.H. Co. (G.E. Co.) Dynamo-electric machines. (17/4/16.)

150,359 B.T.H. Co. (G.E. Co.) Electron discharge apparatus. (1/8/16.)

Comprises an apparatus which includes an electron discharge device furnished with electrodes maintained at suitable potentials, such that the device has a negative resistance characteristic between an electron-emitting cathode and a co-operating electrode, in which the device is furnished with a discharge controlling member in proximity to the cathode, and with means for applying a variable potential to the discharge-controlling member.

1918 Specifications.

122,173 Petersen. Method for transforming the kinetic energy in gases into electrical energy and manner for utilising the latter for carrying out gas reaction. (30/12/18) (Convention date not granted.)

1919 Specifications.

150,372 Heyes. Electric arc welding. (2/4/19. Cognate application, 19,366/19.)

125,084 Blondel. Application of oscillographs and other galvanometers to radio-telegraphy. (4/4/18.)

Comprises the combination of resistance, inductance and capacity added or inserted in the electric circuit, in which a vibration galvanometer or oscillograph is connected for the purpose of bringing about, by means of an appropriate adjustment, the damping of electrical oscillations in the galvanometer circuit, and the electrical resonance of the circuit with the group frequency produced by the station transmitting the waves, or with the beats produced by the receiving station itself, the said circuit being connected with a detector circuit, by inductance, by capacity, or by a transformer, and the galvanometer being mechanically tuned to said frequency.

150,379 Gardner. Microphones or electric transmitters for submarine signalling and the reception of subaqueous vibrations. (2/5/19.)

150,394 Negromanti. Electrically-heated coverings. (27/5/19.)

150,404 Murray & Telephone Mfg. Co. Switch contacts for multiple electric switches. (28/5/19.)

150,413 Igranic Electric Co. & Wright. Coil-winding machines. (29/5/19.)

150,414 Igranic Electric Co. & Wright. Coil-winding machines. (29/5/19.)

150,415 B.T.-H. Co. (G.E. Co.) Amplification of electric currents. (29/5/19.)

150,425 Ricardo. Electric power generating sets. (2/6/19.)

150,438 Phillips & Ellitt Bros. Means for securing the permanent magnets of electrical measuring instruments of the moving-coil type. (4/6/19.)

150,468 B.T.-H. Co. (G.E. Co.) Electric incandescent lamps. (24/6/19.)

150,484 Calvert. Incandescent electric lamps. (2/7/19.)

150,489 Keating. Electric fuses. (4/7/19.)

150,514 B.T.-H. Co. (G.E. Co.) Electric heating devices. (5/8/19.)

150,516 Whiddington. Tuned ionic oscillator. (9/8/19.)

Relates to a wireless transmitting system comprising an ionic discharge device consisting of an anode, electron-emitting cathode and a third electrode enclosed in a partially evacuated envelope, sources of potential applied to the electrodes of such values that the device oscillates of itself, and means for applying these oscillations to associated circuits by resonance or otherwise.

150,523 Newey. Electric switches. (18/8/19.)

150,532 Luca. Electric furnaces. (2/9/19.)

132,788 Meyfarth. Electromagnetic braking apparatus for electrically-propelled railway and tramway vehicles. (19/9/18.)

150,559 Wade. (Mills, H. S.) Alternating-current rectifiers. (22/10/19.)

134,540 Smeekens. Electric signs and the like. (18/10/16.)

136,151 Electrolytic Zinc Co. Recovery of zinc by electrolysis. (3/12/18.)

150,573 Monkhouse & Roberts. Electric switching means for preventing unauthorised starting of motor vehicles. (26/11/19.)

150,579 Higgs. Rotors of squirrel-cage induction motors. (6/12/19.)

APPLICATIONS FOR PATENTS.

May 1, 1920.

12,070 Scott-Snell & Anderson. Electric heaters.

12,102 Taylor. Automatic electromagnetic accumulator charging switch.

12,111 Leitner. Active material for electric accumulators.

12,120 Chamberlain & Hookham & James. Electricity meters.

12,135 Pollak. (Maschinenbau A.G. Seebach.) Electric welding.

12,146 Giles. Electric valves.

May 3, 1920.

12,169 Gilbert & Mobley. Electric machines for perforating designs in paper, leather, &c.

12,182 Etchells. Switches.

12,215 Blezard. Apparatus for self-regulation of dyanmos.

12,225 B.T.-H. Co. (G.E. Co.) Control of electric discharges through gases, &c.

12,229 Hall. Time-controlled circuit controllers.

12,231 Edison Swan Electric Co. Means for arranging electrodes in vacuum tubes.

12,263 Pouchain. Battery electrodes.

12,264 Pouchain. Negative electrodes.

May 4, 1920.

12,275 Hards. Electric light fittings.

12,279 Efandem Co. & Williams. Electric lanterns.

12,291 Automatic Telephone Mfg. Co. Telephone systems.

12,307 Soc. Independante de Telegraphie Sans Fil. Production of sustained vibrations for wireless telephony, &c. (5/11/19, France.)

12,312 Western Electric Co. Telephone systems. (5/5/19, U.S.)

12,332 Donnithorne. Switches, &c.

12,334 Tucker, Peltz & Stamm. Air-cooled motors.

12,338 Hall. Remote-control circuit.

12,352 Ehrmann. Devices for cooling electric machines. (4/4/19, France.)

12,372 Soncini. Electric crucible ovens. (25/4/19, Italy.)

12,389 Percival. (De Matteis Boiler System Co.) Electric cooking apparatus.

12,402 Kollock. Electrically-operated hammers.

May, 5, 1920.

12,407 Swinburne. High-speed telegraphy.

12,439 Scott. Electrically-driven winches.

12,456 Emesco. Electro-chemical de-rusting and cleaning process.

12,475 Siemens-Schuckertwerke. Reversing of a.c. shunt motors. (8/4/14, Germany.)

12,476 Siemens-Schuckertwerke. Methods of transmitting wireless messages. (24/4/18, Germany.)

12,480 Slaby. Electric vehicles.

12,481 B.T.-H. Co. & Ralph. Electric furnaces.

12,482 B.T.-H. Co. Slow-motion devices for rheostats and controllers.

12,488 Cathcart. Directing electric waves.

12,506 Western Electric Co. Telephone exchange systems. (17/12/16, U.S.)

12,525 Relay Automatic Telephone Co. Telephones.

May 6, 1920.

12,533 Cunningham. Switches.

12,549 Garrard, Railing & McColl. Protective apparatus for a.c. systems.

12,567 Allen. Battery electrodes.

12,584 Angus. Insulation of circuits and supply of electricity to circuits.

12,592 Manchester & Railing. Tumbler switches.

12,593 Harris. Recording methods for electrical sign telegraphs.

12,599 Hunt. (Hepworth Co. & Mackintosh.) Method of driving electric centrifugal machines having mechanical unloaders.

12,616 Debauge. Manufacture of electric wires and cables. (23/12/19. France.)

May 7, 1920.

12,662 Cowper-Coles. Electro-deposition of iron alloys.

12,669 Whipp. Electrical fuses.

12,670 Whipp. Electrical terminals.

12,682 Gordelier Amplifying sounds of receivers of telephonic, &c., instruments.

12,717 B.T.-H. Co. (G.E. Co.) Electric ship propulsion.

12,718 B.T.-H. C.o. (G.E. Co.) Electric heating devices.

12,754 Judge. Means for transmitting electric current to electrically-driven motor vehicles

May 8, 1920.

12,798 Berry. Portable electric lamps.

12,808 B.T.-H. Co. (G.E. Co.) High-frequency signalling systems.

12,831 Nieuhold. Apparatus for rectifying high and low frequency alternating currents. (15/5/17, Germany.)

12,833 Pouchain. Positive electrodes.

12,834 Pouchain. Accumulators.

12,835 Philips' Gloeilampenfabricken. Rectifiers of aternating currents. (2/12/19. Holland.)

May 11, 1920.

12,969 Wilson. Thermo-electric apparatus.

12,986 Miller. Electric heating and cooking apparatus.

13,039 Western Electric Co. Telephone systems. (5/6/19. U.S.)

13,042 B.T.-H. Co. (G.E. Co.) Producing alternating currents.

13,053 Watson. Switches, &c.

13,067 Callender's Cable & Construction Co. & Wilson. Apparatus for extracting fuses or links on electric circuits.

13,070 Webb. Electrolysers.

13,071 Western Electric Co. Telephone systems. (10/9/19. U.S.)

13,086 Macforie & Shearing. Thermionic valve transmitting circuits.

Companies' Reports, &c.

The directors of **Babcock & Wilcox, Ltd.**, have declared an interim dividend on the ordinary shares of 1s. 4 4-5d. (7 per cent.), tax free, compared with 6 per cent. last year.

The profit on the **Associated Fire Alarms, Ltd.**, for the year ended June 30 (after providing £272 for depreciation of investments amounts to £2,312, compared with £1,014 last year. With £1,529 brought forward the amount available is £3,841, the whole of which it is proposed to carry forward. The lease of the company's works having expired, a small factory is being erected at Walthamstow.

For the year ended Aug. 31 the profits of **Erinoid, Ltd.**, were £70,136, and after allowing for depreciation, &c., the net profit was £64,162, which together with amount brought forward, makes £65,230 available. The directors have transferred to reserve £36,000, and they recommend a dividend of 15 per cent. (making 22½ per cent. for the year, leaving to be carried forward £2,668. Supplemental premises at Yate, Gloucestershire, have been acquired, and will be equipped as early as possible. The new factory will enable the output to be practically doubled.

The report of the **Electric Supply Company of Victoria, Ltd.**, for the year ended March 31, states that the lamps connected were 268,544 (against 252,407 in 1919), and the passengers carried on the tramways 5,316,136 (4,898,102). The revenue was £105,053 (£101,220) and expenditure £69,712 (£67,159), leaving £35,341 (£34,061). The credit balance is £33,764, and with £24,136 brought forward the total is £57,900. Deducting debenture interest and services and a payment of £10,500 on account of arrears of preference dividend the balance of £32,604 has been carried forward.

At the recent meeting of **Hurst, Nelson & Company, Ltd.**, the directors reported that the gross profit for the year ended July 17 last, after allowing for the usual deductions, was £103,543. After deducting £20,663 for depreciation, adding £16,803 brought in, providing for interim dividend on increased ordinary capital and the preference dividends in November and May next, and placing £20,000 to general reserve, a dividend of 2s. per share and a bonus of 1s. per share were declared or the ordinary shares. Reserves were also provided for the interim ordinary dividend and for equalisation of dividends, leaving £17,684 to be carried forward.

The directors' report of **Drake & Gorham, Ltd.**, for the year ended June 30, states that after payment for all charges, including bonuses due to staff, and making provision for contingencies, the net profit is £23,018, and with £6,717 brought forward, the total is £29,735. It is proposed to pay a dividend at rate of 10 per cent. for the year (£12,500) and write down goodwill by £5,000, and to carry forward (subject to deduction for excess Profits Duty and Corporation Tax) £12,235. During the year the head offices were removed to 36, Grosvenor-gardens, the lease of which has been purchased to 1955, and this investment, added to the requirements of the business under existing conditions, necessitates raising additional working capital. Payment of the dividend declared will therefore have to be deferred. Expenditure hasalso been incurred during the year in initiating extensions of the company's trading, the outlay of which has been written off. In spite of the dislocation involved in reverting from war to peace requirements, the turnover is again greater than that of the previous year, while the orders in hand indicate a further material expansion during the current year. Although the available profits on contracts have been adversely affected by the ever-increasing cost of labour, it is anticipated that in this respect conditions will improve and current orders show better results. The directors have voted £673, being part of the extra remuneration to which they are entitled under the Articles of Association towards the staff bonus account.

New Companies.

CHRISTY & PENNY, LTD. (170,610.)—Private company, reg. Oct. 4, capital £1,000 in £1 shares, to carry on the business of manufacturers, merchants, agents, engineers, electricians, metal workers, &c. First directors are G. Christy and E. C. Penny. Reg. office, Outer Temple, 222, Strand, W.C.

CRAVEN & DISTRICT PRIVATE TELEPHONE& ELECTRIC COMPANY,LTD. (170,536).—Private company. Reg. Sept. 30. Capital £4,000 in £1 shares. To take over from J. Banks and J. H. Oxley the business carried on as the Craven & District Private Telephone & Electric Company. First directors are: J. Banks and J. H. Oxley. Secretary: F. W. Beard. Reg. office: Keighley-road, Skipton, Yorks.

CURRIE, MEREDITH, LTD. (170,614.)—Private company, reg. Oct. 4, capital £1,000 in £1 shares, to carry on the business of mechanical and consulting engineers, manufacturers of and dealers in lathes and tools, machinists, electrical or mechanical engineers, &c. First directors are H. C. Currie and J. Meredith. Solicitor, T. W. McLean, 230, Tower-builidngs, Water-street, Loverpool.

DOME BATTERIES & ACCESSORIES, LTD. (170,537).—Private company. Reg. Sept. 30. £10,000 in 5,000 ordinary share of 10s. each, and 7,500 preferred shares of £1 each. To take over the business of an automobile and die engineer, carried on by W. J. Berry. Permanent directors are: S. B. Harcourt and W. A. C. Dicketts. Reg. office: 12, Hop Exchange, Southwark-street, S.E.

ELECTRIC CAR & ACCESSORIES COMPANY, LTD. (170,569).—Private company. Reg. Oct. 1. Capital £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical motor vehicles, trucks, tractors and locomotives, electricians, electrical and mechanical engineers, &c. C. Macaskie, 24A, Castle-town-road, W., is permanent governing director and chairman.

WAREHAM ELECTRIC SUPPLY COMPANY, LTD. (170,858).—Prviate company. Reg. Oct. 15. Capital £5,000 in £10 shares. To carry on. business as indicated by the title. First directors are: T. Carter, Mrs J. C. Portman, Mrs, E. G. Filliter and Mr. M. P. B. Portman. Reg. office: 20, South-street, Wareham, Dorset.

WELDERS, LTD, (170,859).—Private company. Reg. Oct. 15. Capital £5,000 in £1 shares. To carry on the business of welders and cutters of metals by electricity or oxy-acetylene, &c. The provisional directors are: T. Shipley and A. Garton. Reg. office: Imperial Chambers, Bowlalley-lane, Hull.

WELDING PLANTS, LTD. (170,899).—Private company. Reg. Oct. 18, Capital £100 in £1 shares. To carry on the business of engineers founders, oxy-acetylene and electric welders, manufacturers of welding and metal-cutting appliances, &c. First directors are: T. H. Valentine and F. P. Mahony. Reg. office: 78, Queen Victoria-street, E.C.

Prices of Metals, Chemicals, &c.

TUESDAY, Oct. 26.

		Price.	Inc.	Dec.
Copper—				
Best selected………	per ton	£101 0 0	—	£1 0 0
Electro Wirebars…	,,	£104 0 0	—	£2 0 0
H.C. wire basis……	per lb.	1s. $2\frac{15}{16}$d.	—	$\frac{1}{4}$d.
Sheet ………………	,,	1s. $4\frac{7}{8}$d.	—	$\frac{1}{8}$d.
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis ………	,,	1s. $7\frac{15}{16}$d.	—	$\frac{1}{4}$d.
Brass 60/40—				
Rod, basis ………	,,	0s. $10\frac{3}{8}$d.	—	—
Sheet, basis ………	,,	1s. $4\frac{1}{4}$d.	—	$\frac{1}{4}$d.
Wire, basis ………	,,	1s. $3\frac{3}{4}$d.	—	$\frac{1}{8}$d.
Pig Iron—				
Cleveland Warrants	per ton	£11 7 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£46 0 0	—	£5 0 0
Lead Pig—				
English ……………	,,	£37 5 0	£1 0 0	—
Foreign or Colonial	,,	36 2 6	£0 17 6	—
Tin—Ingot ……………	,,	251 15 0	£12 15 0	—
Wire, basis ………	per lb.	0 3 $3\frac{1}{4}$	$1\frac{3}{4}$d.	—

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £17 15s.

,, (Roll Brimstone).—Per ton £17 15s.

Sulphuric Acid (Pyrites, 168°).—Per ton. £9 17s. 6d.

Copper Sulphate.—Per ton £39 10s.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 2d.

Sodium Chlorate.—Per lb. $5\frac{1}{4}$d.

Rubber.—Para fine, 1s. 6d.; plantation 1st latex, 1s. 5d. to 1s. $5\frac{1}{4}$d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" *are at* 8, *Bouverie Street, London, E.C.*4. *Telegrams: Benbrotric, Fleet, London. Telephone: City* 9853 (4 *lines*).

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Forty Years Ago.

(THE ELECTRICIAN, OCTOBER 30, 1880.)

CYMNER COLLIERY.—Arrangements have been made to light the yard and heapstead with the electric light.

PROGRESS.—Leicester, Liverpool, Nottingham and Over Darwen have obtained borrowing powers for the production and supply of the electric light.

THE ELECTRIC LIGHT IN COLLIERIES.—Mr. W. H. Preece, in a letter to *The Times*, of October 28, fully corroborates our recent remarks (ELECTRICIAN, October 2nd) on this subject, and in fact, adduces the same reasons as we did against the use of electricity in fiery mines.

PROFESSOR GRAHAM BELL.—*La Nature*, speaking of an interview one of its contributors has had with the illustrious inventor, is warm in its praise of his conscientious and indefatigable industry. The amount of calculation and painstaking labour bestowed upon the photophone, the written evidence of which was inspected by the interviewer, is, says *La Nature*, quite astounding.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics."—Subsidies, Air Mails and the Territorial Air Force; "A Comparison of the Flying Qualities of Single and Twin-engined Aeroplanes," by Squadron-Leader R. M. Hill, A.F.A.S.

"The Cabinet Maker."—"High Wycombe as a Cabinet-Making Centre: Photos from the Air"; "State of Hardwood Timber Market"; and "Progress of the Design and Industries Association."

"The Chemical Age."—"Colloid Chemistry and Industry: Special Reports of the London Conference"; "A Review of Canada's Growing Chemical Industry."

"Farm and Home."—Report of London Dairy Show; "Managing the Breeding Sow," by E. W. Lloyd; and The Dairy Shorthorn Association.

"The Fruit-Grower."—(Exhibition Number): Eastern Counties Show at Wisbech (illustrated); "Silver Leaf Disease of Plums"; "Research in the Industry."

"Gardening Illustrated."—"Late Root Action and Bud Formation"; "Rose Joanna Bridge (illustrated)" and "Mixed Borders."

"The Gas World."—"The Industrial Application of Gas—Discussion at the Annual Meeting of the British Commercial Gas Association"; "The Work of the National Gas Council"; "The Market for Sulphate of Ammonia."

"Hardware Trade Journal."—"Electric Lighting of Shop Windows, III"; "Labour Saving in the Foundry," by Joseph Horner (concluded); and "Is the Craft of the Silversmith deteriorating?"

"Ways and Means."—"The Situation: The Way Out," by Sir George Paish; "The German Works Council Act, 1920," by William Wallace; and "The Future of Overseas Air Lines," by Major P. L. Holmes.

Arrangements for the Week.

FRIDAY, OCTOBER 29th (to-day).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

6.15 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Annual General Meeting. Presidential Address by Mr. A. E. Doxford.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.

7 p.m. At the Royal Technical College, Glasgow. Presidential Address by Mr. A. Gray.

INSTITUTION OF MECHANICAL ENGINEERS.

7 p.m. At Storey's Gate, London, S.W. Informal Meeting.

MONDAY, NOVEMBER 1st.

INSTITUTION OF ELECTRICAL ENGINEERS, LIVERPOOL SUB-CENTRE OF THE NORTH WESTERN CENTRE.

7 p.m. At the University, Liverpool. Address by Mr. Ll. B. Atkinson and Chairman's Address by Mr. H. Dickinson.

TUESDAY, NOVEMBER 2nd.

INSTITUTION OF ELECTRICAL ENGINEERS, SOUTH MIDLAND CENTRE, STUDENTS' SECTION.

7.30 p.m. At the University, Edmund-street, Birmingham. Paper on "Electrical Systems and Apparatus Used on Motor Cars," by Mr. H. B. Stanton.

NEWCOMER SOCIETY.

5.30 p.m. At the Patent Office Library, Southampton-buildings, Chancery-lane, W.C. Paper on "The Literature of Historical Engineering," by Mr. E. W. Hulme.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, London, S.W. Thomas Hawksley Lecture on "Limit Gauging," by Sir Richard T. Glazebrook, K.C.B., F.R.S.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, Westminster, London, S.W. Lecturette on "Some Further Locomotive History," by Mr. E. Hooper.

FRIDAY, NOVEMBER 5th.

INSTITUTION OF CIVIL ENGINEERS.

5.30 p.m. At Great George-street, London, S.W. Presidential Address by Mr. J. A. Brodie.

THE ENGINEERS' CLUB.

7.15 p.m. At Albert-square, Manchester. Address on Engineering and Industry in South Africa, opened by Mr. A. E. Snape.

THE ELECTRICIAN

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Notes.

Electrically Driven Rolling Mills.

We have been told that one of the most useful features of our annual "Iron and Steel" issue are the tables giving particulars of electrically operated rolling mills now installed in this country. It has been suggested, in fact, that the list should be extended to include the electrically driven rolling mills of the world. This course was, however, adopted in the first "Iron and Steel" issue, which, it will be remembered, was published in 1912, but it has many disadvantages. The information is hard to collect, suffers from being out of date, and is generally incomplete. The unwary and casual take it as a complete state of the case, which it never can be, and suffer the usual fate of those who walk amid pitfalls with their eyes shut. Later on they blame the editor. Nevertheless, we have gone so far as to attempt to give as complete information as possible in this issue of the present state of the electrically driven rolling mills in this country, and the tables also contain a certain number of foreign mills. They speak for themselves and carry their usefulness on their faces. But they require one comment. They are incomplete. Certain manufacturers of this class of equipment have not seen their way to supply us with the information we require. We hope they will have changed their minds on this point by next year, when we shall hope to make an even nearer approach to real completeness. Until then the unwary are warned.

The Present Position of the Electric Furnance.

Stung to emulation by the success of these rolling-mill tables, we this year made attempts to provide similar information regarding the present position of the electric furnace in this country. But we were met by an unexpected difficulty. It appears that the electric furnace, like the presumptuous child, is suffering from growing too fast. Its development received an over-stimulation during the war when, as we know to our cost, money was spent like water and things were done that were neither economical nor expedient. This is not to say that the electric furnace is neither economical nor expedient, but it was not always installed with a view to the best financial or metallurgical results being obtained. This policy is reflected in the abandonment, temporary, we hope, of certain plants and a reconstruction of certain others on lines which experience has shown to give improved results. For the time being, then, it is expedient that the furnace tables should remain over. Some useful information on the subject may, however, be derived from a Paper read before the Institution of Electrical Engineers some 18 months ago, in which Mr. R. G. MERCER stated that the number of electric furnaces installed in this country at that time was 117, while an article which we publish by Mr. W. S. GIFFORD in our present issue brings matters up to date. In spite of the causes mentioned above, the number of furnaces installed has increased somewhat and is now probably about 150, the furnaces being of various sizes, types and makes. There is therefore no need for pessimism about the future. For certain operations in iron and steel manufacture the electric furnace has proved itself and will continue to receive an ever-increasing application as its advantages become known and as we obtain more experience of its actual working.

Electro-Deposited Iron.

THE article by Mr. W. E. HUGHES on "The Industrial Future of Electro-Deposited Iron," which we publish on another page of this issue, gives an interesting story of the neglect, failure and ultimate success of a most important theoretical investigation with a wide practical application. The neglect occurred mainly in the British Isles, where, as so often happens, the work of pioneers was taken advantage of by everyone but their own countrymen. The failure was that usual in the history of scientific endeavour. Success came during the war, when, as Mr. HUGHES acidly remarks, even Government departments were forced to economise in the expenditure of iron and steel. To those same Government departments, however, is due the credit of setting certain investigations in progress again, and in spite of those idiosyncrasies inseparable from bureaucracy, of making it possible to arrive at a satisfactory solution of some of the outstanding problems relating to the electro-deposition of iron. We are glad to see that with the coming of peace the work has not been dropped, and that the importance of the proper understanding of this subject (an importance that can hardly be overstressed) is being recognised by the promotion of researches in various centres, and by a livening up of those discussions from which so many useful results proceed.

The Importance of Colloids.

The subject of colloids is one that is attracting attention to an increasing extent. Historically the subject is not new, for in 1861 Graham drew a distinction between crystalloids and colloids on the lines that the former have the property of comparatively rapid diffusion through membranes whereas the latter have not this easy mobility. For a good many years this classification remained little more than a statement in chemistry, but more recently it has received the attention of both chemists and physicists, and work upon colloids has now indeed become a branch of physical chemistry with a large bibliography. This is not surprising when we consider that frames of all living beings are made up of colloids; that our food, articles of clothing and building materials are mostly colloids; and that such important substances as glue, starch, wood, cement, clay and rubber are also colloidal. For the physicist the subject is attractive because it forms a bridge between molecular systems, the details of which we cannot see (in other words, crystalloids), and matter in suspension, in which the particles are quite large. The transition from one extreme to the other can be taken by innumerable steps, and thus the properties of colloids vary until in the finest state of sub-division the particles become no longer visible by the ultra-microscope, and we approach the molecule itself.

An Interesting Joint Meeting.

That the subject is of more than usual interest and importance was amply shown at the joint meeting of the Faraday Society and the Physical Society on Monday of last week. This meeting started at 2.30 p.m., and continued with intervals for tea and dinner till the evening. Moreover, the theatre of the Institution of Mechanical Engineers provided no more than sufficient room for the audience, and the subject even received mention in the evening papers, all of which may be taken as ample evidence of enthusiasm, though the discussion indicated a certain degree of hesitation, as though the speakers preferred not to pledge themselves too readily to any particular view. The meeting was opened with an excellent summary of the present position by Prof. T. Svedberg, of Upsala, a well-known worker in colloidal chemistry, and this was followed by a series of Papers by various authors ranging over the whole subject. The branch which appeals more particularly to the engineer is that dealing with solid particles in suspension in a medium. Acheson's lubricant, consisting of particles of graphite suspended in water, is a case in point. Emulsions are exemplified in the unwelcome contamination of condensate by oil in the running of condensing steam plant. But more attention has been focussed recently on cataphoresis, or the migration of colloidal particles towards an electrode under the influence of a potential gradient. The value of this phenomenon has been seen in the purification of clay, and it is probable that further investigation will lead to many other useful applications of this comparatively new branch of electro-chemistry becoming possible.

Rate Relief for Trading Departments.

For many years we have questioned the wisdom of those municipal authorities who have devoted the annual surpluses of their electricity supply and tramway departments to the relief of the local rates. Local authorities who control electricity supply, tramway or similar public undertakings of general utility to the public should first of all provide a good service and then direct their energies towards providing a cheap one, in order that as many of the public as possible may benefit from the expenditure of the capital which is raised upon the credit of the rates. A corollary to this is that they should encourage financial stability by building up adequate reserve funds and effecting maintenance and renewal work as far as possible out of revenue. We are induced to reiterate these observations by the discussion which took place at last week's meeting of Manchester Corporation on the subject of rate relief by its trading departments.

The Disposal of Surpluses.

For many years the tramways, electricity and gas departments of the Manchester Corporation have been obliged to contribute large sums towards the relief of the rates, and last year the contribution amounted to no less than £216,000, a sum equal to a rate of about 11d. in the pound. The basis of the contribution has varied from time to time, but in recent years it has been a small percentage of the capital invested in the respective undertakings. This method, which at least has the merit of providing a definite ascertained sum with certainty, and thus allowing the undertaking to know where they stand. has had many critics, and various committees of the Corporation have considered and reported upon the subject. But owing to a divergence of views a special committee has recently been charged with the task of making a full investigation. We are pleased to see that this committee recommends that the present system of contributions in aid of the rates should be discontinued; that the charges for electricity, gas and tramway fares should be so arranged that the departments will be self-supporting, and that any surplus at the end of the year that is not required should be carried to the credit of the City rate. These recommendations have been adopted by the Corporation. In this they are only following the lead of the Departmental Committee on Smoke and Noxious Vapour Abatement, appointed by the Local Government Board in 1914, who pointed out that smoke abatement was assisted by the employment of electricity and gas, and that to keep up the prices of these commodities in order that the rates might be subsidised was preventing that desirable end being attained.

The Drawbacks of Rate Relief.

There will, therefore, be agreement with the proposal that trading departments should be independent and self-supporting, but we question the wisdom of devoting any surplus they may obtain to the relief of the rates. For by fixing the tariff sufficiently high the departments under such circumstances would be able to provide their Finance Committees with the same amount of money that they are now paying. It is simply a change of method, not of principle. Owing to increased wages and the higher price of coal the charges for electricity and tramway fares have had to be increased very considerably over the pre-war figures, and we think it would be much better for both local authorities and the public to devote—at all events for some years to come—any surplus, after providing for depreciation, obsolescence and contingencies, to the reduction of these charges, and so assist in increasing the number of consumers of electricity. The more general the use of electricity becomes the better for everybody—the consumer, the general public in the area of supply and the nation as a whole—for it would be idle to pretend that the present unavoidably high tariffs are anything but a great hindrance to that general use of electricity for power, lighting and domestic uses which is so essential for progress. We therefore hope that no surplus on electricity supply, tramway or other municipal service will be devoted to anything but the cheapening of these services. Perhaps the Electricity Commissioners, who have lately been devoting a great deal of attention to the proper periods to be allowed for the repayment of loans for plant, &c., might investigate the subject and lay down some general principles for our guidance. The subject will be more complicated when the Joint Electricity authorities are in being, for the duty of providing a "cheap and abundant supply of electricity" which is cast upon these authorities by the Electricity Supply Act is inconsistent with the relief of rates, and for our own part, we should like to see even the principle, hallowed though it be by custom, abolished.

The Economics of Blast Furnaces.

The days are now long past when iron and steel masters could watch with any complacency the residual gas from the blast furnaces being blown into the atmosphere as a waste product; and it is even some years ago since successful attempts were made to use these gases either directly in an internal combustion engine or indirectly as a means of raising steam. Development in the first of these classes of employment has been more rapid on the Continent than in this country, and it is not, therefore, surprising that the usual charges of conservatism and lack of progressiveness have been levelled at those responsible in Great Britain. Nevertheless, there is something to be said for the attitude that has been taken up. For even if we accept Mr. Walter Crooke's opinion that the cloud under which the gas engine still rests emanated in the first place from Johannesburg, it will be agreed that the employment of this form of prime mover in iron and steel works is hedged about with disadvantages sufficiently great to make the bravest pause.

The Problem of the Internal Combustion Engine.

For blast furnace gas cannot be directly used in the cylinders of an internal combustion engine. It must be cleaned first, and, as Mr. H. J. Bush shows on another page of this issue, this cleaning has not been unattended by considerable difficulty. And while the gas engine admittedly has a higher efficiency than the steam engine, yet its overload capacity is small, a point which is not without its importance when it is used for the purposes we are considering. We hesitate to advance any arguments regarding relative reliability and cost as to some extent they have been answered in advance by Mr. Walter Crooke, but the iron and steel master has obviously to consider carefully such matters. It should be added that we are now only dealing with the gas engine as a generator of electrical energy (even most gas engineers only recommend it for that purpose), for, as an actual driving agent, the superiority of the electric motor to any other form of machine is unquestioned. We, therefore, for the moment seem to be rather travelling in a circle. Yet the proper utilisation of the blast furnace gases is of supreme importance, and the employment of such an engine as the Still engine, which combines many of the advantages of both the steam and the internal combustion engine, would seem to give the sort of solution that is required without the difficulties that attend many of the methods now employed. At any rate, it would be worth a trial. For its efficiency is as high as 47 per cent., and it is probably more immune from breakdown and high maintenance costs than some of its forebears. Or must we wait for Dr. Ferranti's dream of the gas turbine to be realised?

The Organisation of Engineers.

We all hope that, in the words of the famous politician, the Great War was the war which will end all wars. But presuming that it does not achieve that desirable purpose the question arises, are we as engineers any better organised to meet the demands of the next war than we were those of the last? In 1914 we were not organised at all. As a body young engineers had no military training, and even those individuals among them who were members of the Territorial Force or Special Reserve as often as not belonged to artillery or infantry units, where their engineering training could not easily be applied to military purposes. This freedom of choice in enlistment was allowed to continue even after war had begun, with the result that throughout the period of hostilities we suffered from an entirely unnecessary drain on our engineering resources. Whatever the future then may bring we are glad to see that Capt. Riall Sankey, in his recent presidential address to the Institution of Mechanical Engineers, expressed the view that with the reorganisation of the Territorial Force should go some scheme for obtaining the services of young engineers in engineering units. Even if we cannot go quite so far as to introduce a species of conscription there would be little objection to the compilation and keeping up a register of those who would be willing to serve in case of emergency even if they had not the time or inclination to undergo any training in peace. In time of war these men would be useful, as a great deal of engineering work then performed requires little military training, but high engineering qualifications. The reverse is, of course, often true, but with that we are not concerned at the moment. It is certainly important that some arrangement of this kind should be organised without delay, and it is a matter in which the three great institutions might well take joint action, and bring combined pressure to bear on the appropriate authorities.

Tramway Troubles.

The increase in wages granted by the National Joint Industrial Council to the workers in the tramway industry a few months ago has not brought the hoped-for peace in its train, and there is at present under consideration an application for a further increase of 12s. per week for adults and 6s. per week for employees under 18 years of age. As we pointed out at the time, the last increase meant a heavy burden on the already slender resources of many tramway undertakings, and we are not therefore surprised to learn that the present demand has been met by a definite *non possumus* from the privately-owned undertakings and by the withdrawal of their representatives from the wages negotiations. We are glad, however, to learn that there has not been (as has been stated) any withdrawal from the Whitley Council itself; that would be deplorable in every way. We think that in pressing further claims at this juncture the employees' representatives are most unwise. The present financial condition of nearly all the privately-owned tramway undertakings is poor and any improvement derivable from the operation of the Tramways (Temporary Increase of Charges) Act 1920 has not yet become apparent. A still further increase in fares would be justly resented by the public, which resentment would probably be shown by a falling-off in the use of the tramways, and a consequent loss in revenue. The equipment would then become more and more in need of repair at a greater and greater cost, unemployment would increase, and gradually the system would fall derelict. Surely this is hardly what the United Vehicle Workers want. They will probably reply that municipalisation is the solution, but we rather doubt whether local authorities are going to find it so easy in future to raise money to support tottering commercial enterprises.

Telephone Charges.

The Post Office Telephone Department is rapidly acquiring an unenviable reputation from the extortionate nature of its demands. Two or three instances of the ingenuity of the officials of the Department in manufacturing financial claims in relation to telephone services has been given by correspondents in "The Times" during the past few days. It appears that when private firms are converted into limited liability companies or when a change takes place in the title of a company the Department wishes to treat demands for the transfer of the telephone number and for the preparation of the new agreement, which under the circumstances is legally necessary, as a case of a "new telephone" service and makes a corresponding charge amounting to several guineas. Even when no additional instrument is required and no work is necessary, except the registration of the transfer and the execution of a new agreement, this still holds good. This attitude might be understood in the case of an Old Bailey lawyer, but it reflects no credit upon a great public Department like the Post Office. It is bureaucracy *in excelsis*, and that is saying something.

The "Homeless" Institution.

The opening meeting of a new session of the Institution of Electrical Engineers takes place next week, and questions are not unnaturally being asked as to how much longer members must remain homeless. The resentment of the questioners is not lessened by the generous hospitality of the Institution of Civil Engineers (much as this is appreciated, as we should have been in Queer Street without them), nor by the just suspicion that the Office of Works has been unnecessarily dilatory in vacating the premises. We are therefore glad to see an inspired announcement in Monday's "Times" to the effect that the building on the Victoria Embankment is to be restored to the Institution at an early date. We hope that this will be the case. But even then the amount of repair work and cleaning that will be necessary will render it improbable that it could be used for meetings during the coming session, though it might be possible to employ it in the early summer for a re-union which would take the place of the usual conversazione. We advance the suggestion for what it is worth.

The Institution and Finance.

Another and more urgent matter for the Institution, both as a corporate body and as individuals, is that of finance. The possession or non-possession of the building rather complicates than solves this. It is hardly necessary to say that expenses have increased, that the purchasing power of the income has decreased, and that if members are to receive their present facilities and more, if those facilities are to be developed in the way we hope they will be, members must be prepared to pay higher subscriptions for the privileges they enjoy. This important question is to be discussed at a special general meeting which will be held on December 2nd and of which full details will shortly be in the hands of those concerned. Without wishing to prejudice the issue we may say that the Institution of Mechanical Engineers have already raised their subscriptions, that the Institution of Civil Engineers are about to follow suit, and that, though it may be thought undesirable to follow their example, the arguments in favour of such a course are both weighty and almost unanswerable. To starve what is the largest and, we may add, the most progressive of the engineering Institutions would, to say the least of it, be bad policy.

Right of Appeal Under the Patents Act.

A decision of some importance to patentees has been given by the Court of Appeal on the question of the right of appeal from decisions on applications for an extension of the period of patents. It will be remembered that Section 7 of the Patents and Designs Act, of 1919, amended Section 18 of the Patents Act of 1907, and by Sub-section 6 of the section in question a patentee who suffered loss or damage owing to the war was given the right to apply, by originating summons, to the Court for an extension of the period of the patent. As already announced in these columns, an application was recently made to extend two of Davidson's patents granted in 1911 and 1915, but Mr. Justice Sargant dismissed the summons, and held that the application was premature, as there was *prima facie* ground for concluding that no change had been made in the practice of applying for an extension shortly before the expiration of the patent. The patentee appealed, but the Court of Appeal have now held, with regret, that the Act gives no right of appeal. The usual procedure is to apply by petition for a prolongation under Section 18 of the 1907 Act, but Section 7 (6) of the 1919 Act provided that an application could be made by an originating summons instead of a petition, and, when so made, the Court could only consider the circumstances of loss or damage suffered by the patentee. But, as a result of the "Schedule of Minor Amendments" made by Section 20 of the Act to Section 92 of the 1907 Act, an appeal will not lie from any decision of a Judge except in the case of an order revoking or confirming the revocation of a patent. The Master of the Rolls, in giving the decision of the Court, said the matter was of great importance, and it was to be regretted that there could be no appeal from Mr. Justice Sargant's judgment. It was clear that any decision of a Judge in a patent case except in the case of an order revoking or confirming the revocation of a patent was not subject to appeal. This is distinctly unfortunate for those patentees who were prevented from exploiting their inventions during the period of the war. The Patents Act of 1919 is a good example of the evils of hasty, ill-considered and ineffective legislation. It is clear that, in this particular instance, it is contrary to the intentions of the Legislature, and a remedy can only be provided by a new Act.

Writ Sarcastic !

In commenting on the award of a contract to the A.E.G. by the Partington Iron & Steel Company, of Irlam, near Manchester, last week, we overlooked the fact that the composition of the directorate of the company in question might be an important factor in determining its course of action. We therefore wish to thank the "Electrical Times" for drawing our attention to the fact that Mr. W. Peter Rylands, president of the Federation of the British Industries, is one of the directors of the Partington Iron & Steel Company, while we have discovered for ourselves that another prominent member of the board is Sir J. Harmood-Banner, a well-known Member of Parliament and a tariff reform advocate. This conjunction of forces is interesting, and may explain much. What, however, it does not explain is why a man should at one and the same time advocate the exclusion of foreign-made goods to assist the home market, if necessary by erecting an unclimbable tariff wall, and then act in a way which gives that same home market a stunning blow in the back. Nor does it explain how a man can buy in the foreign market and, at the same time, unblushingly sit in the presidential chair of an organisation designed for the protection of British trade, whence he makes weighty announcements as to the need of assisting that trade in every possible way. Can it be that in acting in this way they hope to consummate that policy which they now so ardently advocate by showing by example what will happen if their advice is not taken, or can it be (horrid thought) that they think more of their own pockets than of the good of the country's industries ?

The Future of the Iron and Steel Industry.

In presenting our readers with the third Special Iron and Steel Number The Electrician may be said to be perpetuating not only its own traditions, but to be following the admirable examples which of recent years have been set by the "symposium" meetings of some of the more advanced scientific societies and institutions, at which, instead of the usual plethora of Papers dealing with different subjects, a number of Papers have been read by different authors on the same subject

The Scope of the Issue.

It might, superficially, be objected that the current number of The Electrician contains articles which have little or no connection with each other. But the common factor between them all is that they treat of the Iron and Steel Trades. The immediate connection between the greater part of them is, perhaps, less obvious, although it is really not only close, but extremely important. Thus, we have articles by authors of well-known professional standing upon the peculiarly interesting and possibly disputatious question of the electric drive of rolling mills, in which British and American practice are compared and contrasted, and from which valuable deductions can be drawn. Another Paper deals generally with the subject of large internal combustion gas engines as a means for the generation of electrical energy, and the allied subject of gas cleaning is gone into in a subsidiary article descriptive of electrostatic methods of gas cleaning. On the connection between these two main groups and their subsidiary groups it may be advisable to dwell at somewhat greater length.

Two Economical Requirements.

Probably the two most crying needs of the world in its present parlous stage of reconstruction, in which so many traditions have gone by the board, and so many beliefs are in the melting pot, are economy in fuel and in labour. We have put fuel first because it is—at any rate, in this country—a fixed commodity, while labour is still a fluctuating factor, of which the supply is, inexhaustible. If, however, owing to natural causes, fuel becomes scarcer and more costly, and labour, through more recondite causes, becomes both more costly and less efficient, every method which can economise either deserves the serious consideration of industry and becomes a vital factor in the solution of those problems now perplexing mankind. It is an economic fact of prime importance, that production on a large and intensive scale is economically the only sound and enduring policy. The corollary is mass production and specialisation.

Large Units and Specialisation.

The British habit of small units and a sample book of formidable dimensions suited our fathers. The grapes they have eaten may, however, set on edge the teeth of the present generation. These are the soundest exemplifications of the intrinsic economy of large units and of specialised products, to be found, in being, in America and in Germany and, potentially, in France and in Belgium. To have a stock book with a wide divergence of sections may in the past have suited the exigencies of individual small British manufacturers. In that past our foreign competitors had not taken their bearings nor perfected their systems. Circumstances have changed: they are specialising; we are not. In the result a large proportion of the trade we might do is passing into other hands.

An Unsound Policy.

The consumption of coal under boilers for raising steam and the use of steam engines for generating electrical energy are intrinsically unsound, whatever the experience in the past, when coal and labour were cheap, may have been. As potential sources of energy the iron and steel works of Great Britain are and should be self-sufficient. There is no sounder nor more economical method for the development of energy than to consume coal in smelting iron and from the gaseous by-products of that operation to derive all the subsidiary energy required to convert it into steel, to forge and roll it, to saw or shear the rolled products to size and to deliver them, on trucks, at the works. Theoretically this can be done in a modern iron and steel works without burning a pound of coal under boilers. The internal combustion gas engine, using cleaned blast furnace and coke oven gases, can achieve this object. Most of the big iron and steel making plants in this country are already provided with means for effectively cleaning their gases. Indeed, owing to the activities of the Ministry of Munitions most of them are in the position of owning plants, which from the point of view of gas cleaning for use under boilers are manifestly in excess of the requirements. The corollary, again, is the use of these surplus gases in internal combustion engines and the adoption of electrical drives for the rolling mill and the various auxiliary machinery.

Some Industrial Changes.

But the technology of an industry, however highly developed, will not alone make for prosperity. The industrial side is even more powerful. In the economy of any large plant due regard must be had not only to its engineering and technical perfection, but to the state of its order book. A multiplicity of small orders may show a healthy number of customers, but is to be deprecated on the score of true economy. The solution would seem to lie in a system of pooling orders so that the works best suited to their fulfilment should book them and carry them out. It is useless to modernise a blast furnace plant, a steel works, or mills unless a continuity of orders of a uniform and profitable nature can be looked for. As long as orders in themselves are booked in small units plants in themselves must be prepared to take them, despite the economic disadvantages of so doing. The pooling of orders and their rational allocation to works specialised by plant and appliances is the only way in which ultimately our manufacturers, who hitherto have not pooled their orders, will be able to make headway against those of other countries, who probably have.

No technical journal would be wholly fulfilling its duty to its public unless it voiced in season or out of season the ultimate dependance of technical achievements and the industrial administrations on each other. Science is only of immediate and material use to mankind in its applications, which are invariably industrial. Similarly the work of engineers and of chemists may be dissipated or destroyed if the business side of the factory be neglected or badly administered. From an economic standpoint both stand or fall together. It is not sound to make in small units, it is not sound to prepare for intensive manufacture by the expenditure of huge capital outlays unless large and continuous orders are forthcoming. It is for the technical journal to place on record the facts. It is for the administrators and business men in the industry to draw the moral and adorn the tale. The Electrician will be well rewarded if its special number leads managers to think, and leads them to question the old, old claim that "current" British practice is necessarily, and for all time the best, and whether, in, for example, the use of large gas engines for electrical generation, the last word has been said—at home—and all our competitors are wrong.

Notes on Rolling Mill Drives.

By L. ROTHERA, B.Sc., A.M.I.C.E., M.I.S.I.

NOW that electricity can be considered almost the accepted form of motive power for rolling mills, and the total horse-power installed in this country alone exceeds 500,000 h.p., it is interesting to compare present day equipments with earlier examples, and to note along what lines advancement has taken place.

Referring to the earliest installations which were set to work some 16 to 18 years ago, it can generally be said that the main principles governing the correct choice of a motor were well understood, and it argues well for the pioneers of the electric motor that no serious modifications have resulted as greater experience has been gained. Earlier drives showed, as might be expected, a number of instances of constant speed motors where present-day practice would instal variable speed machines, and others in which the power of the motors was under estimated. The latter instances were pleasantly few and were the result of a general lack of knowledge of the power required to roll any particular section, steam engine indicator diagrams proving somewhat misleading as a basis.

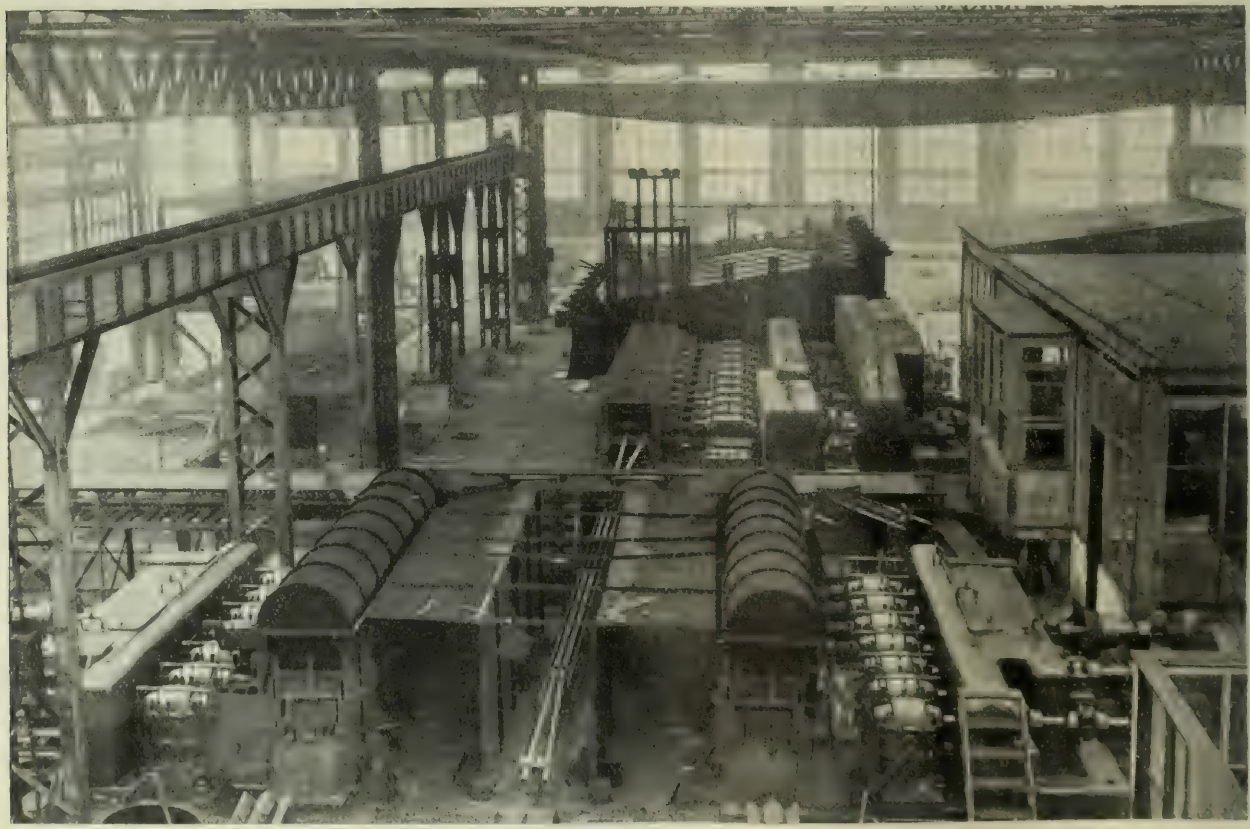

Fig. 1.—View of Continuous Wire Rod Mill.

Where Variable Speed is Essential.

It is now definitely agreed that for merchant mill work where a large variety of sections have to be dealt with in one mill, a variable speed drive is essential.

Practice in this country continues to favour the use of mills for dealing with a large variety of sections in contradistinction to the tendency shown in America of employing specially designed mills on one or, at the most, a few similar classes of work, and it follows that the finishing speed of a mill dealing with such diverse sections as say " H " sections and rounds or flats, will vary considerably. As a consequence, most of the modern drives for merchant mill work are effected by means of variable speed machines giving a speed range of at least 2 : 1, and in some cases, even 3 : 1. It is of great importance to have at command any speed between the limits of the range, and this condition is fulfilled by means of the direct current motor with shunt regulation, or by an alternative composite drive, such as, for instance, the Kramer system, which uses a 3-phase incoming supply but enables a variable speed to be obtained with ease and efficiency.

Increase in Motor Size.

One of the most noticeable features of the present-day drive is the size of the motor adopted, the modern demand for continually increasing outputs requiring corresponding increases in the size of the driving motor. This follows, naturally, from the methods which have to be adopted to obtain greater outputs from the mills, which are :—(*a*) by decreasing the number of passes ; (*b*) by having a larger number of pieces in the rolls at once ; (*c*) by reducing the time lost in handling ; (*d*) by sub-division of the mills.

By adopting either (*a*) or (*b*) an increased size of motor must necessarily be employed. By reducing the intervals between passes, as in the case of (*c*), the actual maximum power required from the motor may not be increased, but the average power demand will be increased, again calling for a larger motor. Sub-division of the mills (*d*) will entail the employment of additional motors, the aggregate power of which will be in excess of a single motor driving the complete mill.

In the earlier types of small merchant mills, it was usual to have three or four stands of rolls in line driven from one end, the sizes of the rolls being the same throughout. Under these conditions a compromise had to be made between the most efficient speed of the roughing mill and the speed of the finishing mill, in order that the rate at which the short billets passed through the roughing rolls might not exceed that which the men could handle. This resulted, in many instances, in a finishing speed considerably less than would have been adopted had there been no limit imposed by the roughing rolls. In order to avoid the limitation of output thus caused, modern practice tends to separate the roughing from the finishing stands and to provide a separate drive for each: this enables the most suitable speed to be chosen for both the roughing and the finishing mills, and an increased output follows.

A similar restriction of output occurs where a reversing mill with a number of stands is driven only from one end, as it is not possible to have more than one piece of metal passing through at one time, and in the more up-to-date drives one, or at most, two, stands are driven from one motor. For really large outputs it is essential that each stand should be driven separately, as this enables three pieces to be dealt with at once where three stands, cogging, roughing and finishing, are employed.

The increase in the size of motors may be emphasised by the following examples:—

A 14 in. merchant mill is driven by a 1,000 H.P., 75/150 revs. per min. motor, and experience has shown that full use could have been made of a motor half as big again, namely, 1,500 H.P. A second 14 in. mill, which is to be used in rolling special steels, is to be provided with a 2,000 H.P. variable speed motor. Another instance is afforded by a 42 in. reversing plate mill recently installed, which carries what is believed to be the largest reversing motor in the world, with a cut-out value of not less than 22,500 H.P. at 40 revs. per min., whilst in the case of a 34 in. and 36 in. section mill the roughing and finishing trains, which are driven together, have been equipped with motors with a cut-out value of 19,000 H.P. at 60 revs. per min. With the size of rolls at present employed and the sections called for, it would appear as though these powers represent about the maximum that will be required, but it is unwise to prophesy, and future demands may call for still larger powers.

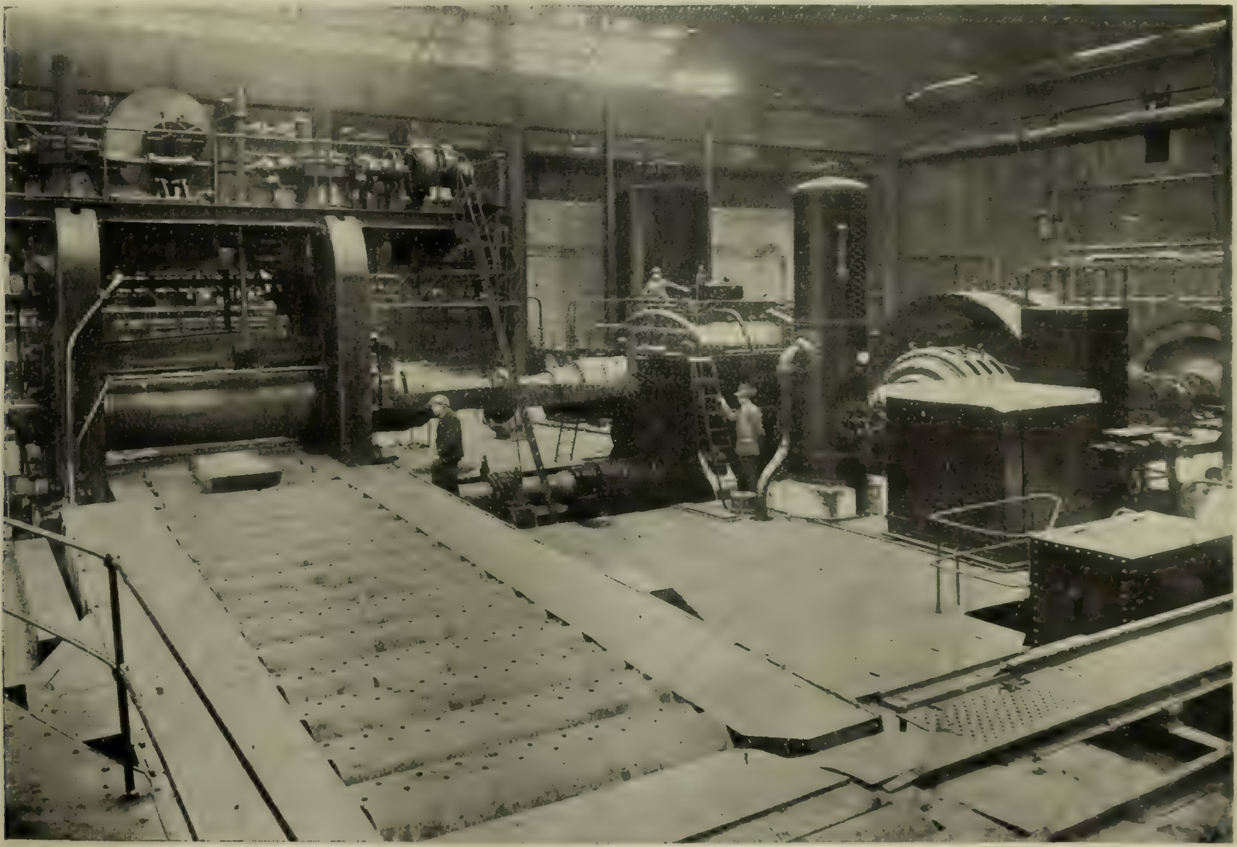

Fig. 2.—View of Modern Electrically Driven 32 in. Three-High Plate Mill.

Operation of the Continuous Mill.

One alteration which has a very marked effect on the size of the motor is the adoption of what is called the "continuous mill" where large outputs of one class of work are required. In this type of mill a series of rolls are set closely one in front of the other, and the ingot or billet enters at one end and passes once through each of the succeeding rolls, leaving them as a semi-finished or finished product. Owing to the close proximity of the rolls, the metal is being dealt with in each of them at the same time, and there may be as many as ten or more passes occurring simultaneously with the corollary of large motor powers. The idea of this mill originated in this country, but its development has been largely left to the Americans, who have installed plant to a total of 80,000 H.P.

In drives of this sort the mill is essentially suitable for very large outputs of closely similar classes of material, as the labour involved in setting up the rolls is so considerable as to render frequent changes of sections impracticable.

The demand for large outputs has resulted in a number of mills of this type being recently installed in this country and, some examples are:—

A wire rod mill, which consists of a roughing train of ten stands feeding two finishing trains, each of seven stands of rolls. Two pieces of metal pass through the roughing rolls simultaneously and then separate, one going to each of the finishing rolls. A 2,750 H.P. motor drives the roughing train, and two independent motors, each of 750 H.P., drive the finishing trains. This plant starts with a 2½-in. billet and rolls it down to No. 5 or No. 6 gauge wire.

Two billet mills have recently been installed, one taking a 10-in. square billet and reducing it to a 4-in. square billet in four stands of rolls, and the second starting with a 4-in. square billet and reducing it to 1¾ in. in six stands of rolls. A motor of 5,000 H.P. is employed to drive these two mills.

Another plant now under construction is for rolling hoops or strips, in which there is a roughing train of seven stands, an intermediate train of one stand, and a finishing train of five stands. For the drive, a motor of 1,500 H.P. is being installed for the roughing train, a 100 H.P. motor for the intermediate train and a 2,500 H.P. motor for the finishing train.

Continuous Mill and Power Demand.

Some idea of the outputs obtained from such a mill is given by the large horse-power of the motors, and an instance may be given where 400 tons of No. 5 gauge wire rod have been rolled in two 10-hour shifts, with four pieces of metal going side by side through the rolls at one time.

From the point of view of the drive, the continuous mill presents no difficulties, the power demand from the motor being almost constant when the mill is working normally. As the first billet enters, the power rises in steps up to a maximum, the steps corresponding with the entry of the billet into the pair of rolls following. With the rolls set so closely one in front of the other, the time taken by the metal to get through all the rolls is only a matter of a few seconds, after which some considerable period elapses before the back end of the billet leaves the first pair of rolls. Almost immediately this occurs the next billet enters the first pair of rolls, so that practically all the rolls are fully occupied as long as any billets remain in the furnace.

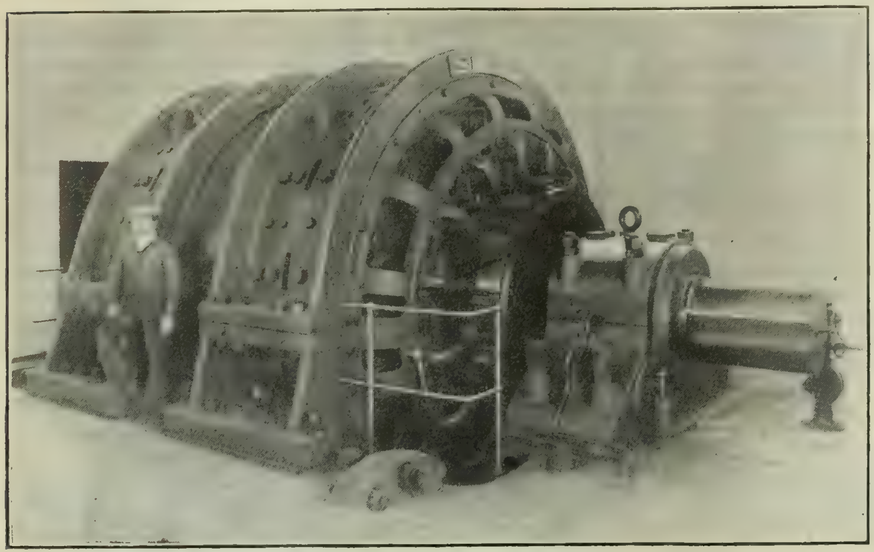

Fig. 3.—12,000 h.p. Variable Speed Motor (0–120 R.P.M.) for Driving Three High Plate Mill.

An Interesting Modification.

An interesting modification of British rolling mill practice is shown by the new plate mills which are now being put down in this country to deal with the demands of the ship-building industry. British and Continental practice, until recently has favoured almost exclusively the large two-high reversing mill for this class of work, whereas the American practice has been to use a three-high continuous mill of the "Lauth" type, and also the universal plate mill by means of which the plates were given a definite width at the same time as they were rolled down to a definite thickness. In the case of four new plate mills, the American practice has been adopted in this country, and three mills of the three-high "Lauth" type are being put down, with one universal mill. This alteration in British practice synchronises with a number of reversing mills being installed by the Americans for rolling plates, so that the relative merits of the two forms of mill are still unsettled. A comparison of the three "Lautb" mills when at work should prove of much interest, for the method of drive varies in each case.

The first mill is driven by a 3,000 h.p. motor running at a normal speed of 514 revs. per min., direct coupled to a high-speed flywheel, approximately 12 ft. in diameter and 42 tons in weight. The combined power given out by the motor and flywheel is transmitted through very heavy reduction gearing to the mill, the gearing being designed to deal with peaks of 10,000 h.p. lasting for about ten seconds at a time.

The second mill is driven by a 3,000 h.p. motor running at 375 revs. per min., geared down to a shaft running at the mill speed, which carries two flywheels, each approximately 80 tons in weight, 12 ft. 3 in. in diameter. The flywheel shaft is coupled direct to the centre roll of the mill.

The third mill is to be driven by a motor direct coupled to the mill without the interposition of any flywheel, the speed of the motor between zero and a maximum being under direct and almost instantaneous control. The motor would have a maximum value of 12,000 h.p. at 60 revs. per min., and is supplied from a flywheel equaliser set working on the Ilgner principle. The driving motor of the flywheel set is of 2,500 h.p. and the flywheel weighs approximately 50 tons, and is 12 ft. in diameter.

Of the three drives, the third has a number of advantages which should be reflected in an increased output and a better class of material rolled. Owing to the speed control the plate can be entered at a low speed and yet finished rapidly. The longer finishing lengths which require a lighter draught can be speeded up considerably above the efficient speed for the first breaking-down passes, and if, by any chance, the plate is entered wrongly into the rolls, the mill can immediately be stopped, whereas with heavy flywheels fitted, as in the case of mills Nos. 1 and 2, if the plate once goes into the rolls it will have to be carried through with a considerable risk of damage either to the mill or the motor.

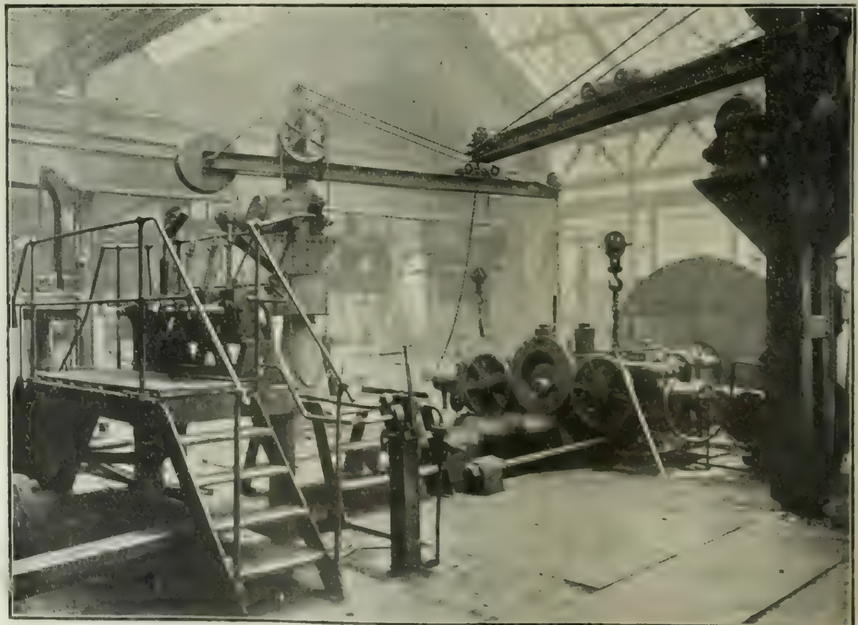

Fig. 4.—View of Roughing Tyre Mill.

Electric Drive v. Steam Drive.

Present-day practice, so far as the general run of rolling mill work is concerned, is all in favour of the electric motor as the form of drive, and it is only rarely that a steam engine is considered as a serious rival. Under certain conditions, however, the efficiency of the Uniflow engine may approach that of electrical plant, and it then becomes a question as to the incidental advantages of the two alternative systems. When it is borne in mind that with the electric drive no boiler plant, with its attendant costs of upkeep, coal and ash cartage, &c., is necessary, that no steam pipes are required with their continual losses and upkeep and their influence on the satisfactory lay-out of the plant, and that considerable savings in oil consumption and maintenance charges are incidental to the electric drive, this latter will, in most instances, be preferred.

The situation is not yet quite so clearly defined for reversing mill drives, and it has hitherto been claimed on the part of the steam engine makers that the large reversing mill presents no case for the electric drive. The experience now available goes to show that this claim is largely unfounded, and a study of the number of electric drives installed in various countries shows how rapidly the situation is changing in this respect. In this country there are now supplied, or under construction, 28 reversing mill equipments; in America up to the end of 1919 there were 28 equipments, and on the Continent and abroad there are 70 equipments in hand. The first electrically-driven mill was put down about 14 years ago, and the increase in numbers, which has been largely concentrated within the last seven years, shows that the results have proved satisfactory. Apart from the equipments in this country, a number of such mills are now under construction by British firms for the Continent.

Taking into account the conditions under which a steam engine has to work on a reversing mill load, the efficiency of such a drive is, of necessity, very low. The load fluctuates from zero to a high maximum, and the whole of the plant has to be designed to meet the worst conditions, *i.e.*, apart from the large size of the engine cylinders, very large steam pipes must be employed to deal with the sudden rush of steam and a large boiler capacity must be installed. Owing to the idle intervals whilst the mill is waiting for new ingots, or other reasons, considerable blowing off of the boilers is likely to occur. These, together with the condensation losses, result in a much heavier coal consumption than would be expected when working on the steam consumption per horse-power of steady load. As it is the coal consumption which determines the cost per ton to roll figures based on the steam consumption on steady load are apt to be misleading.

Tyre Rolling.

A development is taking place in present-day practice in the rolling of tyres which makes the employment of the electric motor practically necessary. In the case of the earlier mills it was usual to drive the outer roll, the inner roll revolving owing to friction between the inner periphery of the tyre and the roll. Present practice favours a simultaneous drive of both the outer and inner roll; and this presents a problem, as the relative speeds of the outer and inner rolls have to vary as the tyre is reduced. When the tyre blank is first brought to the mill it consists of a forged slab, roughly circular in shape, with a hole through the centre. The slab is dropped over the central roll and the outer roll brought up against the outer periphery. As the tyre is rolled, the distance between the outer and inner rolls is gradually reduced, so that the peripheral speed of the rolls, which at the beginning is very different, gradually approaches one to the other. This necessitates relative adjustment of the speeds of the driving mechanism.

Attempts have been made to have an independent steam engine drive for the inner and outer rolls, controlling the speeds by hand by adjustment of the throttle valves, but the difficulties of exact control of the speeds of two independent engines in this way are obvious, and the result has been that considerable slipping between the metal and the rolls takes place, which prejudices the final finish of the tyre. Good tyres are being rolled by this method, but the conditions are far from ideal. The electric drive enables this difficulty to be entirely and very simply overcome. If two direct current motors are employed, one for driving the inner and the other for driving the outer roll, and the armatures of the two motors are connected in series, the speeds of the motors will automatically set themselves to the exact speeds of the inner and outer peripheral speed of the tyre, and further, as the tire is reduced in thickness, the one motor will speed up relatively to the other.

By supplying the motors from a motor generator set on the Ward-Leonard principle, speed control of the motors from zero to a maximum can be easily carried out, and the ideal drive for a tyre mill results. With such a drive it has proved possible to dispense with the preliminary "becking" process, the tyres being rolled in one heat, and a very largely increased output is the result.

The rapid increase in the use of the electric motor for driving rolling mills of all classes is in itself sufficient to prove that the advantages claimed are realised in practice, and there is hardly any need at the present time to lay stress on what is now an accepted fact.

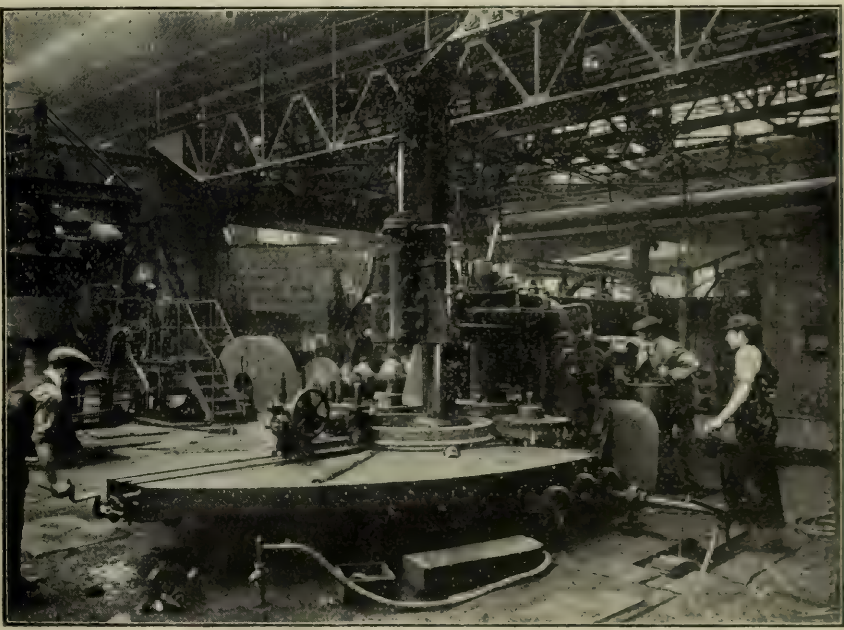

Fig. 5.—View of Finishing Tyre Mill.

Coal Prices and the Electric Drive.

Present-day conditions with the increasing cost of coal and of labour tend to make these advantages more and more pronounced, and with the centralisation of power production under the best and most economical conditions, and the corresponding low cost of current, will render the adoption of the electric drive almost universal.

The relative merits of three-phase machinery and direct current machinery cause a good deal of discussion between the advocates of the two systems; such discussions are largely academic, each motor having its own particular sphere and when correctly chosen giving the best results. A full study of the existing conditions, however, is necessary before such a choice can be made. Generally stated, the three-phase motor leaves nothing to be desired in the case of a constant speed drive, whilst a variable speed drive necessitates a direct current motor or some composite set with similar characteristics. For auxiliary drives, such as live rolls, cranes, shears, saws, &c., the present tendency is towards the employment of direct current plant with, however, a good many exceptions in favour of the three-phase drive.

Electricity in American Steel Works.

By R. ORSETTICH, M.I.E.E.

In visiting American steel works and endeavouring to draw comparisons between their lay-out and auxiliary machinery and those used in this country, some rather striking developments are met with which cannot be explained without taking into account the conditions inherent to the country. It would be advisable, therefore, to mention shortly a few of these before going into details.

Market and Labour Conditions.

The American industry has an immense home market, which is capable of absorbing the bulk of its vast production, almost apart from any export. The steel industry has, therefore, been able to adopt a much more thorough division of work than in this country, and the various mills can standardise on given types of products and continue to produce these for months on end. The frequent changing of the rolls for the production of a particular section in small quantities is entirely unknown. One finds, therefore, a great number of specialised mills, which could not exist in any other country, as, for instance, large steel works producing either plates only or channels only, and even then of a few standard sizes only. These mills are able to purchase very expensive outfits for the most economical handling of their particular production, and by keeping their general expenses low can show reasonably good returns even when prices are cut.

The labour conditions in America differ entirely from those of any other country. The American born white workman is available only in very small numbers; he is usually a skilled man, who has been in his particular trade for several generations. From this class are drawn the foremen and supervisors. To this must be added a certain amount of coloured labour, mostly of the unskilled type. This class preponderates in the Southern States and is also used in semi-skilled occupations in the Eastern and Middle Western States. For over 60 per cent. of the unskilled and semi-skilled workers, America is dependent on immigrant labour. These people, most of whom do not speak English when they enter the States, live together in small colonies near the particular works in which they are employed. They are a close community, supplying all their own wants from amongst themselves; they have hardly any dealings with the remainder of the town, with the result that over half of them never learn to speak English. Instructions as to their work and the manner of performing it are usually imparted through one of their number called a "straw boss," who understands and speaks English. Russians and Slovaks seem to predominate in most works, but other nationalities are represented; for instance, the Bethlehem Steel Works have a strong colony of Greeks, who operate the furnaces and soaking pits.

No Labour Restrictions.

Another factor of the labour situation is the absence of labour restrictions as known in this country. A seven days' week, with 12-hour shifts, and a shift of 18 or 24 hours at the end of the week, is still used in a number of steel works. Some of the large companies and in particular the Steel Corporation have done their best to bring about a change of these conditions, and to establish instead a six-day week, with three shifts of eight hours per day. A strange point in connection with this change was that whilst the men were all anxious to drop the long shift at the end of the week, they were mostly opposed to the reduction in the hours per shift, as even with the increased wages per hour offered their incomes were less. Further, an immoderate amount of overtime is worked in some of the sections, such as the blast furnace or the mechanical department, which is probably a result of the seven-days' week.

In the result, certain apparatus and safety arrangements, which are not strictly enforced in this country, are more necessary in America, owing to the quality of the labour employed.

Electrical gear, which in England is distributed throughout the mills, is segregated in enclosed spaces and guarded by special notices in some foreign language. The number of accidents which occur is very much higher than in corresponding works in England, and must be attributed to the low class of labour. The Medical Director of the Bethlehem Works told the writer that with a force of 18,000 men he had to deal with not less than 250 casualties per day.

Transport Highly Developed.

The transport of materials is highly developed and enables the works to obtain ores and coal from far districts. The average railway truck is made of steel and carries 80,000 lb., although those of 100,000 lb. are not rare. The material is handled very rapidly and efficiently with almost entire exclusion of labour, railway car dumping being adopted universally, just as is done at the pit-head in British coal mines with the small tubs. As all these auxiliaries, as well as the transporters, bridges, &c., are electrically driven, the enormous field which the electrical industry has found in this direction can readily be appreciated.

As an instance of the extent to which means of transportation make an industry independent of local conditions may be quoted the Bethlehem Steel Works, in Eastern Pennsylvania, which obtains its ores from Cuba, and its coal from the Great Lakes, the latter some 400 miles away. At Gary, the ores are brought by Lake Steamers and unloaded with 10-ton grabs at the rate of 12,000 tons per day. The standby stores contain some 500,000 tons of ore, and a corresponding amount of coke, limestone, &c. These enormous masses of material are all dealt with by electric cranes, transporters, cantilever bridges, hoopers and elevators, which deliver them automatically to the blast-furnace mouth.

Labour Costs High.

The cost of labour is very high, and this has influenced the industry very considerably, as mechanical appliances, not required in England, are adopted almost universally, while the speed of production is usually higher in America, labour being out to earn high wages and willing to put forth the greatest effort. This is reflected in the size and types of motors selected for operating the cranes. The lifting and travelling speeds are not much greater than in this country, but the motors themselves are of higher rating, the reason being that the crane itself is used more extensively and more continuously than at home, thereby necessitating larger motors, resistances and controlling gear.

A large number of steel works are of recent design and have been put down by concerns with good financial resources. As a result the shops have been laid out exceedingly well, with ample spaces between them, and full provision for expansion. Every convenience for the rapid unloading, handling, storing and shipping of materials and products is installed, and all operations are performed under a roof, in well-lighted and well-ventilated shops. The Gary works are, for instance, truly remarkable from the fact that the spaces between the shops are kept absolutely clear of the usual accumulation of broken down machinery and heaps of rubbish, which are unfortunately to be found in even the best steel works in this country.

It would be impossible to do justice in a short article to all the great achievements of the American electrical engineer in the steel industry, but we may mention briefly some of the special developments.

Power Generation from Blast Furnace Gas.

The author visited two installations of gas engines driving alternators from blast furnace gas, and he is forced to admit that the results are very satisfactory. In both cases the power was generated at 25 cycles, which no doubt was in favour of the plant, but other instances were mentioned in which 60 cycles were used successfully.

At Bethlehem the fifteen gas engines were made by the Company in their own engine works. They are very massive and are fitted with heavy flywheels. The generators are well damped and work in parallel with an exchange of current of only some 15 to 20 per cent. of the full load current. Excitation is obtained by means of motor generators. Gas cleaning is done by wet washers.

The engineers on this plant declared themselves fully satisfied with the general behaviour of the plant, which has been running several years. The overhauling of the gas engines does not exceed that of large steam engines, and breakages have been rare owing to the very massive construction of all the parts.

Both the gas engines and generators at Gary were supplied by the Allis Chalmers Company. The gas engines are built on the well-known lines of the Nurnberg type, with whom the Allis Chalmers Company apparently had an agreement for the interchange of experience. These engines, however, are not nearly as strongly built as those at Bethlehem, and the paralleling is not quite so good, as the interchange of current amounts often to 60 to 70 per cent. of the full load current, without however causing a falling out of step of the synchronous apparatus on the system. They have 90 ton flywheels and run at 83 revs. per min. Some earlier types running at higher speeds were tried, but were abandoned as unsatisfactory; they were coupled to direct-current generators, which are now used for auxiliary gear only.

The power house is split into several sections, owing to its immense size, and all sections are linked together as independent stations. There is also a reserve of steam power for emergency, consisting of two turbo-generators of some 7,000 kw. each. An idea of the size is gained when one considers that over 300 million units per annum are produced. In addition to this the power house contains a large number of blowing units, consisting of a gas engine in tandem with a blowing engine.

EXTENSIVE USE OF ALTERNATING CURRENT.

The first plants put down in American steel works were mostly of the direct-current type, mainly direct-coupled slow speed sets. In accordance with the usual practice, they were only of 230 to 250 volts pressure. As soon as electric driving proved successful in working, power stations were planned and soon adopted on a more extensive scale. The handicap of the low voltage was then felt, with the result that manufacturers offered instead alternating current plant, which appealed to the mill engineers on account of the simplicity of operation and the absence of commutators, apart from the advantage of transforming the voltage to suit the size of the installation. These first motors, most of which are still in use, were all of the squirrel cage type, and are started by means of compensators.

When a drop in speed is required the resistance is generally embodied in the rotor winding, either by making it of a high resistance metal, or by using a wound rotor short circuited by a separate resistance fixed to the spider.

In spite of the handicap under which these early types were placed, the success of the electric drive was overwhelming, both as regards outputs obtained and improvement of control. Makers of mill engines have repeatedly raised the claim that they could reverse a mill quicker with an engine than with a motor, but mill engineers, who have been using the electric drive, can easily prove that speed of reversing alone does not represent an advantage. Rapidity in starting, simplicity of control, which makes the speed of the mill almost proportional to the position of the operating lever, the material leaving the roll without racing, and finally the fact that the speed of rolling is always ahead of the speed of operating the tables, of screwing down the rolls, or of the supply of billets from the soaking pits, have established beyond doubt the superiority of the electric drive, apart from the question of the lower working cost.

The large majority of the rod and section mills in the States are continuously running mills, and for these the three-phase medium pressure induction motor, with wound rotor, has been almost universally adopted. As in this country, experience proved that a standard commercial machine would not stand up to the special conditions of service, and as a consequence the "mill type" motor has been evolved. The characteristics of this machine might be shortly summarised as follows:—

THE THREE-PHASE MILL MOTOR.

The stator is usually wound for 2,000 or 3,000 volts; it is always of the open slot type, with as small a number of slots per pole and phase as possible to obtain mechanically strong coils, easily replaceable in case of breakdown. These coils are supported by rings, to which they are tied all round, and the insulation of the coils is micanite, built up on the coil itself, and sometimes extended to the overhanging portion of the coil. The insulation is well sealed up by means of oil-cloth tape to exclude the action of scale and metallic dust. The power factor of the motor is usually low, on account of the open slots and the ample air gap, but this is not an objection as it conduces to safe operation, while the power factor of the plant is improved by the use of synchronous converting sets supplying the current for the auxiliaries.

Mechanically, the machines are very massive. The stator stampings are dovetailed into the heavy cast iron frame and are held in position by a number of separate steel plates, clamped by bolts passing across the core, but outside the magnetic circuit. These plates, which take the place of the stator cheeks used in British practice, are fitted with a number of fingers, either cast or welded on, which support the teeth of the stampings. The plates are each separately held by bolts, so that in the event of a coil burning out and of damage to some teeth, the machine can be repaired by removing only a small section of the stampings.

The rotor spider is of cast steel and the rotor stampings are dovetailed into it, either by dovetails punched in one piece with the stamping, or by a kind of double wedge. The bed-plates are often fitted with keeps, in which bearings of low centres are located by steel wedges. The motors are almost always designed to slide axially, so as to expose the stator and rotor windings. On large machines the couplings are of the rigid type, which would not be reputed good practice at home. To overcome the axial thrust which would result from a breakage of the mill shaft, the motors are fitted with a thrust bearing, clamped to the outside pedestal of the motor, and in addition the brushgear is arranged in a kind of carriage, which enables it to slide away with the rotor, should this be forced to move. In some cases the rotor shaft is fitted with a large thrust collar, working on to a gun-metal bearing, fixed at one end of the bush of the main bearing. Neither arrangement is always effective, as the author saw a 6,000-H.P. mill motor at Gary, the rotor of which had been forced against the outer pedestal and had broken it off the foundation. The bearing bush of this pedestal was some 3 ft. bore by 6 ft. long.

Apart from the early plant mentioned above, direct-current motors are not often used for driving cogging and merchant mills, excepting in the case of reversing mills, where they are employed in connection with a Ward-Leonard converting set and flywheel load equaliser.

It will be seen from the above that the main characteristics of the average merchant mills are, firstly, that the motors are usually direct coupled in preference to the rope drives which are popular in this country, and secondly, that the motors are mainly of the alternating-current type, due apparently to the preference of the mill engineer for this type of machine, owing to the absence of the commutator, and the fact that its voltage can be selected to suit the particular conditions. The disadvantages of this type of machine from the point of view of torque and efficiency, when a heavy speed drop is required, are apparently not thought serious enough to counterbalance the above points.

Plate Mill Arrangements.

For plate mills one of the following arrangements is adopted :—

(1) A three high mill with a drive to the middle pinion by means of a direct coupled motor, the speed of which is usually 80 revs. per min., which corresponds to a speed of the rolls of about 50 revs. per min. This arrangement requires a heavy flywheel, and is not very suitable for a three-phase high-tension motor, as the large number of poles and the relatively small air-gap give a very low power factor, especially when the frequency is 60 cycles.

(2) A three high mill, with a Kennedy pinion housing, where the motor drives on to a small diameter pinion, running at, say, 200 revs. per min. This in its turn drives two large pinions, coupled to the rolls. This type has considerable advantages from the point of view of the motor, but has the disadvantage that any power supplied by the flywheel has to be transmitted through the teeth of the pinions.

(3) A tandem mill, in which the slabs are reduced in a reversing roughing mill, with two rolls, and finished in another mill, which is of the three high type, with a drive either as in No. 1 or No. 2. The roughing mill is usually driven by a direct current motor, from a flywheel motor generator set ; the finishing mill, however, is always driven by an induction motor.

Motors for Auxiliary Drives.

There is a remarkable difference in the practice between mills in the States and in this country, as in the former practically all auxiliary drives are effected by direct current machines. Crane motors and live roll motors are almost exclusively of this type. Alternating current live roll motors have been tried, but are not popular. Breakdowns when "plugging," *i.e.*, switching the motor in the opposite direction when running, appear to have been sufficiently severe to have caused this type of machine to be replaced by direct-current equipment.

The live roll motors are of a design very similar to that used in this country, with one or two exceptions. The casing is usually cast in one piece with the bearings, whereas here the bearings are separate and one can obtain access to the inside of the motor by removing them. The reason is probably that the mill motor is an outcome of the traction motor, and that early traction motors were all made in that way.

Another point is the entire absence of terminal boards and boxes, all connections being made by means of split links. These motors are often made in the "open" style, viz., with the commutator and brushgear entirely accessible, a type which does not exist in this country. They also have sometimes a countershaft and bearings cast in one piece with the frame, similar to those of traction motors. The windings are mostly of asbestos-covered wires and strips, well varnished to make them waterproof.

The mill type motor is now used almost universally for all auxiliaries to the mill, such as the screwing down of the rolls, the operation of charging machines, viz., crane motors, also for the opening and closing of the doors of soaking pits, the pushing machine for the billets, for hoists, conveyors, manipulators, &c.

The mill motor is, generally speaking, considerably heavier and more expensive than the corresponding commercial motor, but the additional outlay is well repaid by increased reliability, due to the larger margin of strength of all component parts This policy is no doubt quite sound, and might well be imitated by steel works in this country.

Special mention should also be made of the brakes used with these motors. They are in some cases carried from the motor frame, but mostly secured to a small bedplate of the same height of centre as the motor. They all have very large sheaves, and the shoes are fitted with cooling ribs and hinged in the centre for automatic adjustment for wear. All hinges for the levers and the shoes are made with plain steel rods, kept in place by split pins, so that the taking apart of any of them can be done in a few minutes without special tools.

Controlling Gear.

One of the most striking developments is to be found in the controlling gear of mill motors and auxiliaries. The aim of the designers has been to obtain the greatest degree of reliability when employing the poorest type of labour, and it must be said that very satisfactory results have been obtained. Two types of controllers are used ; the ordinary manually operated and the remote control by a master controller and contactors.

In the former type, one finds besides the drum controller another novel type in the cam-operated controller. This controller operates by means of small contactors, which are thrown in or out by a series of cams fixed on the shaft of the controller, in the place where usually we have the drum. The operation is not more heavy than with a drum, but the contacts in action can be examined and adjusted for wear much better than with the old drum type.

The magnetic controller is much more extensively used than in this country, the importance of obtaining automatic control independently of the operator being fully realised. The construction of each contactor is on lines similar to our own, but whilst a good finish is not always attained, great ingenuity has been used in the design, all screws and bolts being omitted wherever possible, while all wearing parts can be removed by taking out a few split pins. The number of resistance steps is usually smaller than used in Great Britain, the variations of current per step being correspondingly heavier. The service required by the contactors is, therefore, more severe than is customary in this country. The starting gear for smaller motors has been developed in some cases to a very high standard, and some very interesting types of starters for squirrel-cage motors are met with, the contacts working under oil, which can be exposed for examination by turning a handle, without removing the oil. (Crocker-Wheeler design.)

High-tension Distribution.

When power is generated in the steel works itself, it is usually at 6,000 volts, and is distributed at this pressure to all large motors on the system. Smaller motors are supplied at 2,000 and 500 volts. Synchronous apparatus is used in the generating station and in various parts of the plant, to obtain power factor correction.

The feeders from the station to the various sections of the works were originally all carried overhead, but various troubles, due to dirt and accidental shorts, caused them more recently to be put underground. The cables are usually run in fibre conduits, embedded in the ground, and ending in underground chambers, where joints and connections are made. These chambers are also used for ventilating and cooling the ducts. Where very heavy feeders are used, they are split into parallel paths, ending in separate chambers. Independent single cables are used for each phase.

The neutral of the system is seldom earthed, as the mill engineers are of opinion that the benefits thus obtained do not compensate for the trouble of having motors tripped out of circuit by an accidental short on one phase. Where the generating station is linked on to a large supply system (which is always earthed) the generating station of the mill is of necessity earthed as well, mostly by means of an earthing 'bus bar, which allows of any generator being earthed independently. The earthing is usually through high resistances, to limit the current in cases of short-circuit, and this requires the use of relays in the trip gear of the switches controlling the feeders.

Linking-up and Protection of Systems.

Owing to the necessity of utilising on the spot waste gas or steam, large steel works or groups of works have several power stations, which are linked up amongst them for interchange of power and mutual assistance in breakdowns. Where large power supply companies are near at hand, the works generating station is linked up to them. The distribution voltage of such public companies is usually between 60,000 and 100,000 volts, which necessitates the introduction of a transforming station of some magnitude. Such linking introduces also the problem of protection for the steel works plant. The linking-up stations are usually built in the most up-to-date manner, and there appears to be no attempt either in the layout, building, or outfit, to cut down expenditure at the risk of safety. Engineers appear to have a free hand to requisition and install any plant which will guarantee continuity of supply and freedom from troubles. That this is the only correct policy is evident when one considers that there are to-day steel works generating plant of 100,000 kw., and that plans are being made in some cases nearly to double this figure.

Another problem to which great consideration is given is the protection of some of the older sections, mostly the original nucleus from which the installation was developed. In such sections, neither the circuit-breakers nor the 'bus bars or their supports are such as to withstand a short-circuit fed from the generators in the new portion of the system. On the other hand, it is often found impracticable to renew the switchgear to suit the new conditions, and in such cases one of the following methods has been adopted :—

(1) The installation of group circuit-breakers, covering a group of feeders, the individual capacity of whose breakers is insufficient to deal with a short on any of the feeders. These group breakers are interlocked with the feeder breakers as follows : The feeder breaker has a double relay, one direct acting for shorts and one time-set for overload. When a short occurs, the direct acting relay cuts out the overload trip gear on the feeder breaker, but makes contact with the relay of the group breaker, which opens and clears the short circuit, at the same time closing also a circuit which makes the particular feeder breaker come out. After this, the group breaker can be reset, either by hand or magnetically.

(2) Auxiliary bus bar system. In this method the old section of the works is connected to the new by means of two systems of bus bars, installed in a separate house and connected together by linking breakers. The system is to some extent a development of the previous one, and the same conditions for tripping and interlocking rule as before. It can further be extended by installing two separate bus bar systems, some distance apart from one another, connected by breakers at both ends.

(3) The installation of reactances in the feeders and sectionalising tie bars by means of reactance coils to reduce the effect of short circuits.

ELECTRIC FURNACES.

Electric furnaces are very generally employed to produce the ferro-alloys required, either as reagents to remove oxygen from the charge (ferro-manganese), or as carriers of rare metals (ferro-chromium, ferro-tungsten, &c.). The furnaces are mostly of the arc type, three-phase, working with a voltage of 120 to 60 on the secondary, which is mostly mesh connected and obtained from a bank of three transformers. The power factor of the furnaces when the secondary leads are well arranged works out as high as 90 per cent., but some of the early furnaces, probably installed without true appreciation of the value of the inductance of the leads, have a much lower power factor. To obtain the best results and the shortest length of connections in all new plant there is a difference of level of some 12 ft. between transformers and furnace, which gives an almost straight run of leads. The combined reactance of transformers, furnace and leads seems to be about 43·5 per cent., which corresponds with about 2¼ times full load current on a sustained short circuit with full voltage maintained at the primary terminals. The average consumption per ton for, say, a 6-ton furnace is said to be 600 units per ton of steel, starting with a cold charge. To shorten the time required to melt the charge the voltage of the secondary is raised by several methods, the most simple being the following : To start the arc in the furnace the primary of the transformer is connected star, giving a voltage of 90/100 to the secondary ; as soon as the conditions in the furnace become normal, the secondary voltage is raised to 160/170, by connecting the primary in mesh, the increased voltage being used to overcome the magnetic choking of the materials in the furnace. After the charge is melted, the primary is switched over again into mesh connection, and kept thus for the whole period of the refining.

It is interesting to note that the English Greaves-Etchells furnace is fairly extensively used, and well thought of, whereas the induction furnace which is popular in Germany does not seem to have proved satisfactory in spite of the saving claimed due to absence of electrodes.

GAS CLEANING.

The cleaning of blast-furnace gas by means of electrical precipitation has been tried, but apparently so far not quite successfully, owing to the difficulty of cleaning the gas below a certain percentage of solid matter, without causing short circuits in the tubes. The system, however, is very widely used in other chemical industries, and promises well for the future. The precipitation is obtained by means of mechanical rectifiers, working with about 60,000 to 70,000 volts alternating current.

CONCLUSION.

The above article shows only a few of the fields of application which electrical industry has found in the steel works of the United States. The development of the latter and their phenomenal growth has been in no small measure due to the help of the electrical engineer in dealing with their materials and products at all stages. Whilst, no doubt, at the beginning of the electrical manufacture, the steel industry represented a useful field for exploitation by the electrical worker, a change in the conditions has now taken place, which makes growth and further development of the steel industry dependent on the rate at which the electrical industry can supply its machinery and apparatus to the steel maker.

Electric v. Hydraulic Drives for Steel Mill Auxiliaries.

A recent number of the "Electrical Review" of New York contains an article by Mr R. B. GERHARDT on "Electric versus Hydraulic Drives for Steel Mill Auxiliaries." Mr. Gerhardt points out that from the control standpoint the electric drive almost always has the advantage over the hydraulic drive, and that the main difference between the two kinds of power is that one is more easily transferred into reciprocating motion and the other into rotary motion. With regard to efficiency the electric drive has the advantage over the hydraulic drive, for the latter, though very efficient at full load, decreases rapidly in efficiency as the load decreases.

The author gives a detailed analysis of the erection and running costs of the two drives for various forms of steel mill machinery, including furnace door hoists, blooming mill manipulators, lifting tables and middle roll balancers and shears. Reviewing the figures he draws the conclusions that in the case of the furnace door hoists, the expense of operation is about the same whichever drive is used, though the initial cost of the electrical is almost three times that of the hydraulic machinery. With the furnace cover drives the advantage as to expense of operation and initial cost also lies with the hydraulic drive, though ease of control gives electrical equipment a decided advantage, while it is also probable that by its use labour costs are reduced to some extent. The electrically-driven elevator has the advantage over hydraulic elevators in both operating expenses and in initial cost, while as regards the lifting table and middle roll balancers on a three high-plate mill, though the electric drive costs considerably more than the hydraulic drive to install, it is very much cheaper in operation. There is little difference in the cost of operation between electrically-driven and hydraulically-operated bloom shears, though once again the initial cost of the electric drive is considerably higher than that of the hydraulic drive. Mr. Gerhardt is of opinion that there is little to choose in reliability between these two forms of drive.

Variable Speed Rolling Mill Drives.

The Relative Advantages of Direct and Alternating Current.

By W. E. SWALE.

THE conservative attitude of the British steelworks engineer is apparent in regard to the question of variable speed drives for large rolling mills. The subject has been brought into prominence again recently by Mr. C. A. Ablett's Paper on "Direct Current Compared with Three-phase Current for Driving Steelworks Plant,"* which has evoked a good deal of interesting criticism. The possibilities of induction motors used in conjunction with variable speed sets appear attractive, and a few remarks on the subject may be of interest. It is well known that the development of these speed regulating sets has proceeded apace in America and on the Continent for some years past. There is good reason to believe, however, that the lukewarmness of British engineers is based not on insular prejudice alone, but on very sound technical and economic arguments.

Of the various methods that are at present in vogue for attaining speed regulation in non-reversing rolling mills the following three may be looked upon as typical: (*a*) D.C. motor fed from rotary converter; (*b*) induction motor with D.C. auxiliary and rotary converter (Kramer system); (*c*) induction motor with commutator motor auxiliary (Scherbius-Milch system).

To avoid confusion with the many systems that have already been advocated, the accompanying illustrations, Figs. 1, 2 and 3, show diagrammatically the methods of regulation referred to above as (*a*), (*b*) and (*c*) respectively.

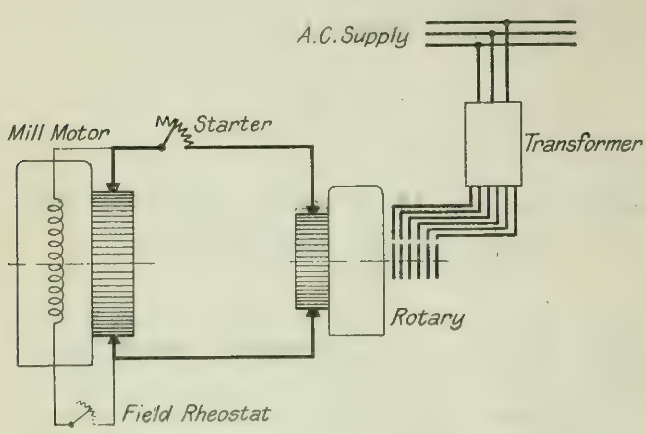

FIG. 1.—D.C.-ROTARY SYSTEM.

COMPARISON OF THE SYSTEMS.

A general comparison of the three systems shows that, as regards achievable results, there is not much to choose between them. The characteristics are those of a compound machine—*i.e.*, speed regulation can be obtained at all loads from no load to full load, and a certain speed drop is available for utilising the flywheel energy. The speed range is usually up to 45 or 50 per cent. In Figs. 1 and 2 regulation is effected with constant horse-power at all speeds. In the usual arrangement of Fig. 3 this is not possible, the total effective horse-power falling with the speed. A variation of Fig. 3 exists in which the auxiliary motor is coupled to the main motor, giving regulation at constant horse-power. Similarly, in the Kraemer system (Fig. 2), the auxiliary motor may be coupled to an asynchronous generator, thus returning the slip energy to the mains instead of to the mill shaft.

The respective merits of the three systems will now be discussed under separate headings, viz.:— Efficiency, Capital, Cost, Reliability and Maintenance, &c.

EFFICIENCY AND POWER FACTOR.

Published figures regarding relative efficiencies are apt to be misleading. In many cases these have been obtained for relatively small sets, and in others comparisons are made in the cases of blower or compressor drives, where conditions are very different from those prevailing in rolling mill service. According to the writer's observations, the difference in overall efficiency between the three systems becomes practically negligible with sets of about 1,500 H.P. and upwards. The following figures are taken from rolling mill sets of approximately 2,500 H.P. output, which are very fairly comparable as regards maximum speed and speed range:—

(*a*) *Direct-current Motor and Rotary*—

	Overall F.L. efficiency. (Motor, rotary & trans.)	Power factor.
Maximum speed	87·6 per cent.	unity
Mean ,, ...	88·1 ,, ...	unity
Minimum ,, ...	88·1 ,, ...	unity

(*b*) *Kramer System*—

	Overall F.L. efficiency.	Power factor.
Maximum speed	93·75 per cent.	88 per cent.
Mean ,, ...	89% ,, ...	87 ,,
Minimum ,, ...	87 ,, ...	92 ,,

(*c*) *Scherbius System*—

	Overall F.L. efficiency.	Power factor.
Maximum speed	88·6 per cent.	90 per cent.
Mean ,, ...	91·0 ,, ...	88 ,,
Minimum ,, ...	89·0 ,, ...	87 ,,

The above figures bear out the general experience that as regards full load efficiency there is hardly anything to choose between the three systems. It should be noted, however, that with large mill drives (upwards of 1,500 H.P.) the rotary set of Fig. 1 will consist of two or more units, so that at any time only as many rotaries are in operation as the load actually warrants. Under light load conditions the overall efficiency may thus be appreciably higher than in the case of the induction motor systems.

As regards power factor, the D.C. rotary system undoubtedly has the advantage, as a factor of approximately unity can be attained at all loads and speeds. It is true that in the case of Figs. 2 and 3 the power factors can be improved beyond the figures given in the tables; but this can be achieved only by a corresponding increase in the size and cost of the regulating sets.

CAPITAL COST.

The prices of plant of this nature depend so much on horse-power, maximum speed, speed range and power factor regulation that relative figures for the three systems do not always show the same ratio. The following figures will give some indication of the relative cost to be expected for sets of 1,500 H.P. and over. If scheme (*a*) costs 100, then scheme (*b*) costs 95 to 110, and scheme (*c*) costs 88 to 92. In comparing the prices of the different sets, the question of total available horse-power must not be overlooked. It is clear that if the regulating set forms an independent unit, as shown in Fig. 3, its operating speed may be considerably higher than if it were coupled to the mill motor shaft as in Fig. 2. Fig. 3 will thus show an advantage as regards first cost. The price of a mechanically coupled auxiliary motor will be higher; but, on the other hand, the set will give constant horse-power at all speeds—*i.e.*, heavy sections can be rolled at lower speeds and greater torques, which in certain mills may be a very real advantage.

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* *See* THE ELECTRICIAN, Vol. LXXXIV., pp. 535-549, May 14, 1920.

Reliability and Maintenance.

There can be no doubt that as regards simplicity and low cost of maintenance, Fig. 1 (D.C. motor and rotary) has a most pronounced advantage. The whole plant consists of entirely standard units, each of which has been developed to a very high state of both efficiency and reliability. The efficacy of this system has been demonstrated in countless installations in this country, and for this reason alone many steelworks' engineers will maintain that it is wiser to sacrifice a few per cent. at a pinch, both in efficiency and capital cost, in order to secure the greatest possible guarantee of continuity of service.

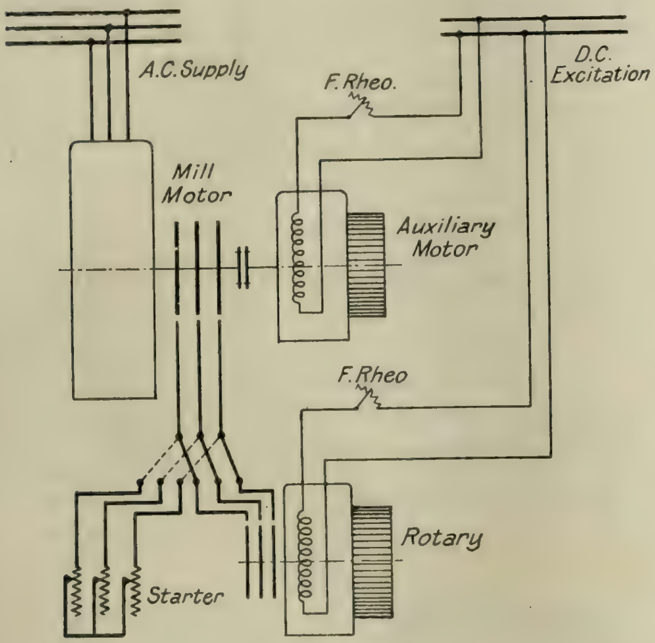

Fig. 2.—Kramer System.

Fig. 2 (induction motor with rotary) likewise comprises well-known units—viz., a rotary converter and a direct-current motor. The latest installations of this kind embody an additional exciter, by means of which the compounding effect increases as the rolling speed goes down. A considerable number of "Kramer" sets are in operation in America and on the Continent, and are giving satisfactory results.

Fig. 3, whilst usually associated with the name "Scherbius," has been modified and perfected in America. In its simplest form it comprises a three-phase commutator motor and an asynchronous generator. Recent developments of the double range set necessitates the addition of a frequency changer exciter, and in some cases a third commutator machine is required. One peculiar advantage of the latest system is that the speed range is obtained in equal proportions above as well as below synchronism, so that for a given rating the machines will be smaller than in the case of Fig. 2. Theoretically, the "Scherbius" set is of extreme interest. It is well known, however, that the three-phase commutator motor, especially in large sizes, presents exceedingly difficult problems, both as regards design and manufacture, and whether such a machine is going to prove its efficacy under the severe conditions of steel works practice is still an open question. The complexity of the set is rather likely to prejudice maintenance engineers, in whose eyes simplicity is an outstanding feature. A number of Scherbius sets of different types are in successful operation in America, but the published data on the subject is meagre, and no figures regarding maintenance costs appear to be available.

Conclusions.

An illuminating commentary on the whole question is the fact that, in spite of the number of speed-regulating sets installed in other countries in recent years, there is, to the writer's knowledge, in this country only a single set, a 1,200 h.p. induction motor, speed variable, 365 to 245 revs. per min., on the Kraemer system—which was put into operation 10 to 12 years ago. It appears, therefore, that no such signal advantages resulted from this first installation as to warrant its general adoption under similar conditions.

The early successes achieved in alternating-current transmission and the construction of high-voltage induction motors lent colour to a view that saw the ultimate banishment of direct current from steelworks practice. This view was for some time sedulously fostered in America and on the Continent, and the induction motor had become all but supreme. One unfortunate result of this movement has been that often enough rolling-mill processes have had to be modified to meet the limitations of the constant-speed drive. More recent investigations into the economy of rolling processes have brought out emphatically the advantages of variable-speed drives, and these are consequently being installed in ever increasing numbers. In such cases the adoption of a constant-speed induction motor in conjunction with a speed regulating set appears to be a resourceful, but fundamentally unsound, method, an ingenious but cumbersome artifice to render suitable for certain service a motor which is constitutionally unfitted for that service.

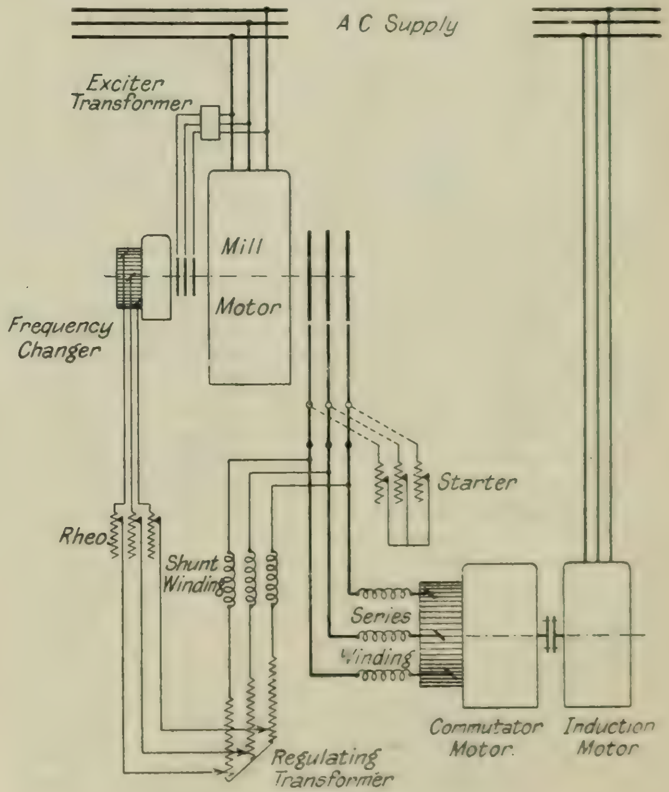

Fig. 3.—Scherbius-Milch System.

It is not to be denied that under certain conditions a regulating set of the type shown in Figs. 2 and 3 forms an attractive proposition, and engineers are looking forward with keen interest to the publication of actual operating figures. At the present time two similar strip mills of the continuous type are under construction in this country, of which the first will be driven by direct-current motors, and the second by induction motors regulated on the Scherbius system. The mills will be operating under practically identical conditions, and when they are put to work it may be possible to obtain data which will throw valuable light on the question under consideration.

The Electric Drive of Rolling Mills.

By **W. E. TAYLOR** and **C. E. RAEBURN.**

THE progress made all over the world in the electrification of rolling mills for all metals and all sections has been remarkable, and of late years is represented by a steeply rising curve. This fact is well known to those who specialise in the design of electrical equipments for rolling mills, although it is not so widely known as it should be throughout steel works engineering circles. There is another class of engineer who is fairly well in touch with the progress of the electrical drive for mills, and that is the steam engineer, but of course it is not his policy to assist in the spread of knowledge in a direction which would hurt his firm's output. There has even been a statement recently circulated that American practice is tending to revert to steam drive for rolling mills. This statement is, of course, opposed to the true conditions of affairs, as may be superficially ascertained by an engineer for himself if he will scan the pages of any American journal specialising in steel works' practice and products. He will then find that in the case of new mills of any type described, and all new mills are lavishly described and illustrated, not 5 per cent. are fitted with steam drive. The curve, Fig. 1, shows a chart of the progress in output of motors for main mill drives in America and Canada since 1905.

HISTORY OF THE ELECTRIC DRIVE.

In connection with this curve it will be of interest briefly to recall the history of electric drive for mills in America. About 24 years ago the first attempts were made to drive a rolling mill electrically, but the results were not altogether encouraging on account of the limitations of the apparatus then available. The first practical results were obtained in Europe in about the year 1900, when a number of small mills were electrified. The first installation of any importance in America was made by the Westinghouse Electric & Manufacturing Company in 1905, when two 1,500-H.P. direct-current motors were installed for driving the No. 3 light rail mill at the Edgar Thompson Works of the Carnegie Steel Company. At the time these motors were installed, they were the largest motors that had been built anywhere for driving rolling mills. In 1906, the first electrically-driven reversing mill was started in Europe, and at the beginning of 1907, the first American installation was put into operation at the works of the Illinois Steel Company at South Chicago. At present there are installed, as nearly as can be ascertained, 90 reversing mills and 1,300 continuously running mills in Europe; and in America 40 reversing mills and approximately 460 continuously running mills. The aggregate horse-power required by the continuously running mills in Europe is approximately 750,000, and of the same type of mill in America the aggregate is approximately 506,000 H.P. The average capacity of the European installation is 600 H.P., and of the American mill 1,100 H.P.

In America the trend still continues in favour of the electric drive. One steel company is installing an engine on a 40-in. reversing blooming mill, but this is an exception, and they are receiving considerable criticism from both electrical and mechanical branches of the engineering profession. The majority of the steam engineers also feel in fact that the particular steel company is making a mistake.

For driving continuously running mills it is generally admitted that the electric drive is without a rival, while practically all new installations, both in this country, on the Continent and in America, are adopting the electrically-driven reversing mill. There still exists, as already mentioned, doubts in some minds about the relative advantages of the electric drive, due to the reason given that the first-class engine builders are naturally fighting its development and progress, and advancing many arguments in favour of the steam drive. These same points were advanced some years ago in America, and in a Paper in 1916 read before the American Institute of Electrical Engineers it was thought advisable to analyse the points so raised.

These same arguments might very well be reiterated here. The following advantages have been claimed by prominent engine builders, *i.e.*, (1) first cost, (2) cost of operation, (3) energy saved during reversal, (4) low power consumption with partial load, (5) greatest economy of time.

FIRST COST PROBLEMS.

When considering the initial cost of an installation it is necessary to include all items, not only the cost of an engine or a motor to drive the mill, but also the plant to supply it. In the steam drive there are a great many items to be considered, including boilers, economisers, valves, piping, coal bunkers, coal and ash handling facilities, condensers, chimneys, &c. In the case of an electric drive, besides the reversing motor, there is the motor generator flywheel set with the necessary auxiliaries, if the power is purchased, while if the steel works supplies its own power then there is in addition the necessary generating plant. The following tables are given as a comparison of the relative drives and are based on the actual installation cost of an equipment for driving a 40-in. blooming mill to roll 60,000 tons of steel per month from 24 in. by 24 in. to 8 in. square :—

Electric Drive with Purchased Power.

Complete cost of reversing motor, flywheel motor generator set, exciters and control equipment ...	£38,000
Foundations, wiring, &c.	2,000
Total	£40,000

Electric Drive with Power Generated at Plant.

Complete cost of reversing motor, &c., as before ...	£38,000
Foundations, wiring, &c.	2,000
Proportion of power-house cost, 2,500 kw. at £10 per kilowatt	25,000
Transmission and outside wiring..	1,000
Total	£66,000

Steam drive.

Compound reversing engine	£25,000
Condenser exhaust piping, including pumps	5,000
Foundations	2,000
Boilers 2,500 H.P., including stokers, coal and ash-handling plant at £6 per horse-power	15,000
Steam piping with covering, valves, &c.	3,000
Water tunnel for condenser with discharge 8,500 gall. per minute	10,000
Total	£60,000

It might be pointed out that the boiler plant, in the case of a steam drive, is usually about double that required in the case of the electric drive. As is usual in steel works, water conditions are not very favourable. This is, therefore, a point worthy of careful consideration.

COST OF OPERATION.

The authors of the Paper mentioned above made a comparison with the test results on a large reversing engine taken from a Paper by Karl Nibecker, read before the Engineers' Society of Western Pennsylvania in July 1914. They give two Tables, I. and II., taken from that Paper, which are results of single ingots, but Table II. gives the result of a series of six ingots from which a fair average can be obtained. Table III. gives the results made upon electrically-driven reversing mills, and is stated to represent "figures based on the power consumption of a large number of ingots rolled during the regular operation of the mill. They do not in any way represent figures made under ideal test conditions. They have been obtained by reading the watt-hour meter in the line supplying power to the reversing mill equipment, including all losses, and represent the total power required to drive the mill. Under normal operating conditions the turbine would run at 70 per cent. of full load, and taking the steam consumption at this point, 1 H.P.-hour can be generated for 13·6 lb. of steam, from which, taking the power requirements, the total steam consumption can be calculated. This will be found to be not more than 50 to 60 per cent. that of the best engines installed in the States to date."

At a recent discussion on "Steam and Electric Drive for the Operation of Blooming Mills," Mr. E. S. Jefferies, engineer to the Steel Company of Canada, gave some very interesting information (*see* Table IV.) with regard to the operation of a 34-in. reversing mill during its working since its commencement, a period of $6\frac{1}{2}$ years. In this time it has rolled 1,353,879 nett tons of various sizes, varying from 10 in. rounds down to 4 by 4's, the average size being about 5 in. by 5 in. From an operating standpoint, this equipment has given practically no trouble, as is illustrated by the fact that in the last $4\frac{1}{2}$ years, which period is taken so as to eliminate the development period during which time it was necessary to make several changes, the total delays charged by the mill department against this equipment were 11 hrs. 35 min., which is roughly 1 min. for every 2,000 tons rolled. A further analysis of the above delays shows that there is only 1 hr. 35 min. which is chargeable to the operation of the equipment.

Energy Saved During Reversal.

The question of saving accelerating energy is one that is being given considerable thought by engine builders, as there is no way of storing it in the engine. With either electric or steam drive, if the mill be operated in an ideal manner, the metal should leave the roll at practically zero speed, so that all the stored energy in the rotating parts will have been usefully utilised. Mills are, however, not operated in this way, as tonnage is the sole object of the workmen, who therefore are not interested in obtaining low power consumption. This is a condition that must be reckoned with, and if possible the design of the equipment should be such that the power consumption cannot be affected materially by unskilled operation.

In the case of steam drive, it is quite common, in spite of the various preventive devices installed, for the engine to race after the metal has left the rolls, especially if the draft has been a heavy one, when there may be a large volume of steam in the cylinder which is not expanded and which accelerates the engine parts. The engine must then be stopped and energy is required to do it. Owing to the fact that the speed of a reversing motor is proportional to the throw of the control lever, and does not vary appreciably with the load, ideal conditions can be more nearly approached than with a steam engine. In the case of electric drive, the motor is stopped by reversing its function and making it act as a generator. This natural characteristic of the equipment enables the braking to be effected very rapidly, and also economically, as the energy stored in the rotating parts is returned to the flywheel of the set. Thus no energy is lost except in the resistance of the windings. The point is of some importance, as it shows up in the relative power consumption of the two methods of drive.

Table I.—*Steam Consumption of Reversing Steam Driven Blooming Mill.*

No.	Size of Ingot. in.	Size of Bloom. in.	No. of Elongations.	Lbs. of steam per ton.	Lbs. steam per ton at 5 Elong.	Lbs. steam per ton at 9 Elong.
A	22×22	$11\frac{3}{4}\times 3$	11·5	643	444	591
B	20×22	$7\frac{3}{4}\times 3\frac{1}{4}$	15·0	600	375	505
C	20×22	7×6	9·0	495	350	495
D	18×32	$23\frac{3}{4}\times 4\frac{1}{2}$	5·0	420	420	...
E	16×32	29×5	3·25	280	...	...
F	19×46	$36\frac{1}{2}\times 4\frac{3}{4}$	4·75	300	...	...
G	18×32	$23\frac{1}{2}\times 3$	7·5	410	256	...

Table II.—*Steam Consumption of Reversing Steam Driven Blooming Mill.*

No.	Size of Ingot. in.	Size of Bloom. in.	Elongations.	Lbs. Steam per ton.	Remarks.
A	20×22	7×6	9·04	587	Cold ingot.
B	20×22	7×6	9·04	490	Hot ingot.
C	20×22	7×6	9·04	497	Good rolling.
D	20×22	7×6	9·04	520	New engineer.
E	20×22	7×6	9·04	518	New engineer.
F	20×22	7×6	9·04	575	Bad rolling.
G	20×22	$7\frac{3}{4}\times 3\frac{1}{4}$	15·1	767	New engineer.
H	20×22	$7\frac{3}{4}\times 3\frac{1}{4}$	15·1	610	Good manipulation.
I	20×22	$11\frac{3}{4}\times 3$	10·75	694	New engineer.
J	20×22	$11\frac{3}{4}\times 3$	10·75	625	Good manipulation.
K	18×36	$23\frac{3}{4}\times 4\frac{1}{2}$	5·13	522	Good rolling—cold.
L	18×36	$23\frac{3}{4}\times 4\frac{1}{2}$	5·13	423	Good rolling—hot.
M	19×46	$36\frac{1}{2}\times 4\frac{3}{4}$	4·62	356	Bad rolling.
N	19×46	$36\frac{1}{2}\times 4\frac{3}{4}$	4·62	292	Good rolling.

Table III.—*Electrically-driven Reversing Mill.*

Ingot. in.	Bloom. in.	Elongation.	H.P.-hrs. per ton.	Lbs.-steam per ton at 13·6 lbs. per H.P. hour.	Remarks.
Round 18	$7\frac{3}{8}\times 7\frac{3}{8}$	4·66	11·4	155	High carbon.
18×20	3×8	12·2	23·0	313	High carbon.
18×20	2×16	9·2	19·4	264	Soft steel.
18×20	4×4	18·5	26·0	354	......
17×15	4×4	16·0	24·0	326	......
20×22	5×5	16·0	25·5	347	......
20×20	8×8	6·25	17·0	231	......

Table IV.—*Electrical Operating Costs per Ton.*

Year.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	Av.	% total.
Months in operation	9	8	12	12	12	12	8†	73	...
Tonnage	119,230	92,622	174,460	238,050	297,224	276,778	155,515	1,353,879	...
Kilowatt-hour per ton	23·9	22·8	21·5	19·8	20·4	21·8	23·4	21·2	...
Power cost	0·160	0·153	0·144	0·133	0·137	0·146	0·157	0·1457	86·7
Repairs and maintenance	0·0069	0·0092	0·0045	0·0102	0·0039	0·0030	0·0027	0·0057	8·0
Miscellaneous supplies	0·0045	0·0049	0·0025	0·0025	0·0029	0·0015	0·0051	0·0032	3·4
Labour in operation	0·0141	0·0161	0·0128	0·0100	0·0128	0·0147	0·0146	0·0134	1·9
Total cost	0·1855	0·1832	0·1638	0·1557	0·1566	0·1652	0·1794	0·1680	100·0

Total Electrical Costs per Ton in Pence.

Year.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	Av.	% total.
Total operating costs	0·185	0·183	0·164	0·156	0·157	0·165	0·179	0·1680	49·17
Interest on investment	0·078	0·101	0·054	0·040	0·032	0·035	0·041	0·0460	13·46
Depreciation (20 years)	0·065	0·084	0·045	0·033	0·026	0·028	0·034	0·0383	11·21
Total main drive	0·328	0·368	0·263	0·229	0·215	0·228	0·254	0·2523	73·84
*Miscellaneous	0·126	0·133	0·115	0·078	0·061	0·063	0·077	0·0894	26·16
Total mill electrical charge	0·454	0·501	0·378	0·307	0·276	0·291	0·331	0·3417	100·00

* All other electrical charges, including overhead.

† Up to and including August 31, 1919.

Electrical Cost Data, December, 1919. 34 in. Reversing Blooming Mill. Steel Company of Canada, Ltd., Hamilton, Ontario.

Lower Power Consumption with Low Loads.

With electrically-driven mills the economy, of course, falls off somewhat on the output, owing to the continuous windage and friction losses of the flywheel motor generator set, which are independent of the load on the machine. Apart from these losses it makes practically no difference whether one or thirty ingots are rolled per hour, as far as the unit power consumption is concerned. In other words, the net power (leaving out the constant losses) per ton of steel is practically independent of the quantity rolled. A similar condition exists with the steam engine, inasmuch as it has certain constant losses due to leakage, piping and auxiliary power. However, apart from these losses the steam consumption will not be constant per unit of work done, as the expansion conditions vary. Recently a large American company investigated the losses in their steam lines, and on Sunday found that they were generating 8,000 boiler horse-power. The valves of the boiler house of two large lines were closed and the load dropped to 5,000 boiler horse-power. Then, after checking up the actual load, they found they were carrying 2,500 h.p. load, which brings out very clearly that the actual economy of the engine on test does not necessarily justify the installation of that type of unit.

Greatest Economy of Time.

It may be true that the steam engine can attain certain given speeds more quickly than the reversing motor. At the same time it does not follow necessarily that the reversing engine will roll any greater amount of metal than the reversing motor. This depends upon many other conditions, such as the way in which the metal is handled on the tables, the maximum speed reached, and also the time lost in the manipulation of the driving unit. In a description of the Brier Hill Steel Company's engine given by Mr. W. C. Coryell, in the discussion on the Paper by Mr. Karl Nibecker, he mentioned he gave a time study when rolling an 18 in. by 20 in. ingot down to 7·06 in. by 7·25 in. in 15 passes. Table V. is a copy of this table, while Table VI. gives the time study of a reversing motor rolling an 18 in. by 20 in. ingot to 3 in. by 8 in. sheet bar, taken from the Paper by Messrs. Sykes and Hall, mentioned above.

Table V.—*Time Study of Reversing Engine.*

Pass No.	Time of entering pass.	Manipulation.
	Secs.	
1	0	......
2	3·5	......
3	9·7	Turn
4	13·0	......
5	17·2	......
6	20·8	......
7	27·2	Turn
8	31·8	......
9	37·0	Turn
10	42·0	......
11	50·0	Turn
12	56·0	......
13	62·0	Turn
14	67·7	......
15	75·8	Turn
Leaving pass	79·3	......

Table VI.—*Time Study of Reversing Motor.*

Pass No.	Time of entering pass.	Manipulation.
	Secs.	
1	0	......
2	3·2	Turn
3	9·4	......
4	12·7	......
5	15·6	......
6	18·8	Turn
7	26·0	......
8	29·2	......
9	31·8	......
10	35·7	Turn
11	41·4	......
12	44·7	......
13	48·5	......
14	53·4	Turn
15	59·8	......
16	64·6	Turn
17	71·8	......
18	81·0	Turn
19	91·0	......

The two tables are self-explanatory, and indicate that in the case of the steam-driven mill it took 75·8 seconds from beginning of rolling to entering the fifteenth pass, as against 59·8 seconds in the case of the reversing motor. While it is not claimed that these figures show the advantages of one over the other system, they are sufficient indication that the reversing motor will operate as quickly or even quicker than the engine. Due to the ease of control of the motor drive it is a good deal lighter on the operator, and consequently he is able to continue running the mill at a maximum capacity with less fatigue than in the case of a steam-driven mill. Fig. 2 shows an actual graphic speed curve taken on the 36 in. reversing blooming mill of the Trumbull Steel Company, and by referring to it it is obvious that this equipment reverses from 90 revs. forward to 90 revs. reverse in 3 seconds, and from 30 revs. forward to 30 revs. reverse in approximately 0·8 second. These times compare very favourably with steam engines. It might here be pointed out that with the steam engine, although it accelerates quickly at the start, it slows down somewhat as the billet enters the mill. The motor, on the other hand, shows no slackening of speed.

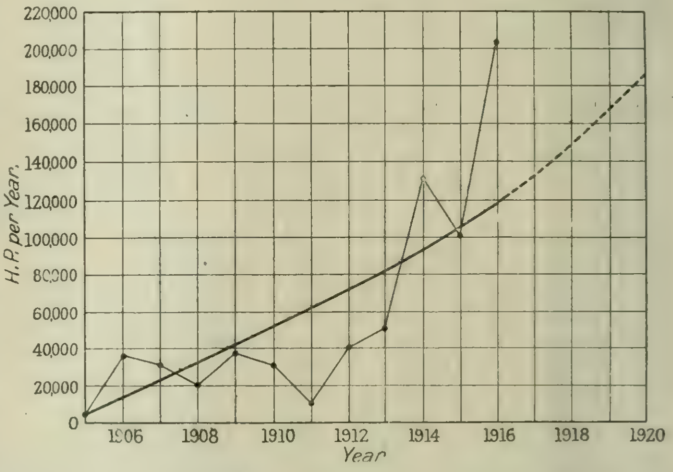

Fig. 1.—Annual Capacity of Rolling Mill Motors (300 h.p. and above) Installed in the United States and Canada.

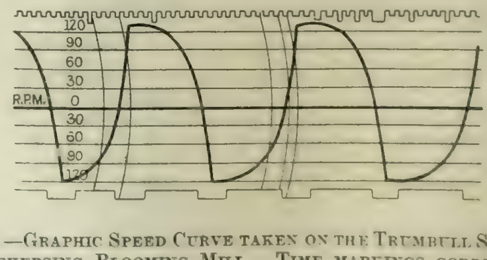

Fig. 2.—Graphic Speed Curve taken on the Trumbull Steel Co.'s 36 in. Reversing Blooming Mill. Time markings correspond to seconds.

With regard to the progress made in this country, it may be stated that it has been rapid over the last few years, and in order to show this clearly a chart, Fig. 3, is given here of the output of motors for the main drive of rolling mills supplied by the Metropolitan-Vickers Electrical Company. Complete lists of motors driving mills also appear on another page of this number of The Electrician.

In the reconstruction of steel mills in Europe there is a great tendency to employ the electric drive, and in their report the mechanical section of Committee No. 3 of the Iron and Steel Institute, in 1917, were led to the conclusion that for continuously running mills the electric drive with slight qualifications is the better method, and also for reversing mills, cogging, finishing and plate mills where "the cost of current is low."

GENERATED v. PURCHASED ENERGY.

When going into the matter of the installation of a new mill or mills of any kind in an existing steel works the engineer has to consider which of the alternative existing sources of power he shall draw upon for the energy for the new mills. There may be available either steam or electricity for the purpose in plenty or otherwise, but if the contemplated additional mills are of any size, as they generally are, the existing source of power supply will be discussed and criticised at this time. The question will be put (*a*) is the production of power in the particular works arranged for on the lines best calculated to secure the cheapest output of all the saleable products? Or, again, (*b*) is the outside source from which power is already purchased ready made, the only available source open? If the gas, or coal fired boilers, or the gas engines, whichever may be in use in the particular works, are of an efficient type, then a decision is easily reached. If the outside (electric) supply company is in a position to quote moderate rates for energy, and is in a district in which a coal supply is always obtainable, then a decision in a certain direction is also a certainty. With favourable answers to these questions, the result would be :—

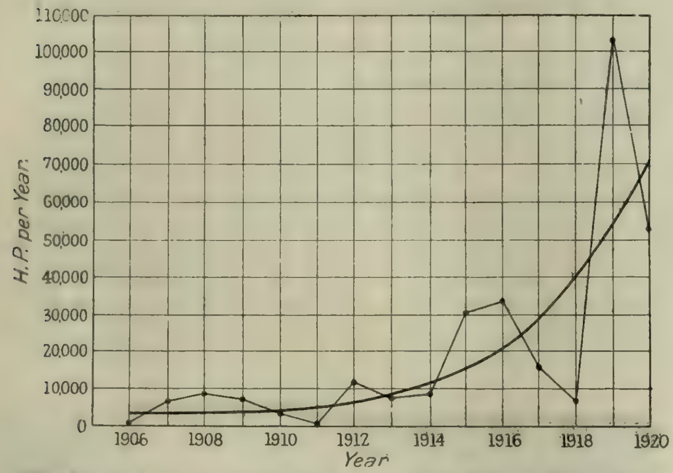

FIG. 3.—ANNUAL CAPACITY OF ROLLING MILL MOTORS SUPPLIED BY THE METROPOLITAN-VICKERS ELEC. CO., LTD. (TOTAL FOR 1920 COVERS UP TO AND INCLUDING JUNE, 1920.)

CAPITAL COST OF MILL ELECTRICAL APPARATUS :

Cogging mill equipment, complete	£43,500
Finishing Mill, equipment complete	35,000
Overhead line on steel towers	5,000
TOTAL	£83,500

WORKING COSTS PER ANNUM :

Power House :

		Cost per kw.-hr.
Fuel	£23,760	0·2805d.
Labour	4,400	0·0520
Oil Waste and Stores	610	0·0072
Repairs and Maintenance	2,660	0·0313
Interest and Depreciation	11,100	0·1310
TOTAL	£42,530	0·5020d.

WORKING COST OF MILL ELECTRICAL APPARATUS :

Interest and Depreciation	£11,350
Maintenance	400
Oil Waste and Stores	200
	£11,950

Thus Making :

Total Capital Costs	£164,985
Total Working Costs per Annum (including interest and depreciation)	£54,480
Cost per ton rolled	6s. 11.03d.

EXHAUST STEAM SCHEME,

CAPITAL COSTS OF BOILER AND POWER HOUSE :

Boiler House, including 17 boilers, economisers, ash-handling plant, telphering and bunkers, chimneys, feed pumps, &c.	£47,920
Power House, including three 1,000-kw., M.P. turbo-alternators, cooling towers, accumulators, switch and control gear, crane, piping, water softening plant, &c.	59,000
TOTAL	£106,920

Say £110,000.

CAPITAL COST OF MILL DRIVING PLANT :

Cogging Mill Equipment, complete	£43,500
Finishing Steam Engine, complete	20,690
	£64,190

WORKING COSTS PER ANNUM :

Power Station :

Fuel	£46,200
Labour	6,310
Oil Waste and Stores	525
Repairs and Maintenance	4,620
Interest and Depreciation	14,900
	£72,555

Working Costs of Mill Equipment :

Interest and Depreciation	£8,717
Maintenance on Cogging Mill, Electric	200
Maintenance on Finishing Mill, Steam	480
Oil Waste and Stores, Cogging Mill	100
Oil Waste and Stores, Finishing Mill	385
	£9,882

Thus making :—

Total Capital Costs	£174,190
Total Working Costs per Annum (including interest and depreciation)	£82,437
Cost per ton rolled	10s. 5·63d.

This shows a difference in favour of complete electrification :—

Less Capital Outlay of	£9,206
Less Interest and Depreciation	£1.167
Higher Working Cost per Annum	£26,790
Less Cost per ton rolled	3s. 6·6d.

On the other hand, should the available conditions of supply be unsatisfactory in the respects named, then it will generally be found that the whole arrangement of power generation is out of date, and drastic reconstruction is a necessity if the material produced is to compete with the production of rival steel works equipped on modern lines.

The following example, in which conditions of power production in an existing steel works in this country came under criticism and were deemed unsatisfactory, is here dealt with. It will be observed from the results that even a "mixed" scheme has no advantages over the straight electric drive.

It is often advanced by steam engine makers, where there are several mills to be laid down, say, a reversing cogging mill and a reversing finishing mill, that as a compromise both steam and electric driving should be used. This is quite a mistaken policy, as the steam engine cannot possibly work at as good an efficiency non-condensing as a good condensing engine can. The authors had, in November, 1917, occasion to work out such a scheme after having shown that the all-electric scheme was far preferable than its steam rival. The scheme involved, on the other hand, the electrification of a complete new works consisting of a cogging mill as well as a finishing section mill, both being of the reversing type, amounting together with all the auxiliaries to 3,200 kw., at a combined load and diversity factor of 45 per cent., making a total for auxiliaries of 1,460 kw. On the other hand a partial electrification of the works driven by a mixed pressure turbo set fed from the exhaust steam of a steam engine driving the finishing section mill had to be considered. It was agreed by the works' engineers that the cost of coal be reckoned at £1 per ton, with an efficiency of the boiler plant plus economiser at 60 per cent.

The results of the investigations which were approved by the works' engineers, still showed a great advantage in favour of the all-electric scheme. A synopsis of the results are given below, based on an annual output of 157,200 tons.

(*a*) Case 1.—Additional turbo-generators with electric drive for new mills, &c.
Case 2.—Additional gas generators with electric drive for new mills, &c.
Case 3.—Additional boilers with steam drive for mills, &c.

b) Additional demand with electric drive for new mills, &c.

COMPLETE ELECTRIFICATION.

The installation consisted of :—

2 3,000 kw. turbo-alternator sets, one being a stand-by. This size of unit was selected as being a convenient size for the commencement of a large station, as there was some talk of completely electrifying the old works.

8 Lancashire boilers would be necessary to raise the required amount of steam, with one additional as a spare and one for the water softening plant, making 10 in all.

Capital Costs of Power House—

Boiler house, including boilers, superheaters, economisers, ash handling plant, telphering and bunkers, chimneys, feed pumps, &c.	£36,735
Power house, including turbo-alternator sets, cooling tower, switchgear and crane, control gear, water softening plant, piping, &c.	44,750
Total	£81,750

Say, £82,000.

The Present Position and Prospects of Electric Steel in Great Britain.

By W. S. GIFFORD.

BEFORE the outbreak of the war in 1914, the use of the electric furnace for steel manufacture was increasing, although it was still regarded by many steel makers as being in the experimental stage. Five furnaces were in operation in Sheffield, and two or three more in other parts of the country, the total capacity being about 4,500 kw., and the production probably about 15,000 tons per annum.

Electric supply authorities were as a rule rather doubtful about the attractiveness of the load, which while giving a good power factor and load-factor and a large unit consumption, was frequently considered to be of such a violently fluctuating character that it would cause trouble with other consumers. In several cases it was found necessary to install motor generators to satisfy their requirements, and this added to the capital cost of the installation and also wasted a large proportion of the power and caused many stoppages from breakdown.

War Conditions.

Almost immediately after the outbreak of war, it became necessary to deal with the rapidly accumulating quantity of turnings, to find a substitute for Swedish raw and finished materials, and to make large quantities of special alloy steels, which were not previously required. As a result of this, within four years the number of furnaces increased to about 100, and the capacity to about 80,000 kw., the steel production being over 200,000 tons per annum. This steel was used for a large number of purposes, the main requirements being for castings, and steel for tanks, aeroplanes, motor lorries, and armour piercing shell. When the war came to an end, a very large proportion of these products were no longer required.

The furnaces used in foundries were not affected, as the demand for castings was still very large, and in some cases where furnaces had previously been used for making ingots, they were immediately diverted to foundry work. Of course in most cases the shops in which they were installed were not suitable, so that another outlet for electric steel had to be found, and in the meantime a number of furnaces had to be shut down.

There was also a large accumulation of alloy steels for the 1919 war programme already in existence, and this added further to the difficulties of disposing of the output. These difficulties are gradually being overcome, and the output of electric steel ingots for 1920, while still considerably lower than in 1918, will be larger than that of 1919, and at least six times as much as that of 1914.

A Promising Outlook.

There are several features that make the outlook promising. Before the war there was still a good deal of prejudice against electric steel to be overcome. Sheffield especially was largely identified with the crucible steel industry, their men being accustomed to the work, and electric steel melters being scarce. It was to their interest, naturally, to insist on the superiority of crucible steels, and there was a feeling that the supremacy of Sheffield in high-grade steel making would be damaged by the introduction of the electric furnace. During the war this prejudice was overcome, and Sheffield more than any other town in the country, and probably in the world, increased its electric steel making capacity. This was largely due to the manner in which the Sheffield Corporation Electricity Supply Authorities rose to the occasion, and were

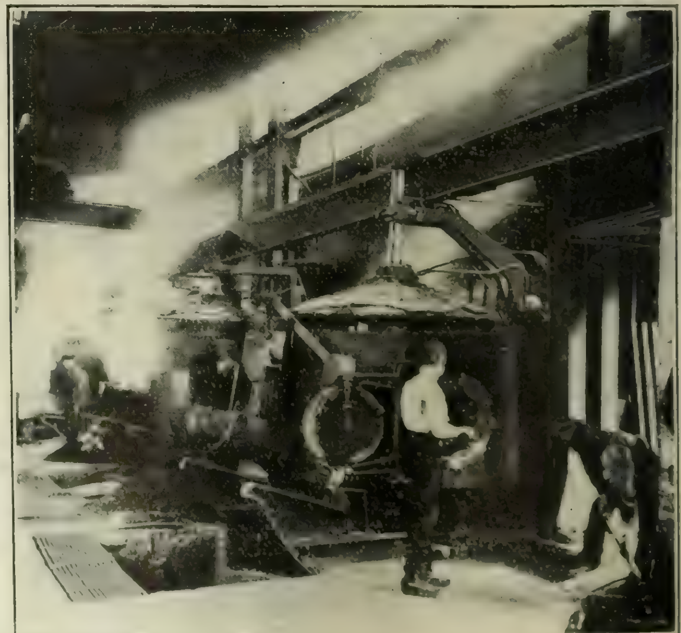

Fig. 1.—General View of three 2-ton Snyder Furnaces.

always able to meet the new demands, so that at the end of the war they were dealing with a total electric furnace load of over 40,000 kw., while private works supplies in Sheffield provided a further 8,000 kw. Other favourable features are that new demands for high-grade and alloy steels have arisen, such as stainless steel, all of which is made in electric furnaces.

Stainless Steel.

The tonnage required for stainless steel cutlery is not, of course, a very large matter, but this steel is certain to be used in increasing quantities for a wide range of purposes, such as valves, hydraulic equipment, &c.

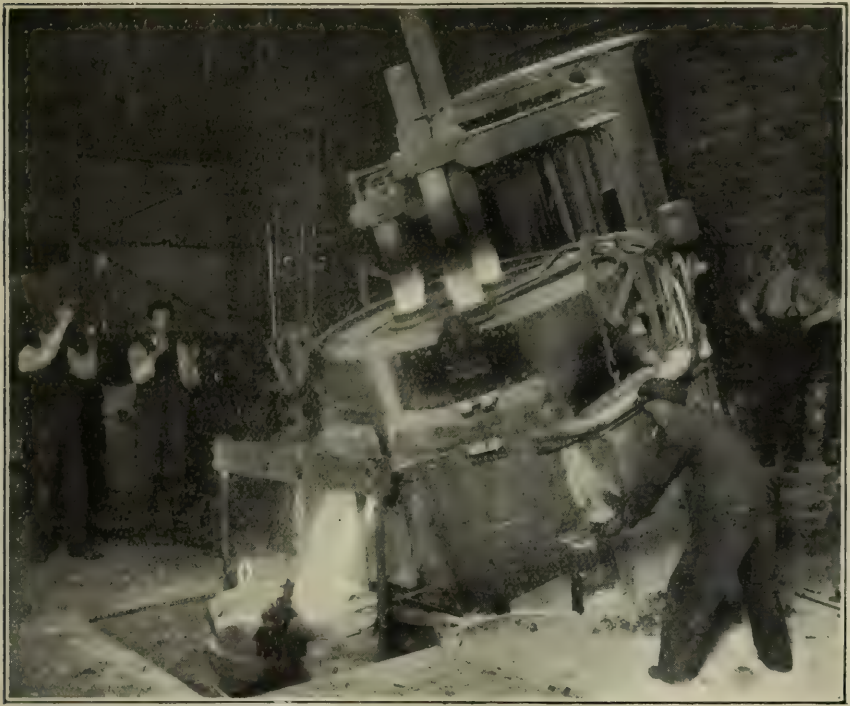

Fig. 2.—View of 30-cwt. Heroult Furnace.

A large proportion of electric furnace steel during the war was used in aeroplane manufacture, and though the demand for this is not large at present, there is every probability of a steadily growing demand. Alloy steels are likewise far more largely used than before the war for motor cars and lorries, and a very large proportion of these steels are made in the electric furnace. In addition to the British demand for these products, there should be a large export trade as soon as conditions become more settled abroad, especially in Russia.

The electric furnace will also still be used for the purposes to which it was applied before the war, such as the manufacture of high-speed steel, drill steel, nickel chrome steels, &c. A number of firms in Sheffield or elsewhere shut down their crucible plant either entirely or in part after the installation of their electric furnaces, and accordingly a considerable proportion of the old crucible output will be replaced by electric steel. In addition to this there should be a very large demand for electric steel for weldless tubes. Before the war all the Mannesmann Company's tube steel, both in Germany and Italy, was made in electric furnaces, and there is no reason why this market alone should not be sufficient to absorb the whole of the present surplus of electric steel capacity.

The Scrap Problem.

At the present moment the scrap problem is one of great importance. It is often thought that the chief essential for the success of an electric furnace plant is cheap power, but cheap scrap is more important still. With power at its present price, the cost per ton of steel is about £2 for current, so that a reduction of 25 per cent. in the power bill only saves 10s. per ton of steel. With scrap at its present price, some firms who have made good contracts are buying for as much as £5 a ton less than their competitors, so that any possible saving in power is very much more than counterbalanced by this item. For this reason, proximity to a large scrap-producing centre is a matter of great importance.

The combination of open hearth-electric or Bessemer-electric has not yet been tried in this country on a large scale, but in America and on the Continent it is frequently employed, and in many cases it might be profitable in this country. Some years ago it was intended to work a Talbot-electric process, which would in many ways be an ideal combination, but owing to shortage of power the scheme was not proceeded with. It seems probable, however, that the next large development of electric steel furnaces will be the manufacture of intermediate grades of steel by the Duplex process.

The manufacture of acid electric steel has not been very widely developed in Great Britain, but in America nearly half the furnaces working in foundries have acid linings. In England it is being successfully used for making castings and high-speed steel, but it could be advantageously used in many other works, where a scrap of good analysis is available and refining is consequently not essential. The time required for the heat is shorter, and there is a consequent saving of power, electrode consumption, wages and repairs.

During the war and especially in 1916 and 1917, the lack of electrodes was a serious handicap to expansion, but this difficulty has now been overcome, and ample supplies both of amorphous and graphite electrodes are now available. Four factories for making amorphous electrodes, and one for graphitising, have been erected in England, and the initial difficulties of working a new process and especially of training the labour, have been overcome.

Illustrations are attached showing typical furnace installations.

An All-Electric Steel Foundry.

The Connecticut Electric Steel Company are making it a practice to use electricity in connection with all the processes at present employed in their works. According to the "Electrical World," steel is melted and refined by electricity, and is also employed on all the other power and heating apparatus usual in a steel foundry. The results have been so satisfactory that extensions are contemplated. It is important to note that the cost of electrical energy is not the determining factor in coming to a decision on such questions, for while as a melting agent it may cost more than ordinary methods its other advantages, such as the production of better results, the ready duplication of results, the simplification of the labour problem, and the need for less skilled attention, must all be taken into consideration. These reasons explain why the electric furnace has been used in these works for over two years, and similar reasons are also responsible for the employment of electric core baking ovens, electric heat treating furnaces and other apparatus. The plant in question has a load of about 2,000 kw., and obtains its energy from the Hartford Electric Light Company at 11,000 volts. The latest application of electricity in these works is to the core baking oven, which has now been in service for several months. The company is also proposing to replace gradually the oil-fired annealing furnace by electric ovens as experience shows the best lines on which to proceed. Electric light and electricity for power purposes is, of course, used throughout the works, with the exception of the portable grinders, where compressed air is employed.

The Industrial Future of Electro-Deposited Iron.

By W. E. HUGHES, B.A. (Cantab.)
(Lately Chief Research Chemist, Electro-Metallurgical Committee Ministry of Munitions).

ONE can always learn something from the past that will be of guidance for the future. This is true in general. It is equally true that the lessons taught by past failures and deficiencies are not always learnt, or, if heeded at all under some stress of necessity are speedily forgotten. The electro-deposition of iron affords a particular instance of this general case. In the Annual Report of the British Association Meeting for 1869 there is to be found some account by M. H. von Jacobi of a process whereby iron was at that time being deposited at the St. Petersburg Government printing-press. This process was worked out by Jacobi himself in collaboration with E. Klein. Several years afterwards, Sir W. Roberts-Austen, then connected with the Royal Mint, discussed the process with Jacobi in London, and subsequently went to St. Petersburg to investigate it for himself. The result was that a Paper upon the subject was read at a meeting of the Iron and Steel Institute in 1887, in which Roberts-Austen commented most favourably both upon the process and the deposited metal. So far as can be ascertained, the matter ended with the publication of Roberts-Austen's paper—inasmuch this country is concerned.

It was different on the Continent. F. Haber,[*] S. Maximowitsch,[†] A. Russ and A. Bogomolny,[‡] H. Lee[§]—to mention only a few—all found it worth while to investigate the process of Jacobi and Klein; and one result was that it was developed and improved, and ultimately adopted and used industrially at the Government printing-press in Vienna.

OBITUARY NOTICES AND DEVELOPMENT.

Something similar happened in the case of the work on electro-deposition of Alexander Watt on the one hand and of W. M. Hicks and L. T. O'Shea on the other. In the pages of THE ELECTRICIAN for 1887 and 1888 can be found a number of articles, written by Watt, containing detailed accounts of experiments performed by him in connection with the deposition of iron from a large number of solutions of salts, both organic and inorganic. These articles contain a fund of information on their subject. Yet they seem to have become lost: they are not even noticed in one of the most recently published textbooks purporting to deal with electro-plating. The work of Hicks and O'Shea[||] fared somewhat better—so far as textbook notice goes; but there has been no industrial outcome from it. Their results seem to be subject matter rather for obituary notices than for scientific and industrial development. In the interval between the publication of the work of Hicks and O'Shea in 1895 and the outbreak of war in 1914 only one Paper of any note relating to the deposition of iron was published in this country, namely, that read by S. Cowper-Coles before the Iron and Steel Institute in 1908. This Paper was concerned with the manufacture of iron tubes and sheets by electro-deposition methods. Criticism of Cowper-Coles' methods would be out of place here; but the Paper is of present interest as indicating that the electro-deposition of iron and its commercial possibilities were not quite forgotten.

POSITION ON THE CONTINENT.

The position on the Continent and in America was very different. The science of the electro-deposition of iron was, during the same interval, fostered by F. Foerster, of Dresden, R. Abegg, H. Lee, R. Amberg, F. Haber, A. Neuburger, and many others; and the application of the scientific principles to industrial purposes was the object of persistent work by F. Fischer in Germany, C. F. Burgess and C. Hambuechen and also O. P. Watts in America, and by L. Guillet (among others) in France. Fischer[*] and Burgess and Hambuechen[†] developed processes whereby iron could be refined successfully by electrolytic methods; and Fischer and Guillet,[‡] each of them, put the manufacture of iron sheets and tubes by electrolysis upon a commercial footing.

THE RESULT OF NEGLECT.

The result of the neglect in this country of electro-metallurgy generally and of iron deposition in particular was felt shortly after the outbreak of war. Iron and steel soon became materials of such value that not even Government departments dared waste them, and it became necessary to find a means of avoiding the scrapping of aeroplane crank-shafts and other parts when these became worn down by a few thousandths of an inch. Someone conceived the bright idea of depositing iron on the worn surfaces, and thus bringing the articles up to gauge. No doubt the conception was formed in complete ignorance of the uses to which copper had been put for many years past. In a short time captains and majors were appointed in several Government departments (each one working in ignorance of what the others were doing) to supervise processes they did not understand, while those few who did know anything of deposition were engaged either in other civil work or in the trenches. Consequently progress was slow. The idea was conceived, but the means of carrying it out were unknown. Credit is due to those engaged in the base workshops in France and elsewhere for succeeding, even partially, in doing deposition work of unknown quality; but it was not till towards the end of 1917 that Lieut. Emptage succeeded in depositing iron of more than two or three thousandths of an inch in thickness and at a reasonable rate. Naturally, having succeeded so far, Emptage was sent to another depot for other work than deposition.

The industrial future of electro-deposited iron depends, in the first place, upon how many of the lessons which can be learnt from the facts contained in the foregoing historical sketch have been learnt, the principal one being that electro-deposition, whether of iron or other metal, is not an art that "any fool" can compass. It is an art which is founded on scientific bases, and if new electrolytic processes and methods are to be applied successfully to economic purposes, careful scientific work must be done beforehand.

SCIENTIFIC CONTROL OF DEPOSITION.

It is one thing to deposit a metal; it is quite another thing to deposit metal that is to be of any use for a given purpose. To attain this latter end, the process of deposition has to be under scientific control. It must be known what particular set of deposition conditions must obtain in order to produce a given result. Moreover, the result must be known in a scientific sense—the structure and properties of the deposited metal must be known, together with the defects to which it is liable. The industrial future of electrolytic iron depends upon the acquisition of this knowledge, which is, as yet, only in partly attained. The writer was sent a sample of deposited iron some little time ago. The sample came with a covering letter that was a veritable song of triumph. The deposit was some 0·12 in. thick, and, casually examined (especially by a layman), seemed very fair. The photo-micrograph, Fig. 1, shows the polished, unetched surface of a cross-section of it: the etched surface is seen in Fig. 2. The sender was proud of the thickness of iron he had deposited: that was all he *knew* about it. The deposit is seen to be full of large holes and to contain innumerable cracks and many small dark patches of inclusions of iron oxide. J. C. W. Humfrey has aptly described a similar deposit as "rotten."* It is utterly useless for any purpose whatever: it was under no sort of scientific control during its formation.

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[*] "Zeit. f. Elektroch.," 1898, Vol. IV., p. 410.

[†] "Zeit. f. Elektroch.," 1905, Vol. XI., pp. 52 and 91.

[‡] "Zeit. f. Elektroch.," 1906, Vol. XII., p. 697.

[§] "Abhandl. der deutsch. Bunsen-Gesellschafft," Nr. 2, p. 59.

[||] THE ELECTRICIAN, Vol. XXXV., p. 843, 1895, and Assoc. Brit. Rep., 1895, p. 634.

[*] "v. D.R.P.," 1908, No. 212994.

[†] "Trans." Am. Electroch. Soc., 1904, Vol. V., p. 201; "Electrochem. Ind.," 1904, Vol. II., p. 184; and see also "Trans." Am. Electroch. Soc., 1906, Vol. IX., p. 229, for an interesting account of the structure of deposits by Burgess and O. P. Watts.

[‡] "Jour." Iron and Steel Inst., 1914 (No. 2), p. 66.

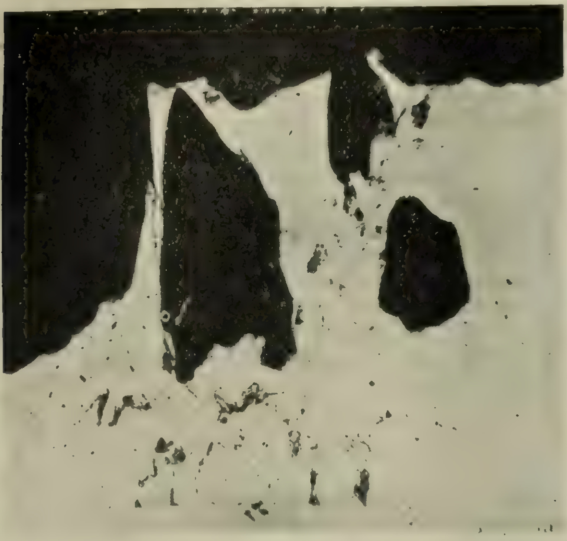

FIG. 1.—IRON DEPOSIT SHOWING LARGE HOLES AND NUMEROUS OXIDE INCLUSIONS × 50.

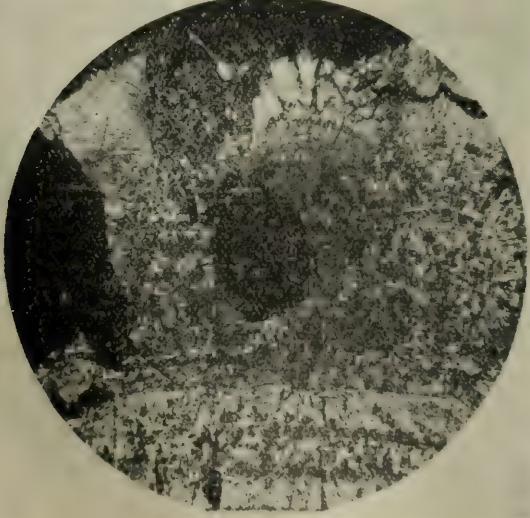

FIG. 2.—IRON DEPOSIT SAME AS FIG. 1, BUT ETCHED × 50.

To illustrate the statement made above in regard to the importance of a knowledge of the structure of the metal deposited, attention is directed to the micrographs, Figs. 3 and 4. Fig. 3 (for the reproduction of which we are indebted the Beama "Journal") shows the structure of what may be called a "normal" deposit of electrolytic iron, or one formed in a neutral solution and without movement either of the cathode, anode, or solution. Fig. 4 shows the difference of structure brought about by employing an *acid* instead of a *neutral* solution. It will be evident that, since difference of structure involves difference of properties, a deposit having the structure shown in Fig. 3 might be desirable in one case, while one having that shown in Fig. 4 might be the requisite in another. Other factors of deposition—current density, concentration of metal content of the solution, agitation of the electrolyte by mechanical or other means, and even temperature—affect the structure of the deposited metal in various ways and degrees. So much is this so that a practised electro-metallurgist can, after examination of it with a microscope, give at least a general history of the formation of a deposit, in the same way, but not in the same detail, as a petrologist can describe the history of the formation of his igneous rocks.

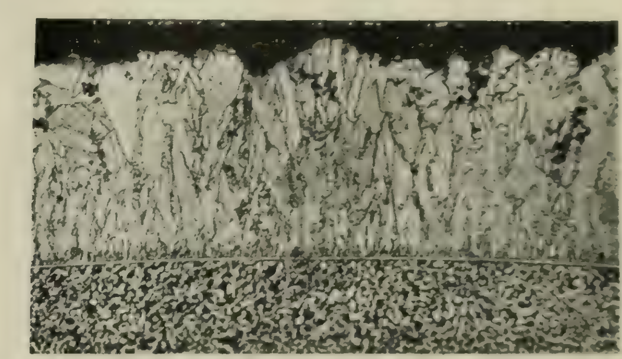

FIG. 3.—IRON DEPOSIT SHOWING "NORMAL" STRUCTURE × 100.

FIG. 4.—IRON DEPOSIT SHOWING EFFECT OF ACID ON STRUCTURE × 150.

Scientific control is important in all deposition processes, but it is, perhaps, more important in the case of iron than in the cases of other metals. Iron brings the electro-metallurgist into close touch with the engineer, both mechanical and electrical; and the industrial future of electrolytic iron depends to no inconsiderable extent upon how far the electro-metallurgist can satisfy the demands and requirements of the engineer. To give the engineer what he wants, the electro-metallurgist must know the means of doing so; and to know these he must be able to correlate conditions of deposition with structure.

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* "Carnegie Scholarship Memoirs," 1912, Vol. IV., at p. 82.

Important Factors.

Factors of great importance to the industrial future of deposited iron are that there should exist solutions from which satisfactory deposits can, under proper conditions of control, be obtained, and that these solutions should be capable of fast work and be as economical as possible in the matter of high current efficiency. Two solutions are known that fulfil the necessary requirements: one is of the chloride,[*] the other of the sulphate type,[†] and both have been put to practical test in industry. The chloride bath consists of a highly concentrated solution of iron (ferrous) and calcium chlorides. It is worked at a temperature between 90° C. and 110° C., and at a current density of anything up to 180 amperes per square foot. The sulphate bath, analogous to the chloride as regards the principles underlying its composition, consists of a concentrated solution of sodium and ferrous sulphates. This bath is worked at or near boiling point, and at a high current density. Both baths are neutral in reaction. The chloride bath is the older, and has been used commercially for a number of years, both for refining iron and for the manufacture of iron sheet. The iron obtained from it is of great purity (99.98 per cent.)[‡]: it is soft and malleable, and it forms excellent material for use in the manufacture of parts of electrical machines.[§] The sulphate bath, which is newer, has not been put to the same severe test as the chloride. But Max Schlötter, the patentee and an authority on the electro-deposition of metals, states that the deposit is very pure and contains but little hydrogen. It may be added that the cathode efficiency of both these baths is very high.

A third solution, which is one of the sulphate type, has stood the test of time as an electro-refining bath. This is the one used by Burgess and Hambuechen since as long ago as the early years of this century. The electrolyte in this case "consists of ferrous and ammonium sulphates; the current density of the cathode is 6 to 10 amperes per square foot of cathode surface, and at the anode slightly less; the E.M.F. for each cell is slightly under one volt; the temperature of the electrolyte is about 30° C."; and "the current efficiency of deposition is very closely 100 per cent." This bath differs in composition from the two before described: the deposit is hard and brittle, but this does not much matter in the case of a refining bath—purity is the great requisite here. There is, too, a great difference in the rate of working, which is of importance inasmuch as the greater the current density employable, the greater, *ceteris paribus*, the output obtained, and, hence, the fewer in number (or smaller in size) the vats required for a given output. It is in this respect—rate of working—that the iron solution used by Burgess and Hambuechen is inferior to the baths of Fischer and Schlötter respectively.

The Present Position.

As shown in the foregoing, a principal requirement for the industrial future of electro-deposited iron, namely, a satisfactory solution, may be fairly said to be satisfied. Work has recently been done in the direction of obtaining such scientific control of the actual deposition that the product desired can be obtained with certainty. The writer has been privileged to help (if ever so little) in this part of the work, and can say, of his own knowledge, that the conditions of deposition that will lead to the formation of iron deposits possessing this or that characteristic structure and definitely desired properties are known in general, at least, if not in very great detail. It follows that by intelligent, informed practice the engineer or manufacturer can be given deposited iron that has properties that are required in the metal in a particular case. This advance ensures that the terms "experiment" and "experimental," which in the mind of many a manufacturer are associated with depletion rather than the inflation of his bank balance, will not appear so harshly and vividly in his imagination. He will, therefore, be much more likely to use electrolytic iron for one purpose or another than if preliminary experiment were necessary before what he requires can be supplied to him: and this is good for the industrial future of electro-deposited iron. Further, there are signs that the lessons to be derived from the former neglect in this country of electro-metallurgy have been partially learnt; and this fact engenders a hope that research upon both the purely scientific and the applied sides of this science will be fostered.

Research Work in London.

Research work has certainly begun. But one finds that in Birmingham—the very centre of applied electro-metallurgy—the University lectureship, once held by McMillan, has fallen into desuetude, though in Sheffield and London research is being encouraged. At the East London College the authorities have promoted research upon the microscopic study of deposited metal by placing at the disposal of a research worker the splendid photo-micrographic outfit in the Engineering School. At the Royal School of Mines, Imperial College, active work is being initiated under the supervision and guidance of Prof. H. C. H. Carpenter, F.R.S., who, for a considerable time past, has taken a lively interest in electro-metallurgy, and who is one of the few men of science of eminence in this country who is a firm believer in the great future of the subject. In another—different, but important—way the performance of the much-needed research is being encouraged, and leading technical journals have recently opened their columns to the discussion of matters concerned with electro-metallurgy, both theoretical and applied.

In yet a third way research upon electro-metallurgy has been of recent years encouraged. For some while now the Scientific and Industrial Research Department has allotted funds for carrying on research on the subject. In all fairness it ought to be mentioned that the freedom of action and of choice of subject allowed to the allottees of the grants has proved quite the contrary to the restricting procedure alleged by certain individuals to be characteristic of the work of the Department. It will, thus, appear that the hope expressed above is based upon substantial foundation. It remains for the manufacturers and engineers in this country to make use of the work that has already been done in several directions upon electrolytic iron, and thereby to indirectly, if not directly, promote and encourage future work. This has been done elsewhere—in France, Germany, and America—for such a considerable time past and on such an extended scale as to justify the inference that the employment of deposited iron is of value in several directions in industrial work. The industrial future of deposited iron certainly depends to a considerable extent upon the overcoming of some initial, not, perhaps, inexplicable prejudice and doubt on the part of industrial users. Once such doubt and prejudice, in so far as they arise from the conscious or sub-conscious fear of the terms "experiment" and "experimental," are allayed, there is no doubt that the present-day applications of deposited iron (several of which have been mentioned in this article) will be speedily and widely extended and that new uses will soon be found for the metal.

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[*] "D.R.P.," 1908, No. 212994.

[†] "D.R.P." 1917 No. 309271

[‡] "Pfanhauser, Galvanotechnik," 1910, p. 750.

[§] C. Duisberg. Internat. Congress of App. Chem., 1912. Vol. XXVIII., p. 60.

Electrostatic-Separation.

How Suspended Particles are Removed from Gases.

By H. J. BUSH.

The problem of cleaning dust-laden gases by subjecting them to the action of electrostatic forces constitutes one of the most fascinating problems presented of recent years to the industrial investigator.

On the face of it the explanation of what happens appears simple; we have a point discharge electrode suitably insulated and connected to a source of high-potential opposed to a plate receiving electrode maintained at zero potential. The "point" electrode may be a thin wire or a sharp edge, and the "receiving" electrode may be a plate or a pipe, in which the discharge electrode is axially suspended. The dust particles approaching the highly charged point electrode take up the same charge, and are repelled from it towards the plate electrode which is earthed.

A Wide Field for Exploration.

This is, however, a very incomplete description of the phenomena in question, and the further we penetrate into the field of electrostatic precipitation the more we find how limited our knowledge is of the laws governing it, and how much still remains to be explored and charted in spite of the immense strides made.

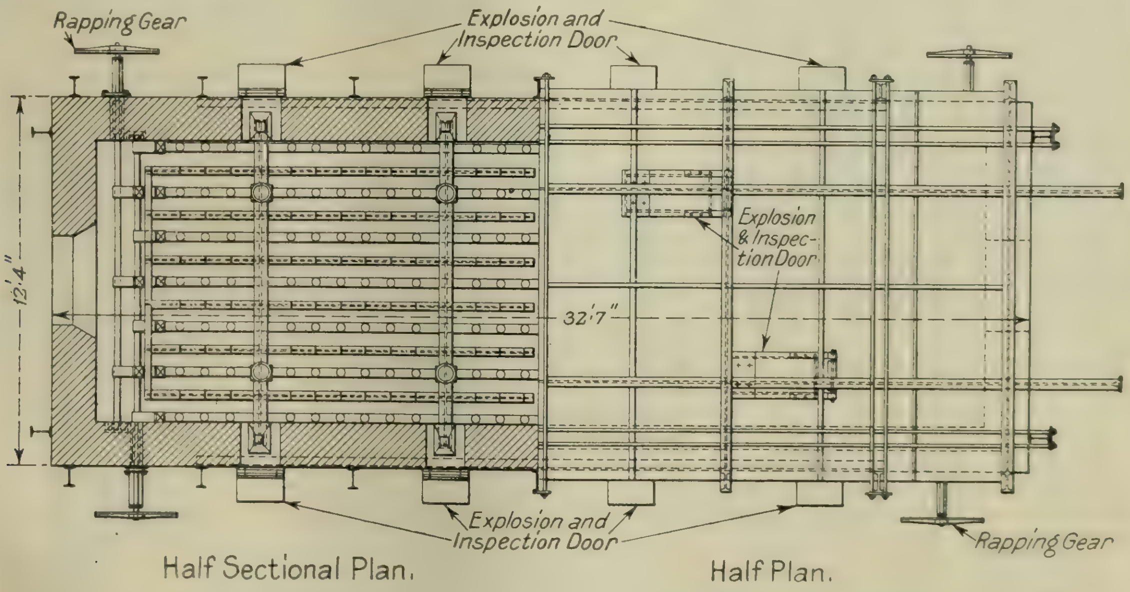

Rapping Gear
Explosion and Inspection Door
Explosion & Inspection Door
12'4"
32'7"
Explosion and Inspection Door
Rapping Gear
Half Sectional Plan.
Half Plan.

Fig. 1.

The band of young enthusiasts in Southern California, mostly students of F. G. Cottrell, while the latter was at Berkley University, have progressed far indeed since they first attempted in collaboration with him to translate his small scale experiments into a technical process, a process which now takes its place as a standard means of separating suspended dust from waste gases, an ever present problem in so many metallurgical operations.

There are now some 150 Cottrell installations in operation in various parts of the world, the results of which are carefully sifted and correlated by a mixed staff of electrical engineers, physicists and chemists. The erstwhile largely empirical methods are giving place to procedure based on certain natural laws which appear to govern the phenomena in question.

The endeavours to apply electrical precipitation to the cleaning of blast furnace gases has once again amply vinditaced the old adage which exhorts us to regard the appearance of the first swallow without undue elation. Short-lived triumphs were followed by disappointing stretches of apparently complete failure, just sufficiently relieved by sporadic flashes of success to keep the conviction alive that the road was the right one, though the precise nature of the obstacles barring the way might not be clearly recognised.

History of the Investigations.

In England, the Huntington, Heberlein Company, as representatives of the Cottrell system, and independently the Lodge Fume Deposit Company, attacked the problem, while simultaneously in America and on the Continent it was receiving the close attention of keen investigators. A great deal of useful and highly interesting material has thus been collected, critical examination of which shows that generally speaking the conclusions arrived at by the different operators correspond very closely while the means adopted to secure success are nearly identical throughout. The few exceptions which do not fall into line at present will no doubt find their explanation in due course; in fact, at any moment the peculiar factors to which they most probably owe their existence may cease to operate either temporarily or permanently, and thus restore the uniformity of the picture.

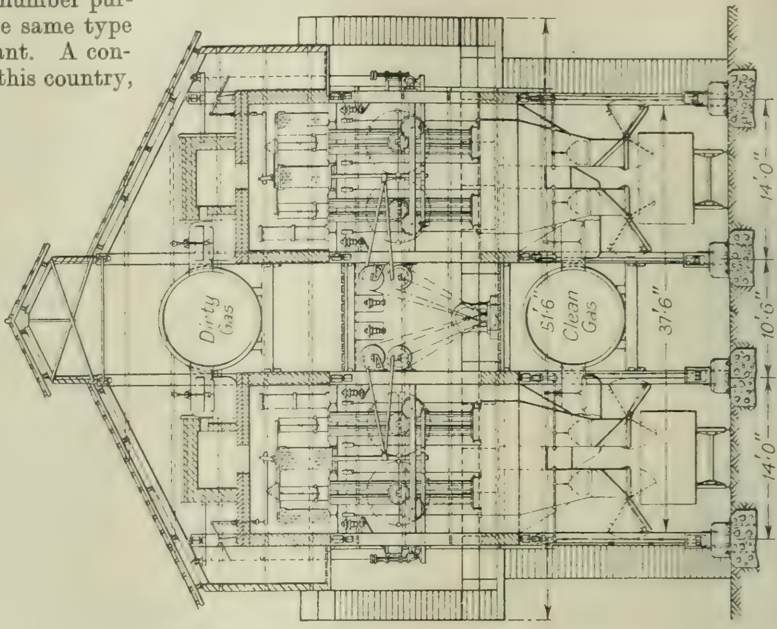
An Early Installation.

The Cottrell system of electrostatic precipitation was tried out on blast furnace gases for the first time in this country at the works of the Workington Iron & Steel Company, who produce basic pig iron from West Coast and Spanish ores. The first experimental plant (Fig. 1) was a brick chamber with electrodes suspended vertically therein parallel to the direction of flow of the gases. The discharge electrodes connected to the source of uni-directional high potential were carried by special quartz insulators, and the receiving electrodes were earthed by connecting them to the steel structure. The calculated capacity was 17,000 cubic ft. of blast furnace gas per minute. The electrical generating set consisted of a direct current motor driven off the works supply, and directly coupled to a 5 kw. alternator with exciter and field resistance to provide the necessary voltage regulation for the primary of the Cottrell step-up transformer. These machines as well as the necessary resistances and switchboard, were of British make. The mechanical rectifier for converting the alternating current delivered by the alternator to intermittent direct current was one of a number purchased from the Ministry of Munitions and of the same type as that installed at the Queen's Ferry Cottrell plant. A considerably modified design is now manufactured in this country, and is giving excellent results.

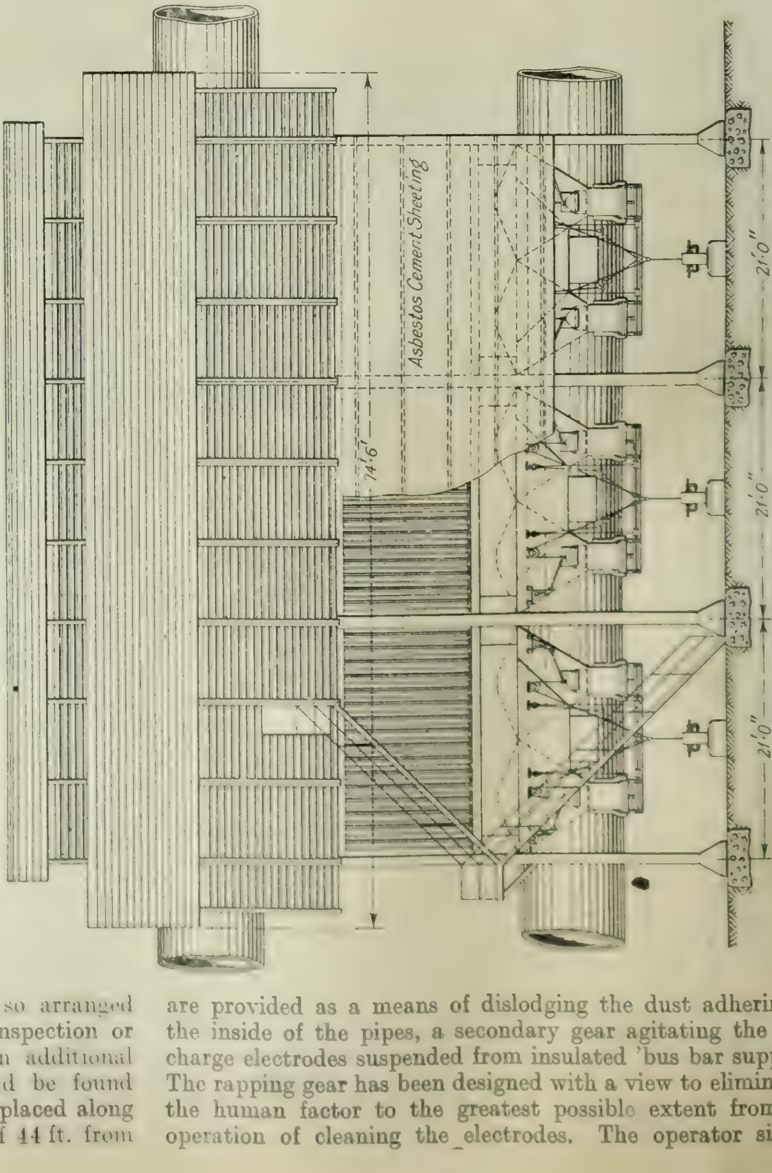
The working voltage of the installation calculated from the primary potential by transformer ratio was 65,000. The temperature of the gas at the point where the branch pipe leads off to the Cottrell precipitator was on an average 250°C., and every endeavour was made to retain this so-called sensible heat of the gas. It soon became apparent that conditions in the precipitator were not as they should be, and every known means of rectifying them was tried without avail. Finally, it was decided to make a radical change in the design of the precipitator, and an entirely different type was substituted, built along the lines of an experimental plant, with which promising results had been obtained at an American steel works. The capacity of the new plant was 240,000 cubic ft. of gas per hour. Vertical pipes 12 in. in diameter formed the collectors, and wires suspended in the centre formed the discharge electrodes. The wires were attached in the usual way to a 'bus bar frame, supported on insulators, and the pipes, including the steel framework, were securely connected to an earth plate, and thus maintained at zero potential. Every effort was made to incorporate in this plant the results of the most up-to-date experience available in the field of electrostatic precipitation, and it was thought that in regard to design nothing had been left undone that could help to make the plant a success.

Early Failures.

The installation was carefully attuned and adjusted, and the gas admitted. Disillusionment was not long in coming. In a short while it became apparent that the only result achieved by altering the design was to reproduce the precise conditions previously established, no amount of coaxing would induce the elusive fume particles to arrest their flight through the pipes, and settle down in a sober fashion under the persuasive pressure of some 60,000 volts. Drastic treatment with water, steam and even sulphuric acid made no impression, and it was feared that Nature was not going to yield the secret of bringing the obstreperous particles to heel, when a chance observation presented a clue, which intelligently followed up supplied the solution of the problem. As soon as the conclusion arrived at had been thoroughly put to the test designs were prepared for an installation to handle the gases from three blast furnaces.



Cross Section. **Fig. 3.**



Elevation. **Fig. 2.**

Figs. 2 and 3 are a section and side static elevation respectively of the electroprecipitator now in course of erection. It comprises six compartments of 64 pipes each, so arranged that any one can be isolated for purposes of inspection or repair. Provision has been made for adding an additional four compartments in case an extension should be found desirable at a later date. The dirty gas main is placed along the centre line of the construction at a height of 44 ft. from the floor level, and the clean gas main in corresponding position at a lower level. Each set of 64 pipes is connected to a 25 k.v.a. generating set, situated in an adjacent building. It is, however, anticipated that one such electrical unit will be sufficient to handle two sets of pipes. A series of hammers arranged on a rocking shaft, and operated by a single motor are provided as a means of dislodging the dust adhering to the inside of the pipes, a secondary gear agitating the discharge electrodes suspended from insulated 'bus bar supports. The rapping gear has been designed with a view to eliminating the human factor to the greatest possible extent from the operation of cleaning the electrodes. The operator simply moves a belt from the loose to the fast pulley, whereupon the hammers are set in motion and simultaneously the discharge electrodes are jerked. The dust collects in steel hoppers fitted with luted valves. Each valve discharges into a box fitted to the bottom of the hopper, which will hold the dust from a six hours' run and has a balanced outlet flap. This arrangement enables the operator to empty the dust into railway trucks independently of whether the compartment in question is working or not.

Electrical Arrangements.

Six electrical generating sets are installed in this plant, each consisting of motor-generator, mechanical potential rectifier, transformer and necessary insulators. Each set has a simple form of hook switch in the high tension line. This is operated by means of an insulated pole and forms a convenient means of making and breaking the high-tension circuit without having to stop the generators. Provision has been made to enable the operator at a moment's notice to connect any one generating set to any of the six precipitator compartments. To guard against the danger of explosion, through air entering the precipitator in the event of the gas pressure in the main dropping below zero, an automatic tripping gear will be installed which is operated by the gas pressure. It consists of a pressure gauge and a secondary circuit, which is closed when the gauge registers a minimum, and, being connected with the no-volt release coils of the circuit-breakers, causes the latter to drop out on all the six sets. The plant should be in operation within the next six months.

Progress in Germany.

In Germany experimental work in the same field has been conducted at the Duisburger Kupfer Hutte, and latterly at Gelsenkirchen. The apparatus at the first named place was a plate and wire type precipitator, and gave some trouble, necessitating radical alterations. At Gelsenkirchen a pipe and wire precipitator was put in of such dimensions that continuous tests could easily be carried out, and all necessary observations taken without interfering with the regular work of the blast furnace. Very extensive tests were made, and many curious observations, which throw additional light on the factors influencing electrical precipitation. It was established beyond a doubt, for instance, that the condition of the furnaces has an appreciable influence on the subsequent precipitation of the dust and this point must be duly taken into consideration in designing an installation, so that its efficiency may not be impaired by the fluctuations normally to be expected in a blast furnace. A discussion of the theories put forward in explanation of the above is outside the scope of this paper, and must be reserved for a future occasion.

Application to Gas Engines.

It is said that in Germany the management stipulate an efficiency of 99·9 per cent. for gas cleaning plants, in order that the gas may be used without further treatment in engines. Undoubtedly the use of blast furnace gas for internal combustion engines is more common in Germany than with us, which may account for the stringent demands made on cleaning plants. It is a debatable point, however, whether in English practice a 99·9 per cent. standard of purity is either necessary or economically justifiable. In view of the fact that the proportion required for the stoves and boilers is at least 80 per cent. of the total it is surely wastful to reduce the dust contents of the gas below that figure. The gas supplied to internal combustion engines has to be cooled, and the reasonable policy to pursue would therefore seem to be to first take out, say, 95 per cent. of the dust from the total available gas, and subsequently to condition only such a proportion of it as is needed to supply the engines by cooling and a second treatment in an auxiliary electrostatic precipitator or by washing in a wet washer.

On the other hand, one must guard against going too far in the other direction, and being content with an efficiency of 80 per cent. or even less.

The constituents of blast furnace gas most difficult to recover are the chlorides of the alkaline earths. Now, not only is it precisely these which are most active in deterioraing of the firebrick linings of the stoves and furnaces if allowed to remain in the gas, but, in addition, failure to recover them deprives the management of a source of revenue, which, modest though it may be, in many cases cannot be entirely disregarded.

The Analysis of Special Steels.

The use of Electrometric Titration Methods.

By C. O. BANNISTER, Ass.R.S.M., F.I.C.

ELECTRICITY has long been of almost indispensable value to metallurgical chemists who have employed the electrolytic method of separation and determination for many of the metals. It seems to have been first applied to the estimation of copper by C. Lucknow* who devised the method in connection with a prize offered in 1867 by the Mansfeld Ober-Berg und Huttendirection for a rapid and at the same time accurate method of determining copper in ores and furnace products. At the time of its introduction, it gave an impetus to the study of other electrolytic methods of analysis and modifications of the original method have been largely used in the determination of lead, nickel, cobalt, zinc and other metals.

Within recent years new methods of analysis have been developed which are of particular importance to chemists engaged in the analysis of special steels. They are known as electrometric titration methods, the principle employed being the measurement of the change of oxidation potential during titration.

Application of the Hydrogen Electrode.

Although the use of the hydrogen electrode as a valuable means of chemical and physico-chemical research has been realised for many years it is only of late that the adoption of this method to practical analysis has received the attention it deserves. The value of the method depends on the fact that if two electrodes of the same metal be placed in solutions containing the ion of the metal in different concentrations, and these solutions are placed in electrical contact, either through a porous partition or by means of a siphon, or even separated by gravity alone, there will exist between the two electrodes a difference of potential the determination of which makes it possible to detect quite accurately even very small ionic concentrations.

The neutralisation of acids and bases, the precipitation of hydroxides and the precipitation of salts of weak acids from their solution in strong acids, &c., are accompanied by changes in the concentration of the hydrogen and hydroxyl-ions which are easily followed by the aid of the hydrogen electrode and may be used as a method of quantitative determination. The first application of these principles to analysis was made by Bottger,[*] who titrated a number of acids and bases, &c. If, instead of a hydrogen electrode, an unattackable electrode be used, it is possible to determine the end point of oxidation and reduction reactions as, for example, the titration of ferrous iron[†] with bichromate solution in the presence of concentrated hydrochloric acid in which case an extremely sharp end reaction is obtained.

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* " Z. Anal. Chem.," Vol. 8, p. 23, 1869.

FORBES' AND BARTLETT'S EXPERIMENTS.

The application of this process was carried further by Forbes and Bartlett[‡] who used it to determine the end point when chromic acid solutions were titrated with ferrous sulphate. In their experiments a rotating electrode of platinum was placed in the chromic acid solution and connected through a potentiometer to a normal calomel electrode whose syphon completed the electrolytic circuit. On adding ferrous sulphate to the solution it was found that the oxidising potential steadily increased with each addition of ferrous salt followed by stirring and waiting, until a final drop established an actual excess of ferrous ion, whereupon a striking and permanent decrease in the E.M.F. of the cell immediately followed.

The determination of vanadium next received attention, the results of experimental work by G. L. Kelley and J. B. Conant[§] being published and followed by a Paper by the same authors on the determination of chromium and vanadium in steel by electrometric titration.[‖]

The details of the apparatus subsequently described in this article were first published by G. L. Kelley, J. R. Adams and J. A. Wiley[¶] in a Paper entitled "A Convenient Apparatus for Electrometric Titration depending on the Change of Oxidation Potential," and in this Paper its application to the determination of small quantities of chromium in steel was more particularly dealt with.

THE DETERMINATION OF MANGANESE.

The determination of manganese in steel in the presence of chromium and vanadium has been dealt with in a Paper by G. L. Kelley, M. G. Spencer, C. B. Illingworth and T. Gray,[**] in which two modifications of the method for manganese were described and also the results of a study of reactions between permanganic acid and mercurous nitrate.

A rapid method for the determination of chromium in steel was described by G. L. Kelley and W. C. Wright,[††] and the selective oxidation of vanadyl salts by nitric acid in the presence of chromic salts was discussed [‡‡] by G. L. Kelley, J. A. Wiley, R. T. Bohn and W. C. Wright in connection with the determination of vanadium in steel by electrometric titration.

It will thus be seen that Dr. Kelley, who is the chief chemist to the Midvale Steel & Ordnance Company, and his associates have done much to advance the application of electrometric methods to the analysis of special steels.

The success of the methods for the above-mentioned determinations depends on the fact that if platinum and calomel electrodes are placed in an oxidising solution, such as chromic acid, a cell is formed with a definite E.M.F. On adding a reducing agent, such as ferrous sulphate, the change in potential will be small until there is a small excess of the reducing agent when the potential of the cell falls very markedly from its first value. The calomel electrode which makes contact with the oxidising solution through a siphon arm containing a solution of potassium chloride or some other neutral salt, has a constant potential (0·56 volt for normal potassium chloride solution). As this solution does not enter into the reaction, the potential of the calomel electrode remains fixed throughout the reaction, all changes taking place at the platinum electrode.

TITRATION RESULTS.

The results of a titration may be plotted graphically as shown in Figs. 1 and 2, for which a Kelley apparatus and a voltmeter with a range of 1·5 volts were used. For the curves, the E.M.F. readings were plotted as ordinates and c.c.'s of reducing solution as abscissæ. Fig. 1 shows the effect of titrating a solution of potassium bichromate with ferrous sulphate. Two hundred c.c.'s of the bichromate solution containing 0·0678 gramme of chromium, to which was added 25 c.c. of concentrated sulphuric acid were titrated with ferrous sulphate solution of approximately equivalent strength. It will be seen from the curve that with the bichromate solution an E.M.F. of 0·720 volts was obtained. On adding the ferrous sulphate solution slowly this gradually changed to 0·77 (1) when 22·0 c.c. had been added, on adding 0·1 c.c. more at this point the potential fell to 0·76 (2), and a further addition of 0·1 c.c. decreased it to 0·447 (3), showing a drop of 0·313 volts for 0·1 c.c. of reducing solution. This marks the end of the reaction and further additions make little difference.

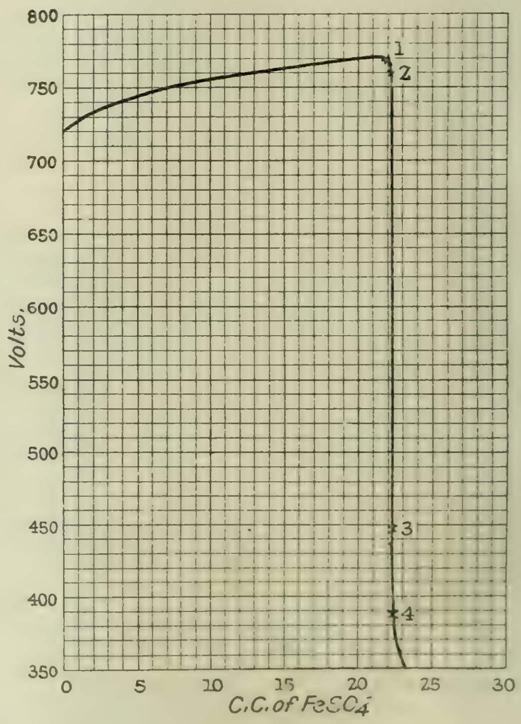

FIG. 1.

Fig. 2 shows the effect of titrating a solution containing 0·021 gramme of chromium with ferrous sulphate, the strength of which was equivalent to 0·001 gramme of chromium per c.c. The portion marked AB shows the result of the first titration of the solution, the difference between the points (1) and (2) corresponding to a change of potential of 0·005 volt brought about by the addition of 0·05 c.c. of ferrous sulphate. The effect of the addition of a further 0·1 c.c. shows a drop of 0·335 volt giving the end point of the reaction. After the addition of a few drops of ferrous sulphate in excess a further quantity of the bichromate solution was added, showing a rise in the voltage to C and then ferrous sulphate, indicated on the curve by CD and again showing a drop in potential between points (1) and (2) of 0·29 volt as the result of the addition of 0·05 c.c. of the reducing solution.

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[*] "Zeit. Physik. Chem.," Vol. 24, p. 253, 1897.

[†] J. H. Hildebrand, J. Amer. Chem. Soc., Vol. 35, p. 847, 1913.

[‡] J. Amer. Chem. Soc., Vol. 35, p. 1,527, 1913.

[§] J. Amer. Chem. Soc., Vol. 38, p. 341, 1916.

[‖] J. of Industrial and Engineering Chemistry, Vol. VIII., p. 719, 1916.

[¶] J. of Industrial and Engineering Chemistry, Vol. IX., p. 780, 1917.

[**] J. of Industrial and Engineering Chemistry, Vol. X., p. 19, 1918.

[††] Iron Age, p. 1,507, 1919.

[‡‡] J. of Industrial and Engineering Chemistry, Vol. XI., p. 632, 1919.

THE APPARATUS USED.

A convenient form of apparatus for carrying out electrometric titrations has been put on the market by Messrs. Arthur H. Thomas Company, West Washington Square, Philadelphia, U.S.A., from whose pamphlets the figures and some of the details for this article have been taken. The outfit shown in Fig. 3 is the result of the work carried out by Dr. G. L. Kelley, mentioned above, in adapting the principles of electrometric titration to commercial methods of steel analysis. After Dr. Kelley's preliminary work[1], the final form of apparatus was designed in the research and engineering departments of Leeds and Northrup Company.

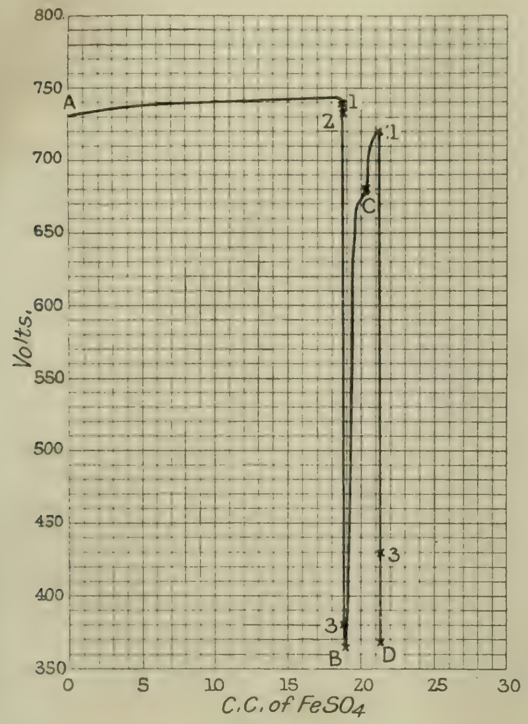


FIG. 2.

The apparatus consists essentially of a wooden case containing two dry cells, an adjustable resistance and a reflecting galvanometer. On the upper surface of the case is a ground glass scale (18) on which the galvanometer readings are taken. Milled heads are provided for adjusting the zero point of the galvanometer and for controlling the resistance and switches for the galvanometer light and motor (12).

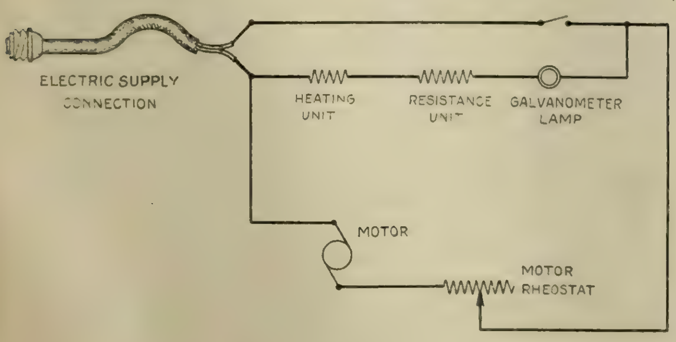


FIG. 4.

Attached to the same stand as the wooden case is an upright standard (13) arranged to carry the burettes (6, 7), electrodes (3, 9), and the motor (10) for stirring the solutions and also a reservoir (5) for the electrolyte.

An adjustable support (1) is provided for the beaker in which the titrations are made.

In using the instrument, the solution to be titrated is placed in the beaker which is then raised and locked in position so that the stirrer (2) is below the liquid. The switch (12) controlling the galvanometer light and motor is then closed. The potentiometer circuit is also closed by means of the other switch (16) and the beam of light is brought on to the scale by an adjustment of the resistance. During the titration, the beam of light is carefully watched until a permanent change of potential is obtained which indicates the end point.

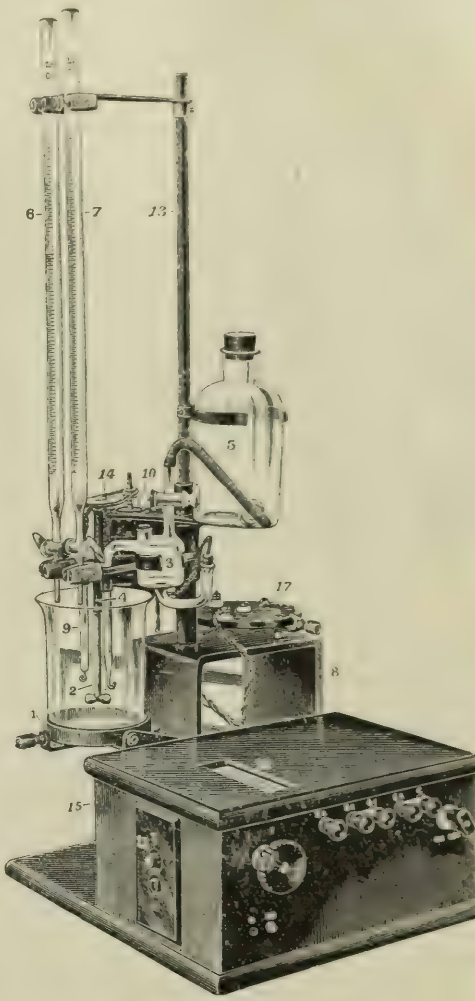


FIG. 3.

Fig 4 shows the electrical connections which may be arranged for a 110-volt circuit either direct or alternating current or for a 220-volt direct-current circuit. This arrangement comprises a heating unit, mounted in a socket on the inside of the box for the purpose of keeping the galvanometer circuit dry and preventing possible leakage due to moisture, a lighting unit for the reflecting galvanometer and a power unit for driving the motor, equipped with a rheostat for variable speeds.

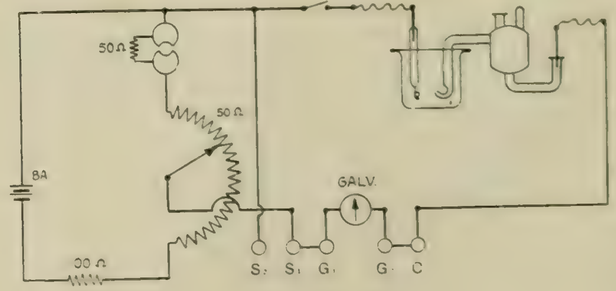


FIG. 5.

Fig. 5 shows the potentiometer circuit which includes two dry cells, resistance, galvanometer, calomel electrode cell and platinum electrode.

Before using the apparatus, the glass tube of the platinum electrode is filled with mercury for contact. The calomel cell is also filled to a depth of about $\frac{1}{4}$ in. with mercury, allowing it to rise to the same height in the tube connected to the bottom of the cell. A thin layer of calomel is then placed over the mercury and the cell is filled with a normal solution of potassium chloride which has been shaken with freshly precipitated calomel and allowing to settle.

Advantages of the Method.

The chief advantages associated with this method of analysis are rapidity, this being of special value where a large number of determinations have to be made, and accuracy, which is of vital importance. In the case of chromium determination, for example, an accuracy to 0·1 per cent. can be obtained with samples containing 20 per cent. chromium and an accuracy of 0·01 per cent. with samples containing from 0·2 to 3·0 per cent. chromium. The fact that deep colours or even turbidity do not interfere with the determinations, owing to the fact that no chemical indicators are necessary, is also important. For works purposes, the fact that highly-trained and skilled chemists are not essential for carrying out accurate determination is also advantageous.

The following are the details of the methods used for the determination of chromium, vanadium and manganese in steel.

Determination of Chromium.

Take 2 grammes for steels containing less than 0·5 per cent. chromium, 1 gramme for steels containing 0·5 to 5 per cent. and 0·25 gramme for steels containing 10 to 20 per cent Dissolve in sulphuric acid (1·2 sp. gr.), 100 c.c. will be required for 2 grammes, 70 c.c. for smaller quantities. It is necessary to break up the carbides and as this is assisted by rapid solution, hot acid may be added to the drillings, and the solution should be evaporated until the salts separate. This is always necessary when there is over 0·5 per cent. of chromium present. The solution is now carefully diluted to 50 c.c. with hot water and whilst boiling, 2 to 3 c.c. nitric acid are added to oxidise the iron. It is desirable that the solution be now evaporated a second time with the salts separate, particularly in case of high chromium steels. The solution is now diluted to 250 c.c. with hot water and to the boiling solution 10 c.c. of silver nitrate solution (2·5 grammes per litre) are added, followed by 20 c.c. of ammonium persulphate solution (100 grammes per litre). In the presence of manganese, the success of this step is indicated by the formation of permanganic acid. The solution is boiled for 8 to 10 minutes and whilst still boiling, 5 c.c. of dilute hydrochloric acid (1 to 3) is added and boiling continued for 5 minutes. The solution is cooled to 20°C. and placed in the beaker for titration. In order to titrate, bring the beam of light from the galvanometer near the left end of the scale and add ferrous ammonium sulphate solution (23 grammes plus 100 c.c. strong sulphuric acid per litre) gradually from the burette until the beam has permanently moved to the right. Chromate solution (2·829 grammes potassium bichromate and 5 grammes sodium carbonate per litre) is now added slowly drop by drop until the beam will move no more to the left. Ferrous ammonium sulphate solution is now again added until one drop produces a small permanent movement to the right. This represents the end point and in order to calculate the result, as 1 c.c. of each solution is equivalent to 0·1 per cent. chromium in a one gramme sample, subtract the number of c.c.'s of chromate solution from the number of c.c.'s of ferrous ammonium sulphate solution and divide by the number of grammes taken and by 10. Before using the solutions mentioned above, they should be titrated against each other and the iron solution adjusted so that 1 c.c. is equivalent to 1 c.c. of the chromate solution.

In the presence of vanadium, this element will be titrated with the chromium, and in this case the vanadium should be determined separately, the result multiplied by 0·339 and subtracted from the chromium plus vanadium figure obtained as above.

Determination of Vanadium.

Take 2 grammes for steels containing less than 0·5 per cent. vanadium, and dissolve in 40 c.c. strong sulphuric acid and 60 c.c. water. When the solution is complete, oxidise by the addition of 3 c.c. strong nitric acid. Boil for a few minutes, dilute to 200 c.c. and add 40 c.c. strong nitric acid. Boil for one hour so that at the end of this time the volume will be between 100 c.c. and 125 c.c. Cool, dilute with ice cold water to 300 c.c. and titrate with ferrous ammonium sulphate solution (8 grammes plus 50 c.c. sulphuric acid per litre). There will first be a gradual fall in potential after which the beam of light will come to rest,on continued addition of ferrous sulphate the light will again move. When this occurs sufficient chromate solution (0·9609 gramme potassium bichromate per litre) is added to bring back the light to its original position, and then the titration is finished with ferrous sulphate solution until a first large movement is obtained, which is the end point. In order to calculate the result, subtract the number of c.c.'s of chromate solution from the number of c.c.'s of ferrous ammonium sulphate solution and divide by the number of grammes taken and by 10, because 1 c.c. of either solution is equivalent to 0·001 gramme vanadium. The method of oxidation given above is found to oxidise 99 per cent. of the vanadium present, therefore the results should be divided by 0·99. In the presence of tungsten, a further correction is necessary because vanadium is occluded by tungstic oxide. With steels containing 11 to 15 per cent. tungsten 0·015 should be added to the percentage found and with steels containing 20 per cent. tungsten, it is necessary to add 0·02 per cent. The ferrous sulphate and chromate solutions should be titrated against each other and the iron solution adjusted to make 1 c.c. equal to 1 c.c. of the chromate solution.

Determination of Manganese.

Take 1 gramme of the steel and dissolve in 50 c.c. nitric acid (sp. gr. 1·13), add 10 c.c. ammonium persulphate solution (100 grammes per litre) and boil until the persulphate is decomposed. Reduce with a saturated solution of sodium thiosulphate, boiling for a further three minutes. Add 50 c.c. of special nitric acid (250 c.c. nitric acid, 750 c.c. water, plus 2 grammes sodium bismuthate) and cool to 20°C. Oxidise with 1 gramme of sodium bismuthate and filter through asbestos, washing with 100 c.c. of special nitirc acid solution (30 c.c. nitric acid, 970 c.c. water plus 1 gramme sodium bismuthate). To the filtrate add 50 c.c. sulphuric acid (sp. gr. 1·58) and sufficient ice to cool to 20 deg. and titrate with mercurous nitrate (10·5 grammes mercurous nitrate in 150 c.c. water, to which 2 c.c. of nitric acid has been added, then the clear solution decanted and made up to 1 litre); the strength of this solution should be adjusted to equal the permanganate solution.

Near the end of the mercurous nitrate titration, successive additions of mercurous nitrate cause the light to leave the scale, after which it returns slowly. Mercurous nitrate should then be added drop by drop until the light remains off the scale. Then add one or two drops of permanganate solution (1·5 grammes potassium permanganate per litre; strength adjusted so that 1 c.c. contains 0·0005 grammes manganese), in order to cause the light to return to its original position, and again titrate until the light is permanently moved at least five large divisions from the original position. In order to calculate the result, subtract the number of c.c.s of permanganate from the mercurous nitrate solution used and divide the figure obtained by 20. With high chromium content, the steel should be dissolved in hydrochloric acid and evaporated three times with nitric acid, and then proceeded with as above.

In the presence of cobalt, it is necessary to separate the manganese.

The Coal, Iron and Steel Industries of South Russia.

By ARTHUR W. RICHARDS.

THE mineral resources of the South of Russia are enormous, but no real effort of a successful nature was made before 1870 to develop the iron industry. Charcoal iron, it is true, was produced in 1834, the output being 170,000 tons, and was protected by an import duty of £6. 10s. a ton, but up to 1851 the output had increased only to 200,000 tons. The Government tried to encourage enterprise, but their attempts were failures. Peter the Great sent geologists to the South to find coal, but it was not until 1784 that coal was really discovered by Capt. Skarnakoff in the Don territory. This discovery induced the Government to build a furnace near Lougansk to smelt local ore, but it never produced any iron. Another attempt was made in 1845 at Kertch, in the Crimea, to produce iron with anthracite, but this, too, failed to mature. In the early fifties a furnace was built near the present Russo-Belgian works at Korsoun, and was called the Petroffski furnace, after Peter the Great, but after making 150 tons of iron the brick lining melted, after which it was abandoned. In 1866 the Government built another furnace at Lisichausk to use coke as fuel, but when the furnace was completed, it was found that the coal available would not coke, and the furnace was shut down after a short run. In 1869 the Government made a concession of about 1,000 acres of land in the Donetz basin to John Hughes, an Englishman, for the purpose of building an ironworks, the conditions being that the Government undertook to pay a subsidy of £3. 5s. a ton on rails up to 5,000 tons a year until 1881, in return for which the works had to undertake to make not less than 100 tons of iron per week, and supply the Government with not less than 2,000 tons of coal a year, from coal properties bordering on their concession. The company was registered in England with a capital of £300,000, under the title of the New Russia Company. After great difficulties the works were erected, and in 1874 were successful in producing 7,000 tons of iron per annum. In 1887 the New Russia Company was making 50,000 tons of iron a year, which attracted new capital to the country, as the Krivoi Rog ore deposits were then connected by railway with the Donetz coalfields. In that year the Briausk Company started their Alexandrovsk works in Ykaterinvoslev; two years later the Kamenskoi works of the Dnieprovienne Company started near the same town. In later years between 3,000,000 and 4,000,000 tons of iron were produced in South Russia.

Coal.

The Donetz basin contains every variety of coal of excellent quality, besides limestone, dolomite, iron ore, refractories, &c.; it is, in fact, one of the principal coalfields of the world, and has practically inexhaustible supplies. It was at Grousheffka, in 1840, that the first coal was really worked. This was anthracite, and in 1888 only 500,000 tons were produced. It was the iron and steel development which stimulated the coal industry, so that in 1912 21,000,000 tons were raised. In 1881 coal was selling in the Donetz basin at 5s. a ton. The coalfield covers great areas within the following places: Lisichausk, in the north west; Elenoffka, in the south west; Grachi, in the north east; and Alexandra Groucheffka, in the south east. The strata dips north and south alternately, and the dip of the seam varies from a few degrees from the horozontal to nearly 90 deg., as the fold of the strata is undulating or steep. Numerous seams are worked, varying in thickness from 2 ft. to 7 ft. The French and Belgians own nearly one-half of the whole of the bituminous coal mines of the Donetz, and will restart their mines as soon as it is possible, and intend to find all the capital necessary. In the Caucasus large deposits of coal and iron ore occur, but are quite undeveloped for want of capital for railways.

Coke Ovens.

Nearly every important colliery company has large installations of coke ovens, the coke being used either at blast furnaces affiliated to the colliery company, or by arrangement to certain metallurgical works, who take the whole output. There is likewise a large demand for coke in the open market for foundries, &c. The ovens are arranged in batteries of 100 to 200 ovens, with by-product recovery plants for the recovery of sulphate of ammonia, and there are several benzol plants. The system mostly used is the Coppée. The Coppée Company has built several large batteries of ovens in Russia on payment by the instalment system, the ovens with their by-product plants being built free of charge, and the by-products being taken as payment over periods ranging up to 14 years or more. Some plants are incompleted, and others were completed but have never been worked. The regenerative oven is not used. The gas from the ovens goes to heat the boilers, and also to the by-product plants. The Lancashire boiler has been largely superseded by the tubular boiler, especially where gas and coal are both burned under the same boiler, great economies being the result. The first by-product plant started in 1908, and in 1912 the output of sulphate of ammonia had risen to 4,000 tons, tar 19,000 tons, pitch 4,700, and heavy oils 3,760 tons. The coke produced in 1912 amounted to 3,800,000 tons.

Iron Ore.

The first ironworks depended on local ores, which exist in pockets, and were phosphoric, containing 40 to 50 per cent. of iron. These ores made excellent foundry iron. The Krivoi Rog ores were known to exist in 1835, but it was not until 1886 that the Government was induced to construct the railway to the Donetz basin. The main deposit is a pure hæmatite, and occurs as lenticular inclusions up to 130 ft. thick between layers of hard silicate of iron. The ore contains from 54 to 68 per cent. of iron. It outcrops for about 50 miles over a more or less continuous line, which runs north east-south west along the two rivers, Saxagan and Tugouletz. The ore has generally been worked open cast at depths up to 600 ft., but recourse has had to be made to underground working, and at greater depths the ore is even richer, and has not shown any sign of tapering out. In 1912 5,250,000 tons of ore were raised at Krivoi Rog, of which 4,400,000 tons were smelted in the south, and the rest exported, mostly to Germany.

Manganese Ore.

Besides the world-famous Caucasian ores, which for 10 years (up to 1913) had an average output of 195,000 tons per annum, there exist important manganese mines at Nikopol, on the Dnieper River, which produced in 1912, 240,000 tons, or an average for 10 years (to 1913) of 195,000 tons. They were discovered in 1885, and the ore is interstratified with wet clay, and lies as a nearly horizontal deposit, from a few inches in thickness up to 11 ft., on a bed of granite, covered by tertiary and alluvial deposits. The ore occurs at depths varying from 30 ft. to 200 ft., and when brought to the surface is mixed with the wet clay and has hard lumps in it, which have to be crushed. The whole is then washed, and the resulting product is as rich as the Caucasian ore. The ore is won by small temporary shafts, which are sunk to the seam from which narrow roads are driven from the pit bottom in several directions. The ore is taken out, starting from the boundary, and the roof is allowed to fall in behind as the ore is extracted. As soon as the ore is all taken out new shafts are sunk on an adjoining area.

Iron and Steel Works.

Very large and very important iron and steel works exist in Russia. The only British owned works were those of the New Russia Company, which were sold over two years ago to Russian interests. For a long time they were the foremost and largest works in Russia, but French and Belgian capital, which controls most of the iron industry in South Russia, extended their works, and spent enormous sums of money, as the industry proved highly remunerative. These undertakings soon, therefore, surpassed, in importance, the New Russia works. The blast furnaces produced up to 2,000 tons per unit per week, working entirely on Krivoi Rog ore, and as much of the ore is small the coke consumption is higher than is usual with so pure a hæmatite. Many processes of briquetting the ore and the dust formed have been introduced, but not with any great success. The blast furnaces produce hæmatite and basic pig, as well as ferro-manganese, spiegel and silico-spiegel.

The cleaning of the gas is a great problem, as the blast furnaces often " slip," and eject enormous volumes of dust. Zig-zagging of the gas tubes has been much adopted, and where there are gas engines the system used is wet cleaning. Where gas engines have been installed for blowing the blast furnaces they have given a lot of trouble. In a country like Russia complicated machinery is most difficult to maintain, for no sooner is a gang of men trained to special work than they leave, either to farm their own land or for other reasons. They constitute, indeed, a very shifting population. The turbo-blower has met with much success and has superseded the steam blowing engine. Molten iron is taken either to mixers or direct to open-hearth furnaces for steel making, the basic open hearth predominating, as several of the ores from Krivoi Rog are phosphoric near the surface, making the iron too high in phosphorus for the acid open hearth process. Fully 60 per cent. of the ores are, however, very low in phosphorus, and the acid Bessemer process is worked in several of the works. At the Kertch works the basic Bessemer process was employed, as the iron produced from local ores contains 1½ per cent. phosphorus.

Electrical Developments.

Very important installations of electrical power have been made in South Russia, both at the collieries and at the works. Every colliery has its power station, electricity being often generated in mixed-pressure turbines. Exhaust steam is used from the winding engines, and the remainder made up by steam from boilers heated by waste heat from the coke ovens and by coke oven gas. The units generally do not exceed 2,000 kw. At the iron and steel works electricity is generated from exhaust steam turbines, and the author was introducing 5,000 kw. sets when the war stopped all such work. The polyphase system is practically universal. Electric winding at collieries has not been adopted at all, and electric driving of rolling mills has made very little progress, one or two mills only having been altered to this system. In the iron and steel works it is not likely that any extensions will be made to power plants for a long time to come. To begin with, there is the troubling question of capital, machinery being so much more expensive than before the war, and, secondly, most of the works are on the coalfield, and as the coal will be raised for a long time to come more cheaply in the Donetz basin than anywhere else in Europe, the works will make the best use of the plant they have

Having regard to the question of transport in Russia, this has practically vanished, and recourse will probably be had to electricity whenever coal has to be sent any appreciable distance. The ore supply, for example, is a long way from the coal, and in normal times was about 12 hours' distant by train from the coal capital of the south—Touzowka—so that the haulage of coal to the mines is over a great distance and very expensive. The author had arranged, and the scheme was sanctioned by his board, to electrify the mine belonging to the works where he was consultant , as a great saving could have been effected not only in fuel, but in general convenience of working, but the war interfered with these plans. In 1912 it was proposed to erect some of the largest power stations in the world in the Donetz basin for supplying power to the outlying collieries and mines, including the anthracite collieries, at a distance of about 30 miles from Touzowka. With the difficulty of transport in the country such schemes will become realities in some districts of Russia.

Costs of Production.

Coal, iron and steel have been produced in Russia at low cost, and, as an instance, the author well remembers that about 15 years ago many thousands of tons of heavy steel rails were *delivered* in London for English railways at £4. 10s. per ton, a lower price than that quoted by any British firm or any other foreign country.

Some General Information.

The industries of Russia have for the present ceased. A few coal mines are being worked by the Soviets, but practically all the iron and steel works, as well as the collieries, are idle, and, as timber is very scarce, the result is that the people are without fuel in their houses ; the coming winter, therefore, means further privation and starvation for all classes. For those who are not conversant with what has been happening in Russia since the Revolution, it may seem strange that the mines and the whole of the iron and steel works are closed down, but it is quite simply explained. In one day after the Revolution commenced the whole of the police system in the country was abolished, and power was taken over by the people. They began to ask for shorter hours and larger wages, which they easily got. They got, indeed, anything they liked to demand, until one colliery after another and one iron and steel works after another exhausted their resources and shut down. It is a great mistake to suppose, however, that the mines and works have been destroyed ; this is not the fact, they remain intact.

To regain the friendship of Russia, and to capture her trade, it is well known to those who understand Russia, that Germany will make very great efforts, and has, in fact, already made elaborate plans to re-establish herself in the country. Germany always supplied whatever Russia required on the credit system, and is prepared to do so again for definite concessions. Generally British manufacturers require payment quickly for what they supply, especially when there is plenty of demand for their output, and they are not prepared to give long credits. Russia is in a desperate condition, and has very little money, and must trade with those countries which offer her the easiest terms. Whichever country comes first to her aid will receive her friendship and alliance ; she feels deserted, and is convinced that Germany is her only friend. The question is complicated, but in the author's opinion arrangements could be made to supply what Russia requires, and Russia could pay for such goods supplied by barter trade. Up to the present this has presented many difficulties, as so many people advance the view that Russia has nothing to export. But Russia is a very rich country, and has ample exportable material ; all she requires is assistance to re-establish her industries, whereupon she can export, for instance, coal, which was formerly all required for the various works. Certain it is that the country which first goes to her aid and gives her a start, and is willing to supply what she requires on easy terms, will reap the bulk of her trade in the future.

The cloud which now overhangs Russia must and will disappear, and she will become again a very powerful and rich country. She will eventually find the means to pay for what she requires out of her magnificent natural resources ; in fact, the author is interested in a scheme to restart her industries, and so help her pay for what she receives. It is a pity that the country is so little understood by the British trader generally, but those who have the courage to trade there in the future should receive a rich reward, besides cementing the friendship which already exists between the two countries, but which a policy of *laissez-faire* is sooner or later bound to impair and to divert to channels prejudicial to British interests

Motor Equipment for Main Drive of Rolling Mills.

We give below particulars of electrically-driven rolling mills in so far as such data has been supplied to us :

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Steel, Peech & Tozer	Continuous billet	5000/12000	92	3 ph., 6300 v., 50 cyc.	Gear	B.T.H.
Whitecross Co.	Wire rod	2000/4700	490	3 ph., 2000 v., 50 cyc.	Rope & gr.	B.T.H.
Steel, Peech & Tozer	Slab	1200/3000	240	3 ph., 6300 v., 50 cyc.	Gear	B.T.H.
S. African Steel Union Corporation	3 high	750/1800	365	3 ph., 525 v., 50 cyc.	Rope	B.T.H.
Govt. Rolling Mills, Southampton	24 in. & 20 in. sheet	750/1600	266	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
Elliott Metal Co.	Sheet	700/1450	120	3 ph., 440 v., 25 cyc.	Rope & gr.	B.T.H.
F. Smith & Co.	Roughing & finishing rod	650/1400	365	3 ph., 2200 v., 50 cyc.	Rope drct.	B.T.H.
Andrews & Co.	9 in. rod (finishing)	650/1300	650	3 ph., 3300 v., 50 cyc.	Direct	B.T.H.
Melingriffith Co.	24 in. sheet (three mills)	550/1500	360	3 ph., 2200 v., 25 cyc.	Gear	B.T.H.
Babcock & Wilcox	Tube piercing	550/1400	290	3 ph., 400 v., 25 cyc.	Gear	B.T.H.
Birmingham Corrugated Iron Co.	28 in. sheet (two mills)	350/1400	730	3 ph., 440 v., 50 cyc.	Gear	B.T.H.
Upper Forest & Worcester S. & T. Co.	24 in. sheet (four mills)	550/1300	210	3 ph., 3300 v., 50 cyc.	Gear	B.T.H.
Upper Forest & Worcester S. & T. Co.	24 in. sheet (four mills)	550/1100	210	3 ph., 3300 v., 50 cyc.	Gear	B.T.H.
Upper Forest & Worcester S. & T. Co.	24 in. sheet (four mills)	550/1100	210	3 ph., 3300 v., 50 cyc.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	20 in. & 18 in. sheet	500/1100	292	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
Weldless Steel Tube Co.	Tube piercing	500/1200	730	2 ph., 2700 v., 50 cyc.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	20 in. & 18 in. sheet	500/1000	292	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
F. Smith & Co.	Draw benches	400/1000	730	3 ph., 2200 v., 50 cyc.	Gear	B.T.H.
Andrews & Co.	14 in. roughing	400/900	730	3 ph., 3300 v., 50 cyc.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	18 in. sheet	400/800	332	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
Govt. Rolling Mills, Southampton	16 in. & 15 in. sheet	400/800	332	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
Babcock & Wilcox	Tube rolling	375/800	104	3 ph., 400 v., 25 cyc.	Gear	B.T.H.
Stewart & Lloyds	20 in. sheet (3 stands)	350/900	360	3 ph., 400 v., 25 cyc.	Rope & gr.	B.T.H.
Munition Factory, Birmingham	30 in. & 24 in. sheet	300/1000	360	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
T. Bolton & Sons	Slabbing and sheet	300/750	580	3 ph., 400 v., 50 cyc.	Gear	B.T.H.
Elliott Metal Co.	Sheet	300/690	360	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	15 in. & 12 in. sheet	300/600	322	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
Govt. Rolling Mills, Southampton	Sheet	300/600	322	3 ph., 3300 v., 50 cyc.	Rope & gr.	B.T.H.
Andrews & Co.	14 in. intermediate	300/600	210	3 ph., 3300 v., 50 cyc	Direct	B.T.H.
Tubes, Limited	Tube rolling	300/600	290	3 ph., 5000 v., 25 cyc.	Rope	B.T.H.
Tubes, Limited	Hydraulic piercing	260/800	485	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Tubes, Limited	Tube piercing	250/720	730	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Tubes, Limited	Tube piercing	250/720	730	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Tubes, Limited	Tube piercing	250/720	730	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Munition Factory, Birmingham	24 in. & 18 in. sheet	250/650	360	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Babcock & Wilcox	Tube piercing	250/600	730	3 ph., 400 v., 25 cyc.	Gear	B.T.H.
Munition Factory, Birmingham	Sheet	250/550	290	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Muntz Metal Co.	Tube piercing	250/500	480	2 ph., 440 v., 50 cyc.	Gear	B.T.H.
Muntz Metal Co.	Tube rolling	250/500	480	2 ph., 440 v., 50 cyc.	Gear	B.T.H.
Aluminium Corporation	Sheet	250/500	415	3 ph., 440 v., 50 cyc.	Rope	B.T.H.
Jones & Colver	Rod	200/500	485	2 ph., 200 v., 50 cyc.	Belt	B.T.H.
Perfecta Tube Co.	Pilger	200/400	360	3 ph., 440 v., 25 cyc.	Rope	B.T.H.
Babcock & Wilcox	Pilger	180/360	360	3 ph., 400 v., 25 cyc.	Rope	B.T.H.
Dorman, Long & Co.	Continuous rod	150/325	360	3 ph., 440 v., 40 cyc.	Gear	B.T.H.
Dorman, Long & Co.	Continuous rod	150/325	470	3 ph., 440 v., 40 cyc.	Gear	B.T.H.
Dorman, Long & Co.	Continuous rod	150/325	780	3 ph., 440 v., 40 cyc.	Gear	B.T.H.
Oldbury Rolling Mills	9 in. rghng. & 7 in. finshg.	150/300	360	3 ph., 400 v., 25 cyc.	Rpe. & dir.	B.T.H.
Munition Factory, Birmingham	Sheet	125/250	490	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Elliott Metal Co.	Sheet	100/200	490	3 ph., 440 v., 25 cyc.	Gear	B.T.H.
Cammell, Laird & Co.	Sheet	100/200	360	3 ph., 440 v., 25 cyc.	Gear	B.T.H
Tupper & Co.	Rod	80/160	475	2 ph., 200 v., 50 cyc.	Belt	B.T.H.
Govt. Rolling Mills, Southampton	12 in. finishing	50/100	480	3 ph., 440 v., 50 cyc.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	12 in. finishing	50/100	480	3 ph., 440 v., 50 cyc.	Gear	B.T.H.
Govt. Rolling Mills, Southampton	8 in. finishing	40/80	715	3 ph., 440 v., 50 cyc.	Gear	B.T.H.
Heeley Silver Mills	Cold rolls	30/60	725	2 ph., 200 v., 50 cyc.	Gear	B.T.H.
Dorman, Long & Co.	28 in. cogging	1200/3600	90	3 ph., 400 v.	Direct	B.T.H.
Dorman, Long & Co.	Wire rod	1250/2500	120/180	460 v. d.c.	Gear & blt.	B.T.H.
Partington Steel & Iron Co.	20 in. 3 high roughing	1200/3000	55/90	500 v. d.c.	Direct	B.T.H.
Partington Steel & Iron Co.	18 in. 3 high intermediate	1200/3000	90/180	500 v. d.c.	Direct	B.T.H.
Partington Steel & Iron Co.	18 in. 3 high finishing	1200/3000	90/180	500 v. d.c.	Direct	B.T.H.
Blaenavon Co.	Tyre finishing	1000/2000	175/350	460 v. d.c.	Gear	B.T.H.
Looke, Lancaster & Co.	Sheet	440/880	660	460 v. d.c.	Gear	B.T.H.
Glengarnock Iron & Steel Co.	12 in. guide	350/700	130/170	440 v. d.c.	Direct	B.T.H.
Metal Mfg. Co.	Tube piercing	200/400	500	250 v. d.c.	Gear	B.T.H.
London	Special	150/300	480	440 v. d.c.	Gear	B.T.H.
Gravesend Steel & Tinplate Co.	Cold rolls	75/200	200/300	220 v. d.c.	Gear	B.T.H.
Gravesend Steel & Tinplate Co.	Special	75/150	500	440 v. d.c.	Gear	B.T.H.
Neville Druce	Sheet	62/124	525/600	500 v. d.c.	Gear	B.T.H.
Neville Druce	Special	50/100	600	440 v. d.c.	Gear	B.T.H.
Dorman, Long & Co.	42 in. reversing plate	6000/20500	40/70	3 ph., 2750 v., 40 cyc.*	Direct	B.T.H.
Steel, Peech & Tozer	36 in. reversing cogging	6000/15500	48/100	3 ph., 6300 v., 50 cyc.*	Direct	B.T.H.
Dorman, Long & Co.	29 in. reversing plate	4000/12000	50/100	3 ph., 2750 v., 40 cyc.*	Direct	B.T.H.
Dorman, Long & Co.	28 in. reversing cogging	1200/3600	70/90	3 ph., 2750 v., 40 cyc.*	Direct	B.T.H.
John Brown & Co.	24 in. reversing cogging	600/1800	117/170	3 ph., 6600 v., 50 cyc.*	Gear	B.T.H.
Patent Shaft & Axletree Co.	Special	250/500	90/180	3 ph., 5000 v., 50 cyc.*	Direct	B.T.H.
Locke, Lancaster & Co.	21 in. sheet	125/300	200	460 v. d.c.	Gear	B.T.H.
F. Smith & Co.	Copper rod	950/1900	375	3 ph., 6500 v., 50 cyc.	Rope	B.T.H.
Hadfield's, Sheffield	14 in. finishing	500/1000	75/150	230 v. d.c.	Direct	B.T.H.
Hadfield's, Sheffield	11 in finishing	400/800	150/250	230 v. d.c.	Direct	B.T.H.
Hadfield's, Sheffield	28 in. cogging	3200/11600	60/120	3 ph., 3000 v., 50 cyc.	Direct	B.T.H.
O. B. Jacobsen	Sheet	400/950	480	3 ph., 500 v., 50 cyc.*	Gear	B.T.H.
O. B. Jacobsen	Sheet	350	415	3 ph., 500 v., 50 cyc.	—	B.T.H.

* With flywheel motor-generator sets.

Motor Equipment for Main Drive of Rolling Mills—*continued.*

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
United Steel Cos., Ltd.	Hoop (roughing)	1500/805	325/175	3 ph., 6300 v., 50 cyc.†	Gear	B.T.H.
United Steel Cos., Ltd.	Hoop (intermediate)	100/50	500/300	230 v. d.c.	Gear	B.T.H.
United Steel Cos., Ltd.	Hoop (finishing)	2500/1670	240/160	3 ph., 6300 v., 50 cyc.†	Gear	B.T.H.
United Steel Cos., Ltd.	Merchant	3000	470/280	3 ph., 6300 v., 50 cyc.†	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	200/400	500	250 v. d.c.	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	200/400	500	250 v. d.c.	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	400/800	489	3 ph.,400/400 v.,50 cyc	Gear	B.T.H.
Phillips, Gilbert & Co.	Piercing	400/800	489	3 ph.,400/440 v.,50 cyc	Gear	B.T.H.
Armstrong, Whitworth & Co.	Light sheet steel	650/2500	200	6,600 v., 50 cyc., and 500 v. d.c.*	Gear	Lancs. D. & M. Co.
Hanson, Dales & Co.	Lead	150	600	345 v., "Lancs." drv.	Dir. cpld.	Lancs. D. & M. Co.
Walker, Parker & Co.	Lead	150	600	420 v., "Lancs." drv.	Dir. cpld.	Lancs. D. & M. Co.
Walker, Parker & Co.	Lead	100	400	460 v., "Lancs." drv.	Gear	Lancs. D. & M. Co.
Armstrong, Whitworth & Co.	Tool steel (non-reversing)	120	400/475	500 v. d.c.	Gear	Lancs. D. & M. Co.
Blaenavon Co.	Steel tyres (non-reversing)	300	300	460 v. d.c.	Gear	Lancs. D. & M. Co.
Blaenavon Co.	Steel tyres (non-reversing)	300	300	460 v. d.c.	Gear	Lancs. D. & M. Co.
Darlington Rolling Mills Co.	Steel bars (non-reversing)	1000/1300	200	440 v. d.c.	Rope	Lancs. D. & M. Co.
Smith & McLean	Steel sheets (non-revers.)	400	120/200	500 v. d.c.	Gear	Lancs. D. & M. Co.
Taylor Bros.	Steel wheels (non-revers.)	530/800	300/600	250 v. d.c.	Gear	Lancs. D. & M. Co.
Bibby & Co.	Copper (non-reversing)	100	360/480	460 v. d.c.	Rope	Lancs. D. & M. Co.
British Insulated & Helsby Cables Co.	Copper (non-reversing)	400	350/400	240 v. d.c.	Rope	Lancs. D. & M. Co.
Broughton Copper Co.	Copper (non-reversing)	300	350/400	500 v. d.c.	Rope	Lancs. D. & M. Co.
G. Adams & Sons	Non-reversing	200	415	2700 v., 50 cyc.	Rope	Lancs. D. & M. Co.
Chesterfield Tube Co.	Tube (non-reversing)	150	240	440 v., 50 cyc.	Gear	Lancs. D. & M. Co.
Earle, Bourne & Co.	Non-reversing	600	240	5000 v., 25 cyc	Dir. cpld.	Lancs. D. & M. Co.
Earle, Bourne & Co.	Non-reversing	450	360	5000 v., 25 cyc.	Dir. cpld.	Lancs. D. & M. Co.
Earle, Bourne & Co.	Non-reversing	200	360	5000 v., 25 cyc.	Dir. cpld.	Lancs. D. & M. Co.
Earle, Bourne & Co.	Non-reversing	225	360	2750 v., 50 cyc.	Dir. cpld.	Lancs. D. & M. Co.
Low Moor Iron Co.	Bar (non-reversing)	250	243	1000 v., 50 cyc.	Rope	Lancs. D. & M. Co.
Low Moor Iron Co.	Bar (non-reversing)	400	480/375	1000 v., 50 cyc.	Rope (cascade set)	Lancs. D. & M. Co.
Low Moor Iron Co.	Bar (non-reversing)	175	243	1000 v., 50 cyc.	Rope	Lancs. D. & M. Co.
J. Reynolds & Sons	Non-reversing	80	480	400 v., 25 cyc.	Gear	Lancs. D. & M. Co.
Skinningrove Iron Co., Ltd.	Reversing, roughing & fng.	19000	140	465 v. d.c.	Direct	English Elec. Co.
Skinningrove Iron Co., Ltd.	Reversing, cogging	12000	120	550 v. d.c.	Direct	English Elec. Co.
Cammell Laird & Co.	Reversing, roughing & fng.	19000	150	465 v. d.c.	Direct	English Elec. Co.
Wellman Seaver Rolling Mill Co.	Reversing, cogging	12000	120	650 v. d.c.	Direct	English Elec. Co.
Scottish Iron & Steel Co., Ltd.	Reversing, cogging	6380	175	630 v. d.c.	Direct	English Elec. Co.
Monmouthshire Steel & Tinplate Co.	Reversing (finishing)	5300	140	600 v. d.c.	Direct	English Elec. Co.
Elliott's Metal Co., Ltd.	Reversing copper plate	890	105	400 v. d.c.	Gear	English Elec. Co.
Birmingham Mint	Reversing copper plate	780	500	400 v. d.c.	Gear	English Elec. Co.
Birmingham Battery & Metal Co., Ltd.	Reversing copper plate	450	210	435 v. d.c.	Gear	English Elec. Co.
Manganese, Bronze & Brass Co.	Extruding press	240	400	500 v. d.c.	Gear	English Elec. Co.
Mond Nickel Co., Ltd.	Reversing 2 stand	1200	100	450 v. d.c.	Direct	English Elec. Co.
David Colville & Sons, Ltd.	3 high plate	12000	0/120	680 v. d.c. supplied from flywheel m.g.	Direct	English Elec. Co.
David Colville & Sons, Ltd.	Merchant	400	200/100	220 v. d.c.	Direct	English Elec. Co.
David Colville & Sons, Ltd.	Merchant (finishing)	400	150/300	220 v. d.c.	Direct	English Elec. Co.
David Colville & Sons, Ltd.	Merchant (rfg.)	250	90/150	220 v. d.c.	Direct	English Elec. Co.
Richard Johnson & Nephew, Ltd.	Wire	2750	500	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
Richard Johnson & Nephew, Ltd.	Wire	750	750	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
Richard Johnson & Nephew, Ltd.	Wire	750	750	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
Kayser, Ellison & Co.	Wire	1200	245/365	3 ph., 500 v., 50 cyc.	Rope	English Elec. Co.
Kayser, Ellison & Co.	Cogging	375	375	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.
Eston Sheet & Galvanising Co., Ltd.	Sheet	1060	200	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
Bolchow Vaughan & Co., Ltd.	Sheet	1060	200	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
Cargo Fleet Iron Co., Ltd.	Merchant	1000	150/75	3 ph., 2750 v., 40 cyc. (variable speed set)	Direct	English Elec. Co.
Elliott's Metal Co.	Copper	1000	250	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Birmingham Metal & Munitions Co., Ltd.	Sheet	750	187	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Monmouthshire Steel & Tinplate Co.	Cogging	750	75	3 ph., 2750 v., 25 cyc.	Direct	English Elec. Co.
Baldwins, Ltd.	Hot tinplate	600	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Hot tinplate	600	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Hot tinplate	600	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Cold rolls	440	150	3 ph., 2100 v., 50 cyc.	Rope	English Elec. Co.
Baldwins, Ltd.	Cold rolls	300	250	3 ph., 2100 v., 50 cyc.	Rope & gr.	English Elec. Co.
Darlington Rolling Mills Co., Ltd.	Rail	600	270/450	460 v. d.c.	Rope	English Elec. Co.
Darlington Rolling Mills Co., Ltd.	Merchant	450	110/247	460 v. d.c.	D.C. & R.	English Elec. Co.
Darlington Rolling Mills Co., Ltd.	Forge train	250	300/450	460 v. d.c.	Rope	English Elec. Co.
Darlington Rolling Mills Co., Ltd.	Forge train	250	300/450	460 v. d.c.	Rope	English Elec. Co.
Monks, Hall & Co., Ltd.	Wire (finishing)	550	400/530	500 v. d.c.	Direct	English Elec. Co.
Monks, Hall & Co., Ltd.	Wire (roughing)	400	200/300	500 v. d.c.	Direct	English Elec. Co.
Monks, Hall & Co., Ltd.	Merchant	400	92/125	500 v. d.c.	Direct	English Elec. Co.
Raine & Co., Ltd.	Rail	600	60/120	500 v. d.c.	Direct	English Elec. Co.
Raine & Co., Ltd.	Merchant (roughing)	400	80/160	500 v. d.c.	Direct	English Elec. Co.
Raine & Co., Ltd.	Merchant (finishing)	400	60/250	500 v. d.c.	Direct	English Elec. Co.
Tubes, Ltd.	Tube	375	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	200	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	200	375	3 ph., 5000 v., 25 cyc.	Rope	Elngish Elec. Co.
Tubes, Ltd.	Tube	170	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	170	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	170	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Tubes, Ltd.	Tube	150	480/360	460 v., 25 cyc. d.c.	Belt	English Elec. Co.
Tubes, Ltd.	Tube	80	600/700	460 v., 25 cyc. d.c.	Belt	English Elec. Co.

* With flywheel motor-generator sets. † Induction motor drives with speed regulating sets.

Motor Equipment for Main Drive of Rolling Mills—*continued.*

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r p m.			
Howell & Co., Ltd.	Pilger tube	350	300/428	3 ph., 3000 v., 50 cyc.	Dir. cpld.	English Elec. Co.
Howell & Co., Ltd.	Tube	250	585	3 ph., 3000 v., 50 cyc.	Dir. cpld.	English Elec. Co.
Howell & Co., Ltd.	Tube	110	600	3 ph., 3000 v., 50 cyc.	Dir. cpld.	English Elec. Co.
Howell & Co., Ltd.	Tube	75	600	3 ph., 500 v., 50 cyc.	Dir. cpld.	English Elec. Co.
John Brown & Co.	Tyre	1350	500	3 ph., 6600 v., 50 cyc.	Gear	English Elec. Co.
John Brown & Co.	Tyre	600/1200	500	3 ph., 6000 v., 50 cyc.	Gear	English Elec. Co.
John Brown & Co.	Bar	200	450/200	230 v. d.c.	Rope	English Elec. Co.
John Brown & Co.	Bar	200	450/200	230 v. d.c.	Rope	English Elec. Co.
Corrugated Iron Co., Widnes	— —	600	585	3 ph., 440 v., 50 cyc.	—	English Elec. Co.
Monkbridge Iron Co., Ltd.	Tyre	600	500	2 ph., 2000 v., 50 cyc.	Direct	English Elec. Co.
Monkbridge Iron Co., Ltd.	Tyre	300	500	2 ph., 2000 v., 50 cyc.	Direct	English Elec. Co.
English McKenna Process Co., Ltd.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co., Ltd.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co., Ltd.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co., Ltd.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co., Ltd.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co., Ltd.	Rail	500	280	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
English McKenna Process Co., Ltd.	Merchant	350	250/125	3 ph., 400 v.	Direct	English Elec. Co.
John Williams	Merchant	500	300	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
Sheffield Forge & Rolling Mills Co., Ltd.	Merchant	500	88	3 ph., 3300 v., 50 cyc.	Direct	English Elec. Co.
Sheffield Forge & Rolling Mills Co., Ltd.	Merchant	350	125	3 ph., 3300 v., 50 cyc.	Direct	English Elec. Co.
Sheffield Forge & Rolling Mills Co., Ltd.	Sheet	250	375	2 ph., 2000 v., 50 cyc.	Gear	English Elec. Co.
Sheffield Forge & Rolling Mills Co., Ltd.	Merchant	300	500	2 ph., 3300 v., 50 cyc.	Gear	English Elec. Co.
Sheffield Forge & Rolling Mills Co., Ltd.	Merchant	150	500	2 ph., 3300 v., 50 cyc.	Gear	English Elec. Co.
Waterloo Tinplate Co., Ltd.	Hot	500	214	500 v. d.c.	Gear	English Elec. Co.
Waterloo Tinplate Co., Ltd.	Cold	225	300	500 v. d.c.	Gear	English Elec. Co.
Bowesfield Steel Co.	Sheet	750	194	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
Weldless Steel Tube Co.	Tube	340	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Weldless Steel Tube Co.	Tube	340	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Weldless Steel Tube Co.	Tube	150	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Weldless Steel Tube Co.	Tube	150	750	2 ph., 2750 v., 50 cyc.	Gear	English Elec. Co.
Barrow Hematite Steel Co., Ltd.	Merchant	360	85/200	440 v. d.c.	Direct	English Elec. Co.
Barrow Hematite Steel Co., Ltd.	Hoop	375	230/350	440 v. d.c.	Direct	English Elec. Co.
Barrow Hematite Steel Co., Ltd.	Planishing	340	230/350	440 v. d.c.	Direct	English Elec. Co.
Barrow Hematite Steel Co., Ltd.	Roughing	400	270/600	440 v. d.c.	Gear	English Elec. Co.
Barrow Hematite Steel Co., Ltd.	Finishing	400	270/600	440 v. d.c.	Gear	English Elec. Co.
Dorman Long	Sheet	1800	200	3 ph., 2750 v., 40 cyc.	Rope	English Elec. Co.
Beardmore & Co., Glasgow	Three high plate	3000	375	3 ph., 3300 v., 25 cyc.	Gear	English Elec. Co.
J. B. & S. Lees	Strip mill	380	200/350	500 v. d.c.	Rope & dir	English Elec. Co.
J. B. & S. Lees	Strip mill	338	200/350	500 v. d.c.	Direct	English Elec. Co.
Brown Bayley's Steel Works, Ltd.	Merchant	400	85/200	460 v. d.c.	Direct	English Elec. Co.
Brown Bayley's Steel Works, Ltd.	Merchant	2000	80/150	460 v. d.c.	Direct	English Elec. Co.
Improved Steel Co.	Roughing	600	500	2 ph., 2700 v., 50 cyc.	Gear	English Elec. Co.
Improved Steel Co.	Finishing	600	600/340	2 ph., 2700 v., 50 cyc.	Gear	English Elec. Co.
Wm. Bain & Co., Ltd.	Merchant	350	300/100	3 ph., 440 v., 25 cyc.	Direct	English Elec. Co.
Guest, Keen & Nettlefolds, Ltd.	—	275	375	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Guest, Keen & Nettlefolds, Ltd.	—	200	750	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Guest, Keen & Nettlefolds, Ltd.	—	175	375	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Guest, Keen & Nettlefolds, Ltd.	—	100	375	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
Birmingham Battery & Metal Co., Ltd.	Piercer mill	300	600	440 v. d.c.	Direct	English Elec. Co.
Birmingham Battery & Metal Co., Ltd.	—	120	550	440 v. d.c.	Dir. cpld.	English Elec. Co.
Nederlandsche Kabelfabrick Delft. Holl.	Copper mill	300	375	3 ph., 220 v., 50 cyc.	Direct	English Elec. Co.
Charles Clifford & Sons	Sheet	275	300	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Charles Clifford & Sons	Sheet	275	300	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Charles Clifford & Sons	Sheet mill	105	250	3 ph., 440 v., 25 cyc.	Direct	English Elec. Co.
Dugard Bros.	Sheet brass	275	375	3 ph., 5000 v., 25 cyc.	Gearing	English Elec. Co.
Dugard Bros.	Sheet brass	100	500	3 ph., 5000 v., 25 cyc.	Gearing	English Elec. Co.
Willans & Robinson, Ltd.	Tube	275	360	410 v. d.c.	Rope	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	250	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	250	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	150	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	150	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	100	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	100	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
Allen Everitt & Sons, Ltd.	—	80	500	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
District Iron & Steel Co.	Hoop	250	365	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Union Steel Corporation	Merchant	255	90/180	3 ph., 525 v., 50 cyc.	Direct	English Elec. Co.
Barker & Allen, Ltd.	Sheet nickel	215	300	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Barker & Allen, Ltd.	Sheet nickel	120	300	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Barker & Allen, Ltd.	Sheet nickel	50	375	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Barker & Allen, Ltd.	Sheet	50	750	3 ph., 440 v., 25 cyc.	Belt	English Elec. Co.
Barker & Allen, Ltd.	Breaking down	130	500	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Cammell, Laird & Co., Ltd.	Merchant	210	750	3 ph., 3000 v., 50 cyc.	Belt	English Elec. Co.
John Hill & Sons	Hoop	250	250	2 ph., 2700 v., 50 cyc.	Direct	English Elec. Co.
F. R. Simpson & Co.	Merchant Rgh 9 in. Fin 7in.	250	500	3 ph., 400 v., 25 cyc.	Rope	English Elec. Co.
Kynochs, Ltd.	Sheet	200	600	3 ph., 500 v., 50 cyc.	Gear	English Elec. Co.
Kynochs, Ltd.	Sheet	200	600	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	200	600	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	165	600	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	165	600	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	115	600	3 ph., 500 v., 50 cyc.	Gear	English Elec. Co.
Kynochs, Ltd.	Sheet	115	600	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.
Kynochs, Ltd,	Sheet	115	600	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.
Kynochs, Ltd.	Sheet	115	600	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	100	750	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	80	750	3 ph., 500 v., 50 cyc.	Belt	English Elec. Co.

Motor Equipment for Main Drive of Rolling Mills—*continued.*

Installed for.	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Kynochs, Ltd.	Sheet	75	750	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	Sheet	75	750	3 ph., 500 v., 50 cyc.	Pinion	English Elec. Co.
Kynochs, Ltd.	——	65	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	65	750	3 ph., 520 v., 50 cyc.	—	English Elec. Co.
Appleby Iron Co.	40 in. reversing slabbing	6000/15200	48/100	1350 v. d.c.	Direct*	Met. Vickers Elec.
Appleby Iron Co.	10 ft. reversing plate	6000/15200	48/100	1350 v. d.c.	Direct*	Met. Vickers Elec.
Appleby Iron Co.	7 ft. reversing plate	5000/13300	60/120	1350 v. d.c.	Direct*	Met. Vickers Elec.
J. Cockerill & Co.	36 in. reversing cogging	5000/16500	60/120	1350 v. d.c.	Direct*	Met. Vickers Elec.
J. Cockerill & Co.	33½ in. reversing section	5000/16500	60/120	1350 v. d.c.	Direct*	Met. Vickers Elec.
Bolckow, Vaughan & Co.	40 in. reversing cogging	4800/13700	50/100	1200 v. d.c.	Direct*	Met. Vickers Elec.
Bolckow, Vaughan & Co.	18 in. finishing	1200/2500	290	3 ph. 60 per. 2400 v.	Geared	Met. Vickers Elec.
Bolckow, Vaughan & Co.	16 in. roughing & finishing	500/1000	360	3 ph. 60 per. 2400 v.	Geared	Met. Vickers Elec.
La Magona d'Italia	Reversing plate	3300/9520	50/100	800 v. d.c.	Direct*	Met. Vickers Elec.
La Magona d'Italia	——	1200/2400	86	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia	——	1200/2400	86	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia	——	1200/2400	86	3 ph. 50 cyc. 500 v.	—	Met. Vickers Elec.
La Magona d'Italia	——	1200/2400	75	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia	——	700/1400	250	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia	——	700/1400	250	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia	Cold rolls	350/700	500	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
La Magona d'Italia	——	250/500	300	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
Vickers, Ltd.	28 in. reversing cogging	3000/8000	50/100	800 v. d.c.	Direct*	Met. Vickers Elec.
Vickers, Ltd.	24 in. sheet	450/900	250	3 ph. 50 cyc. 650 v.	—	Met. Vickers Elec.
Vickers, Ltd.	12 in. bar	400/800	87/125	220 v. d.c.	Direct	Met. Vickers Elec.
Vickers, Ltd.	Tube piercer	250/500	600	220 v. d.c.	—	Met. Vickers Elec.
Vickers, Ltd.	Tube piercer	150/300	485	3 ph. 50 cyc. 650 v.	—	Met. Vickers Elec.
A. Hickman & Co.	26 in. reversing section	3000/9700	60/140	900 v. d.c.	Direct*	Met. Vickers Elec.
Palmers Shipbuilding & Iron Co.	36 in. reversing section	3000/9500	45/120	900 v. d.c.	Direct*	Met. Vickers Elec.
Palmers Shipbuilding & Iron Co.	38 in. reversing cogging	2500/8500	40/75	800 v. d.c.	Direct*	Met. Vickers Elec.
Whitehead Iron & Steel Co.	Morgan finishing	2500/1560	240/160	500 v. d.c.	Geared†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	Morgan roughing	1500/815	350/175	500 v. d.c.	Geared†	Met. Vickers Elec.
Whitehead Iron & Steel Co.	Morgan edging	100/40	600/240	500 v. d.c.	Geared†	Met. Vickers Elec.
Ilva Steel Mills	500 m/m	1500/3000	74	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Ilva Steel Mills	350 m/m	1500/3000	107	3 ph. 50 cyc. 5000 v.	Direct	Met. Vickers Elec.
Ilva Steel Mills	550 m/m	1500/3000	107	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Ilva Steel Mills	——	800/1600	136/205	3 ph. 42 cyc. 2000 v.	Geared	Met. Vickers Elec.
Ilva Steel Mills	——	500/1000	85	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Ilva Steel Mills	——	500/1000	85	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Electric Supplies for Barcelona	630 m/m	1500/3750	294	3 ph. 50 cyc. 3000 v.	Rope	Met. Vickers Elec.
Electric Supplies for Moreda	240 m/m	800/1600	490	3 ph. 50 cyc. 5000 v.	Direct	Met. Vickers Elec.
Electric Supplies for Moreda	350 m/m	700/1400	188	3 ph. 50 cyc. 5000 v.	Direct	Met. Vickers Elec
Electric Supplies for Moreda	300 m/m	500/1250	365	3 ph. 50 cyc. 5000 v.	Direct	Met. Vickers Elec
Electric Supplies for Echevarria	——	180/360	195	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Wm. Beardmore & Co.	3 high plate	1500/3000	295/270	220 v.	Geared	Met. Vickers Elec.
Wm. Beardmore & Co.	Tyre finishing	700/1400	490	3 ph. 25 cyc. 6500 v.	Geared	Met. Vickers Elec.
Wm. Beardmore & Co.	Tyre roughing	600/1200	405	345 v. d.c.	Geared*	Met. Vickers Elec.
Wm. Beardmore & Co.	Tyre roughing	400/800	585	230 v. d.c.	—	Met. Vickers Elec.
Pearson & Knowles	Wire	1500/3000	187	3 ph. 50 cyc. 2200 v.	Direct‡	Met. Vickers Elec.
F. Braby & Co.	30 in. sheet	1300/3250	28/36	550 v. d.c.	Direct†	Met. Vickers Elec.
J. Lysaght for Australia	Sheet	1300/3250	28/34	500 v. d.c.	Direct†	Met. Vickers Elec.
Sociedad Espanola	21 in. reversing section	1250/3000	60/120	440 v. d.c.	Direct*	Met. Vickers Elec.
Taylor Bros. & Co.	Tyre roughing	1200/2400	365	3 ph. 50 cyc. 6600 v.	Geared	Met. Vickers Elec.
Taylor Bros. & Co.	Tyre finishing	1200/2400	365	3 ph. 50 cyc. 6600 v.	Geared	Met. Vickers Elec.
District Iron & Steel Co.	Strip	1000/3000	245	3 ph. 50 cyc. 5000/5500v	Geared	Met. Vickers Elec.
District Iron & Steel Co.	12 in. continuous	1000/2300	180	3 ph. 25 cyc. 5000/5500v	Geared	Met. Vickers Elec.
District Iron & Steel Co.	10 in. continuous	600/2000	240	3 ph. 25 cyc. 5000 v.	Direct	Met. Vickers Elec.
District Iron & Steel Co.	Strip	500/1000	365	3 ph. 25 cyc. 5000 v.	Geared	Met. Vickers Elec.
District Iron & Steel Co.	Strip	300/700	360	3 ph. 25 cyc. 5000 v.	Geared	Met. Vickers Elec.
District Iron & Steel Co.	12 in. merchant & spoke	265/900	360	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Ebbw Vale Steel, Iron & Coal Co.	Sheet	1000/2500	184	3 ph. 50 cyc. 2200 v.	Geared	Met. Vickers Elec.
Ebbw Vale Steel, Iron & Coal Co.	Sheet	1000/2500	184	3 ph. 50 cyc. 2200 v.	Geared	Met. Vickers Elec.
Cargo Fleet & Iron Co.	11 in. merchant	1000/2000	130/300	550 v. d.c.	Direct†	Met. Vickers Elec.
Tubes, Ltd.	Piercing	800/2500	60/100	460 v. d.c.	Direct†	Met. Vickers Elec.
Tubes, Ltd.	Pilger	750/1875	50/100	460 v. d.c.	Direct†	Met. Vickers Elec.
Tubes, Ltd.	Piercing	500/1000	730	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Tubes, Ltd.	Piercing	300/600	290	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Tubes, Ltd.	Tube	200/450	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Tubes, Ltd.	Tube	200/450	365	3 ph. 25 cyc. 440 v.	Rope	Met. Vickers Elec.
Dorman, Long & Co.	3 and 2 high finishing	800/2000	200/225	400 v. d.c.	Direct	Met. Vickers Elec.
Dorman, Long & Co.	3 high roughing	325/700	585	3 ph. 40 cyc. 2750 v.	Geared	Met. Vickers Elec.
Sandycroft, Ltd.	——	800/536	112/75·5	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Cammell Laird & Co.	Tyre roughing	800/1600	405	360 v. d.c.	Geared*	Met. Vickers Elec.
Cammell Laird & Co.	Tyre roughing	500/1000	400	240 v. d.c.	Geared*	Met. Vickers Elec.
Cammell Laird & Co.	Tyre finishing	800/1600	500	500 v. d.c.	Geared*	Met. Vickers Elec.
Cammell Laird & Co.	Tyre finishing	750/1500	480	3 ph. 50 cyc. 3000 v.	Geared	Met. Vickers Elec.
S. Fox & Co., Ltd.	14 in. double, 2 high sheet	750/1690	125/200	500 v. d.c.	Direct†	Met. Vickers Elec.
Societe Metailurgique de Montbard-Aulnoye	Tube	750/1500	500	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
Effingham Steel Works	Strip	600/1200	290	3 ph. 50 cyc. 3300 v.	Rope	Met. Vickers Elec.
J. Baker & Co.	Wheel	570/1000	490	3 ph. 50 cyc. 6300 v.	Geared	Met. Vickers Elec.
J. Baker & Co.	Wheel	570/1000	490	3 ph. 50 cyc. 6300 v.	Geared	Met. Vickers Elec.
T. Bolton & Sons	Copper plate and bar	550/1500	490	3 ph. 50 cyc. 490 v.	Geared	Met. Vickers Elec.
Soc. Italiana Metallurgica (Leghorn)	2 high brass and copper	550/1500	375	3 ph. 50 cyc. 5000 v.	Geared	Met. Vickers Elec.
Societa Italiana Metallurgica (Leghorn)	Copper	550/1356	300/365	3 ph. 50 cyc. 5000 v.	—	Met. Vickers Elec.
Pather Iron & Steel Co.	12 in. merchant	500/1500	365	3 ph. 25 cyc. 400 v.	Ropes	Met. Vickers Elec.

* With M. G. Set. † With rotary converter. ‡ Direct on to countershaft.

Motor Equipment for Main Drive of Rolling Mills—*continued.*

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Pather Iron & Steel Co.	Forge	350/700	242	3 ph. 25 cyc. 400 v.	Rope	Met. Vickers Elec.
Etna Iron & Steel Co.	12 in. merchant	500/1500	365	3 ph. 25 cyc. 400 v.	Rope	Met. Vickers Elec.
Etna Iron & Steel Co.	9 in. merchant	250/600	480	3 ph. 25 cyc. 440 v.	Rope	Met. Vickers Elec.
Glencairn Iron & Steel Co.	Merchant	500/1500	365	3 ph. 25 cyc. 440 v.	Rope	Met. Vickers Elec.
Smith & McLean	2 high sheet	500/1300	27·5/34·5	500 v. d.c.	Direct	Met. Vickers Elec.
Holmes Steel Foundry Co.	12 in. strip	500/1200	163	3 ph. 50 cyc. 3000 v.	Direct	Met. Vickers Elec.
Holmes Steel Foundry Co.	Strip	500/1000	585	3 ph. 50 cyc. 3000 v.	—	Met. Vickers Elec.
Holmes Steel Foundry Co.	Strip	460/920	580	3 ph. 50 cyc. 3000 v.	—	Met. Vickers Elec.
Holmes Steel Foundry Co.	Strip	300/600	240	3 ph. 50 cyc. 3,000 v.	—	Met. Vickers Elec.
Holmes Steel Foundry Co.	Strip	220/500	360	3 ph. 50 cyc. 3,000 v.	—	Met. Vickers Elec.
Motherwell Iron & Steel Co.	10 in. merchant	500/1100	120/240	3 ph. 25 cyc. 2,200 v.	Direct	Met. Vickers Elec.
Parkgate Iron & Steel Co.	10 in. finishing	500/1000	150/250	240 v. d.c.	Geared	Met. Vickers Elec.
Parkgate Iron & Steel Co.	——	500/1000	150	—	—	Met. Vickers Elec.
Parkgate Iron & Steel Co.	18 in. cogging	250/550	244	3 ph. 50 cyc. 3,000 v.	Rope.	Met. Vickers Elec.
Richard Johnson & Nephew	Wire	500/1000	415	3 ph. 50 cyc. 440 v.	Geared	Met. Vickers Elec.
Tinsley Rolling Mill Co.	12 in. merchant	500/1000	100/200	460 v. d.c.	Direct†	Met. Vickers Elec.
English McKenna Process Co.	Re-rolling rails	500/1000	290	3 ph. 50 cyc. 440 v.	Geared	Met. Vickers Elec.
English McKenna Process Co.	Merchant	350/700	250/125	3 ph. 50 cyc. 440 v.	Geared	Met. Vickers Elec.
T. Smith's Stamping Works	10½ in. finishing	500/1000	150/350	440 v. d.c.	Direct†	Met. Vickers Elec.
T. Smith's Stamping Works	14 in. roughing	200/400	585	3 ph. 50 cyc. 440 v.	Geared	Met. Vickers Elec.
J. Spencer & Sons	22 in. turnover	500/864	260/315	480 v. d.c.	Geared	Met. Vickers Elec.
Soc. Anon. des Acieries d'Anvers	Roughing	450/1000	230	3 ph. 50 cyc. 2,150 v.	Geared	Met. Vickers Elec.
Soc. Anon. des Acieries d'Anvers	Finishing	325/700	300	3 ph. 50 cyc. 2,150 v.	Geared	Met. Vickers Elec.
Soc. Anon. des Acieries d'Anvers	Roughing	150/450	300	3 ph. 50 cyc. 2,150 v.	Belt	Met. Vickers Elec.
The Mint, Birmingham	Merchant	400/1500	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
The Mint, Birmingham	Hot rod	275/900	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
The Mint, Birmingham	Roughing and finishing	225/600	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Sir Theo. Fry & Co.	Forge	400/800	330	3 ph. 40 cyc. 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	16 in. mill	250/500	385	3 ph. 40 cyc. 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	16 in. mill	250/500	385	3 ph. 40 cyc. 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co.	10 in. mill	250/500	385	3 ph. 40 cyc. 400 v.	Rope	Met. Vickers Elec.
Sir Theo. Fry & Co	8 in. mill	250/500	385	3 ph. 40 cyc. 400 v.	Rope	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass	400/800	365	3 ph. 25 cyc. 5,000 v.	Rope	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	265/530	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	160/500	365	3 ph. 25 cyc. 400 v.	Geared	Met. Vickers Elec.
Birmingham Metal & Munitions Co.	Copper and brass sheet	160/500	365	3 ph. 25 cyc. 400 v.	Geared	Met. Vickers Elec.
Italian Co., for Villa Cogozza	——	400/800	412	3 ph. 42 cyc. 500 v.	Rope	Met. Vickers Elec.
Harts Hill Iron Company	10 in. merchant	350/700	220/100	650 v. d.c.	Direct†	Met. Vickers Elec.
Redheugh Sheet Iron & Steel Co.	2 in. high sheet	350/1000	360	3 ph. 40 cyc. 400 v.	Ropes	Met. Vickers Elec.
Shelton Iron, Steel & Coal Co.	10 in. bar	350/700	450/720	500 v. d.c.	Ropes	Met. Vickers Elec.
Shelton Iron, Steel & Coal Co.	12 in. bar	350/700	450/660	500 v. d.c.	Ropes	Met. Vickers Elec.
Fielding & Platt, Ltd.	Pilger	350/700	365	3 ph. 50 cyc. 2,000 v.	Direct	Met. Vickers Elec.
Union Steel Corporation	——	350/700	485	3 ph. 50 cyc. 525 v.	Rope	Met. Vickers Elec.
J. Summers & Co.	3 and 2 high strip	325/800	570	3 ph. 40 cyc. 400 v.	Rope	Met. Vickers Elec.
D. Bennie & Sons	3 high roughing	300/600	250/330	500 v. d.c.	Direct	Met. Vickers Elec.
D. Bennie & Sons	2 high finishing	150/300	200/265	500 v. d.c.	Direct	Met. Vickers Elec.
Prafilprig (Italy)	6 plate mills	300/900	410	3 ph. 42 cyc. 500 v.	Belt	Met. Vickers Elec.
Elliott's Metal Co., Ltd.	Cold brass	300/600	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Pitney Steel Rolling Mills, Ltd.	Cold brass	300/600	360	3 ph. 25 cyc. 5,000 v.	Rope	Met. Vickers Elec.
Tividale Rolling Mills Co.	Cold brass	300/600	365	3 ph. 50 cyc. 200 v.	Geared	Met. Vickers Elec.
Heeley Silver Mills, Ltd.	Cold cupro-nickel	300/600	365	3 ph. 50 cyc. 3,300 v.	Geared	Met. Vickers Elec.
Heeley Silver Mills, Ltd.	Cold cupro-nickel	300/600	365	3 ph. 50 cyc. 3,300 v.	Geared	Met. Vickers Elec.
Perfecta Tubes, Ltd.	Piercer	300/600	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Perfecta Tubes, Ltd.	Breaking down	200/400	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Perfecta Tubes, Ltd.	Breaking down	150/300	365	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Armstrong, Whitworth & Co.	——	280/560	390	3 ph. 40 cyc. 440 v.	Ropes	Met. Vickers Elec.
Armstrong, Whitworth & Co.	Brass sheet	150/300	390	3 ph. 40 cyc. 440 v.	Geared	Met. Vickers Elec.
Tupper & Co., Ltd.	Strip	275/690	365	2 ph. 50 cyc. 2,700 v.	Rope	Met. Vickers Elec.
Royal Arsenal, Woolwich	——	250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich	——	250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich	——	250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich	——	250/500	370	500 v. d.c.	—	Met. Vickers Elec.
Royal Arsenal, Woolwich	——	250/500	370	500 v. d.c.	—	Met. Vickers Elec.
G. Johnston & Co.	Brass sheet	250/700	240	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
British Insulated & Helsby Cable	2 high sheet	250/375	350/380	240 v. d.c.	Belt	Met. Vickers Elec.
Victoria Iron Rolling Co.	——	250/290	210/700	460 v. d.c.	Geared	Met. Vickers Elec.
Evered & Co.	Strip	250/600	375	3 ph. 25 cyc. 400 v.	Gared	Met. Vickers Elec.
Muntz Metal	Tube piercing	250/300	485	3 ph. 25 cyc. 400 v.	Geared	Met. Vickers Elec.
Old Park Silver Mills Co., Ltd.	2 pair cupro-nickel	230/460	320	3 ph. 50 cyc. 350 v.	Geared	Met. Vickers Elec.
Wm. Hunt & Sons	Strip	200/450	365	3 ph. 25 cyc. 400 v.	Rope	Met. Vickers Elec.
Wm. Hunt & Sons (The Braides)	Special	200/600	365	3 ph. 25 cyc. 400 v.	Rope	Met. Vickers Elec.
J. Booth & Co., Ltd.	Brass	200/400	360	3 ph. 25 cyc. 5,000 v.	—	Met. Vickers Elec.
J. Booth & Co., Ltd.	Brass	100/200	480	3 ph. 25 cyc. 440 v.	—	Met. Vickers Elec.
J. Booth & Co., Ltd.	Brass	100/200	480	3 ph. 25 cyc. 440 v.	—	Met. Vickers Elec.
J. Booth & Co., Ltd.	Brass	100/200	480	3 ph. 25 cyc. 440 v.	—	Met. Vickers Elec.
J. Booth & Co., Ltd.	Brass	100/200	480	3 ph. 25 cyc. 440 v.	—	Met. Vickers Elec.
J. Booth & Co., Ltd.	Brass	75/150	720	3 ph. 25 cyc. 440 v.	—	Met. Vickers Elec.
Cocker Bros., Ltd.	12 in.	200/400	600	230/240 v. d.c.	—	Met. Vickers Elec.
Cocker Bros., Ltd.	10 in.	100/200	530/800	220 v. d.c.	—	Met. Vickers Elec.
J. Williams & Co.	2 high sheet	200/600	365	3 ph. 25 cyc. 400 v.	Rope	Met. Vickers Elec.
W. H. Moore & Sons	Brass sheet	200/600	240	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Jonas & Colver	Bar	200/400	500	2 ph. 50 cyc. 200 v.	Belt	Met. Vickers Elec.
J. Brown & Co.	12 in. merchant	200/400	200/450	230 v. d.c.	Geared	Met. Vickers Elec.
J. Brown & Co.	12 in. merchant	200/400	200/450	230 v. d.c.	Geared	Met. Vickers Elec.
W. Jessop & Sons	Merchant	150/300	216	500 v. d.c.	Direct	Met. Vickers Elec.

† = With rotary converter.

Motor Equipment for Main Drive of Rolling Mills—*continued.*

Installed for	Description of mill.	Motor.		Supply.	Drive.	Installed by
		H.P.	Speed r.p.m.			
Oldbury Rolling Mills	3 high merchant	150/400	480	3 ph. 25 cyc. 400 v.	Geared	Met. Vickers Elec.
Harrison & Co.	Cold brass	150/300	480	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Harrison & Co.	Cold brass	100/225	480	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
W. H. Robertson, Ltd.	Groove	150/300	640	110 v. d.c.	Geared	Met. Vickers Elec.
Britannia Tube Co.	Brass	150/300	240	3 ph. 25 cyc. 440 v.	Rope	Met. Vickers Elec.
Barker Bros., Ltd.	Cold cupro nickel	130/400	480	3 ph. 25 cyc. 440 v.	Belt	Met. Vickers Elec.
Bassett, Bagnall & Co.	Strip	125/190	575	500 v. d.c.	Geared	Met. Vickers Elec.
Hall Steel Metal Rolling Co.	Cold brass	125/250	480	3 ph. 25 cyc. 440 v.	Rope	Met. Vickers Elec.
C. A. Robinson & Co.	Strip	100/250	480	2 ph. 25 cyc. 200 v.	Geared	Met. Vickers Elec.
Empire Aluminium Co.	Aluminium sheet	100/200	400	500 v. d.c.	Direct	Met. Vickers Elec.
Scottish Tube Co., Ltd.	Tube	100/200	470	3 ph. 25 cyc. 440 v.	Geared	Met. Vickers Elec.
Rotherham Forge & Rolling Mill Co.	8 in. rod	100/200	725	3 ph. 50 cyc. 3,000 v.	Geared	Met. Vickers Elec.
Holman, Mitchell & Co.	Reversing lead	90/180	120	550 v. d.c.	Geared*	Met. Vickers Elec.
Foster, Blackett & Wilson	Reversing lead	90/180	435	460 v. d.c.	Geared*	Met. Vickers Elec.
Foster, Blackett & Wilson	Lead sheet	90/180	570	3 ph. 40 cyc. 400 v.	Geared	Met. Vickers Elec.
R. B. Byass & Co.	Copper	90/180	500	500 v. d.c.	Geared	Met. Vickers Elec.
R. B. Byass & Co.	Copper	90/180	500	500 v. d.c.	Geared	Met. Vickers Elec.
Mardy Tinplate Co.	3 sheet	80/200	300	400 v. d.c.	Geared	Met. Vickers Elec.
Kynochs, Ltd.	Sheet	65	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Kynochs, Ltd.	Sheet	65	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Kynochs, Ltd.	—	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	—	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	—	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	—	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	—	42	750	3 ph., 500 v., 50 cyc.	—	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Kynochs, Ltd.	Sheet	42	750	3 ph., 520 v., 50 cyc.	Sheet	English Elec. Co.
Tregoning & Co., Ltd.	Cold rolls	200	200	3 ph., 500 v., 50 cyc.	Rope	English Elec. Co.
Davy Bros., Ltd.	Plate	200	600	3 ph., 220 v.	Rope	English Elec. Co.
Davy Bros., Ltd.	Merchant	120	500	2 ph., 2000 v.	Rope	English Elec. Co.
Davy Bros., Ltd.	—	120	500	2 ph., 4 wire, 50 cyc.	—	English Elec. Co.
Henry Wiggin & Co., Ltd.	Sheet nickel	200	300	3 ph., 440 v., 25 cyc.	Gear	English Elec. Co.
Henry Wiggin & Co., Ltd.	Sheet nickel	150	375	3 ph., 440 v., 25 cyc.	Rope & gr.	English Elec. Co.
Daniel & Arter	Strip	158	300	3 ph., 440 v., 25 cyc.	Gearing	English Elec. Co.
John Baker & Co., Ltd.	Disc	290	150	3 ph., 6300 v., 50 cyc.	Gearing	English Elec. Co.
John Baker & Co., Ltd.	Disc	290	150	3 ph., 6300 v., 50 cyc.	Gearing	English Elec. Co.
Clyde Alloy Steel Co.	Merchant	250	500	3 ph., 400 v., 25 cyc.	Rope	English Elec. Co.
Jones & Rooke, Ltd.	Breaking down	350	300	3 ph., 5000 v., 25 cyc.	Gearing	English Elec. Co.
Jones & Rooke, Ltd.	Breaking down	350	300	3 ph., 5000 v., 25 cyc.	Gearing	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Chas. Hirst & Co.	Draw benches	110	375	235 v. d.c.	Gear	English Elec. Co.
Aston Chain & Hook Co.	—	200	375	3 ph., 5000 v., 25 cyc.	Belt	English Elec. Co.
Steel Nut & Joseph Hampton, Ltd.	Draw benches	200	510	3 ph.	Rope	English Elec. Co.
Wm. Bayliss, Ltd.	—	200	375	3 ph., 440 v., 25 cyc.	Rope	English Elec. Co.
Wm. Bayliss, Ltd.	—	172	500	3 ph., 5000 v., 25 cyc.	—	English Elec. Co.
Wm. Bayliss, Ltd.	Tube	120	500	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150/400	500	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150/300	600	440 v. d.c.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150/300	600	440 v. d.c.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150/400	500	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
Crosthwaites Engineering & Furnace Co.	Reeling	150/400	500	3 ph., 400 v., 25 cyc.	Gear	English Elec. Co.
George Jones, Ltd.	Sheet	350	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
George Jones, Ltd.	Tube	120	550	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
George Jones, Ltd.	—	100	500	500 v. d.c.	—	English Elec. Co.
Richard Hill & Co., Ltd.	Wire	175	385	3 ph., 2750 v., 40 cyc.	Gear	English Elec. Co.
Richard Hill & Co., Ltd.	Wire	175	385	3 ph., 2750 v., 40 cyc.	Gear	English Elec. Co.
Richard Hill & Co., Ltd.	Wire	132	392	3 ph., 440 v., 40 cyc.	Gear	English Elec. Co.
Winfields Rolling Mills, Ltd.	Brass sheet	175	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Winfields Rolling Mills, Ltd.	Brass sheet	108	375	3 ph., 5000 v., 25 cyc.	Rope	English Elec. Co.
Wilkes, Son & Mapplebeck, Ltd.	Copper plate	150	485	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Wilkes, Son & Mapplebeck, Ltd.	Copper plate	120	485	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Wilkes, Son & Mapplebeck, Ltd.	Copper plate	75	485	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
A. F. Parkes	Sheet steel	150	375	3 ph., 5000 v., 25 cyc.	—	English Elec. Co.
A. F. Parkes	Sheet steel	142	375	3 ph., 5000 v., 25 cyc.	—	English Elec. Co.
Heaton Dugard	Sheet	140	375	3 ph., 5000 v., 25 cyc.	—	English Elec. Co.
Heaton Dugard	Sheet	100	500	3 ph., 440 v., 25 cyc.	Gear	English Elec. Co.
Heaton Dugard	Sheet	100	500	3 ph., 440 v., 25 cyc.	Gear	English Elec. Co.
Heaton Dugard	Sheet	80	500	3 ph., 440 v., 25 cyc.	Gear	English Elec. Co.
John Hands & Sons, Ltd.	Sheet	150	375	3 ph.	Belt	English Elec. Co.
Wm. West	German silver	150	500	3 ph., 5000 v., 25 cyc.	Gear	English Elec. Co.
Elliotts Metal Co.	—	150	375	3 ph., 400 v., 25 cyc.	—	English Elec. Co.
John Summers & Sons, Ltd.	—	140	500	3 ph., 440 v., 50 cyc.	—	English Elec. Co.
British Aluminium Co.	Breaking down	300	375	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.

* = With M. G. Set.

Motor Equipment for Main Drive of Rolling Mills—*continued.*

Installed for	Description of mill.	Motor.		Supply.	Drive	Installed by
		H P	Speed r p.m.			
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	Strip	100	750/1100	460 v. d.c.	Gear	English Elec. Co.
British Aluminium Co.	—	135	400/600	460 v. d.c.	—	English Elec. Co.
British Aluminium Co.	—	135	400/600	460 v. d.c.	—	English Elec. Co.
The Redbrook Tinplate Co., Ltd.	Cold rolls	125	240	3 ph., 2200 v.	Rope	English Elec. Co.
The Redbrook Tinplate Co., Ltd.	Hot tinplate	100	240	3 ph., 2200 v.	Rope	English Elec. Co.
John Wood & Sons	Merchant	125	490	2 ph., 2000 v., 50 cyc.	Rope	English Elec. Co.
Thomas Smith & Sons	—	105	150	3 ph., 440 v., 25 cyc.	—	English Elec. Co.
H. Roberts	—	100	750	2 ph., 200 v., 50 cyc.	—	English Elec. Co.
Perry & Co.	—	100	300	3 ph., 25 v., 440 cyc.	Gear	English Elec. Co.
Carr, Wild & Co.	—	100	750	2 ph., 200 v. 50 cyc.	Direct	English Elec. Co.
Isaac Nash & Sons, Ltd	—	95	375	2 ph., 2700 v., 50 cyc.	Belt	English Elec. Co.
Kemp & Sons	Sheet	80	500	3 ph., 440 v, 25 cyc.	Gear	English Elec. Co.
Kemp & Sons	Sheet	80	500	3 ph., 440 v. 25, cyc.	Gear	English Elec. Co.
Kemp & Sons	Sheet	45	500	3 ph., 440 v., 25 cyc.	—	English Elec. Co
Rotherham Forge & Rolling Mills	Reeling	54	725	460 v. d.c.	Belt	English Elec. Co
E. Lloyd & Co.	Sheet	50	500	—	—	English Elec. Co.
E. Lloyd & Co.	Sheet	50	500	—		English Elec. Co.
J. J. Habershon & Co.	Cold rolls	66	585	3 ph., 50 cyc., 200 v.	—	English Elec. Co.
Bayliss, Jones & Bayliss, Ltd.	—	500	240/312	440 v d.c.	—	Elec Con. Co.
Bayliss, Jones & Bayliss, Ltd.	—	600	280/380	440 v. d.c.	—	Elec. Con. Co.
Metal Manufacturers, Ltd.	—	400	300	250 v. d.c.	—	Elec. Con. Co.
Thomas Bolton & Sons, Ltd.	—	475	300/400	205 v. d c.	—	Elec. Con. Co.
Thomas Bolton & Sons, Ltd.	—	600	380/400	205 v. d.c.	—	Elec. Con. Co.
Usines Metallurgiques de Saint Eloi	—	600	250	550 v. d.c.	—	Elec. Con. Co.
Louis Piret & Co.	—	600	250	550 v. d.c.	—	Elec. Con. Co.
Trefileries & Laminoirs du Havre	—	800/1600	60/90	440 v. d.c.	—	Elec. Con. Co.
Welsh Tinplate & Metal Stamping Co.	—	500	135/150	500 v. d.c.	—	Elec. Con. Co.
Samuel Osborn & Co., Ltd.	—	350	550/440	2-ph. 2000 v.	—	Elec. Con. Co.
Richard Johnson & Nephew, Ltd.	—	500	428/360	3-ph. 6500 v.	—	Elec. Con. Co.
Alfred Hickman, Ltd.	Cogging & live rolls	4,800	120	460/500 v. c.c.	Geared	Elec. Con. Co.
Alfred Hickman, Ltd.	Bar	6,000	120	460/500 v. c.c.	Dir-coup	Elec. Con. Co.

The Advantages of Large Gas Engines for Central Power Stations.

By WALTER CROOKE.
(Lilleshall Co., Ltd.)

ONE of the most acute problems facing this country is the economy of its fuel supplies; the time when the engineer could afford to disregard the extravagant use of coal has disappeared. In solving this problem much greater attention will have to be paid to the installation of large central power stations. The coal used in this country for power generation is given as 80,000,000 tons per annum, while it would not be far wrong to average the overall-thermodynamic efficiency at about 8 per cent. Under the same conditions, gas engines and producers with exhaust boilers would give an efficiency of 30 per cent.

Very little attention has been given to the use of large gas engines for public supply power stations in Great Britain as compared with the Continent. The author knows of no case where a serious attempt has been made to use the available power obtainable from the blast furnaces and coke ovens of the country for the relief of the present serious situation. Indeed, with the exception of Accrington and the north-east coast, the large gas engine has not been used in public supply power stations at all. There is, without doubt, a large field for the advantageous employment of large gas engines for electric power purposes in the coal and iron industry and its attendant coke oven plants. Great Britain compares most unfavourably with other countries in its utilisation of this source of supply. Germany, for example, is using 25 per cent. of the power so obtainable as compared with 2½ per cent. for this country.

The reliability of the gas engine for work under the most strenuous conditions has already been established. Considering that twenty years ago an engine of 200 H.P. was a great experiment, the industry has made very rapid strides, and, while further improvements will naturally be forthcoming, it can safely be said that the experimental period has been passed.

THE AFTERMATH OF JOHANNESBURG.

In this country opinion has been divided between the high speed vertical tandem multi-cylinder engine and the slow-speed horizontal engine, introduced and built extensively both on the Continent and in America. This latter type would appear to offer the greater advantages for large units, owing to the absence of a multiplicity of cylinders and their attendant heat losses, and, generally, the greater simplicity of their design from a "running" point of view.

The idea that large gas engines are unreliable is an unfortunate legacy from the Continent; in order to reduce the cost of manufacture, the makers were inclined to rate the mean effective pressure at too high a figure. From a table, compiled by the author, of the chief types of horizontal high-power gas engines, it was found that the average M.E.P. worked out at 68 lb. per square inch. Experience has taught that where this is a possible rating, so long as the load factor is below 30 per cent., the mean effective pressure for an engine required for continuous running at full load should not be more than 50 lb. to 55 lb. per square inch.

It was, however, the failure of the Johannesburg gas-power station which had the greatest effect in subjecting gas engines to suspicion. While admitting that the design of engines used was not the most suitable, there is no doubt that the failure was largely attributable to the use of an untried producer plant and unsuitable fuel. The result of this was that the gas delivered to the engine contained large quantities of tar, which is fatal. With the present well-tried equipments for gas production, however, such a contingency is a thing of the past.

Below is given a list of gas power stations equipped by some of the leading gas engine builders, sufficiently large to convince anyone of the fact that gas engine stations are long past the stage of experiment or doubt.

Firm.	No. of stations.	Capacity.
M.A.N.	3	27,000 B.H.P.
M.A.N.	6	15,000 B.H.P.
M.A.N.	13	10,000 B.H.P.
Thyssen & Company	...	65,000 B.H.P.
Neunkirchen	...	14,000 B.H.P.
Erhardt & Sehmer	...	14,600 B.H.P.
Allis-Chalmers Company	...	56,000 B.H.P.
Snow Steam Pump Company	...	21,600 B.H.P.
Lilleshall Co., Ltd.	...	8,000 B.H.P.

THE ADVANTAGES OF CO-OPERATION.

In this connection it is advisable to emphasise the advantages of co-operation between neighbouring power stations, which are still more apparent if gas power stations running on waste gases are connected. In the Saar district a high-voltage network exists which is about 50 miles long, belonging to the State collieries. It is worked with three-phase current at 10,000 volts. The network is supplied both from a steam turbine station in Luisenthal of about 15,000 B.H.P., and from a gas engine station in Heinitz developing some 13,000 B.H.P. from coke-oven waste gas.

The Rhenish-Westphalian Electricity Works has some six plants, half steam and half gas stations of the neighbouring iron and steel works and collieries, on its distributing network, which is about 900 miles long. The capacity of this company's station is about 40,000 kw., and their power costs were reported to be 0·54d. per kw.-hour consumed in 1906, as against 0·83d. in neighbouring stations at Dusseldorf, 0·89d. at Dortmund and 1·14d. at Elberfeld.

On the north-east coast we have the powerful long-distance networks of the Newcastle-upon-Tyne Electric Supply Company, having a capacity of well over 100,000 H.P. Half of this is developed from waste gases burnt under boilers. If internal combustion were adopted, this company would have an extra 50,000 to 60,000 H.P. to dispose of for the same fuel consumption.

One of the few producer gas stations in public service is situated at Kamata, near Yokohama, and was supplied by the Lilleshall Company, Ltd., to the Imperial Japanese Government. This consists of four gas engines and generators supplying power to the railway between Tokio and Yokohama. The current is three phase 25 cycles at a pressure of 11,000 volts. This plant has been in operation for six years with entire success.

VARIATIONS IN PRESENT DESIGNS.

The design of the most successful type of large gas engine—that is, the four-stroke horizontal double-acting tandem arrangement—is so well known nowadays that no more than a reference to the accompanying illustration of this type is necessary. There are many makers of this type of engine. The engines made are superficially identical, but vary in detail. Some of these variations are discussed below.

There is little variation in the frames of the various makers' engines. The frame is anchored down into very massive foundations, the remainder of the engine being free to move longitudinally. In the case of very large sizes, the frames are made in halves in order to facilitate transport. The main guide and cylinder seating are bored and faced at one setting. It is impossible, therefore, to get the cylinder out of line provided it is faced truly.

In America the over-hung crank with single bearing is greatly favoured, on the ground that the alignment of three bearings is a difficult matter. Personally, the author finds no difficulty at all, and the distribution of stress in the main frame is better with a two-web crank.

There is a certain amount of variation of design in the cylinders. Originally the cylinders were built-up structures consisting of three or more castings bolted or studded together. This practice is more common in America than in Europe, and the reasons given are, generally, easier moulding and elimination of casting strains with less costly renewals in case of failure; with one piece cylinders, designed and made by experienced manufacturers, however, there is little chance of failure. Originally, the one-piece cylinder was made with the valves and sparking plugs in so-called "onions." The trouble with these cylinders was chiefly cracking. The cracks were due to three causes. The main one was the presence of these unnecessary pockets; the sharp corners were exposed to the maximum temperatures, and cracks nearly always started therefrom. Another important point was that sufficient care was not exercised to render the design symmetrical. Further, very little attention was paid to selecting the most suitable iron to withstand heat strains, and to the analysis of the finished casting.

The author's experience is that one-part cylinders, with flush valves, and having the stiffeners between the inner and outer walls arranged symmetrically, and cast in suitable metal, are entirely free from the trouble of cracking.

VALVE DESIGN.

Another detail with regard to the cylinders likely to give trouble is the exhaust valve seat. In the arrangement usually adopted the seating and valve guide are made in one. This makes a particularly difficult and expensive casting to produce. Under these circumstances the resultant castings are always a source of uncertainty in the engine, and should anything go wrong—say the valve seat—the whole casting must be replaced, making an expensive repair.

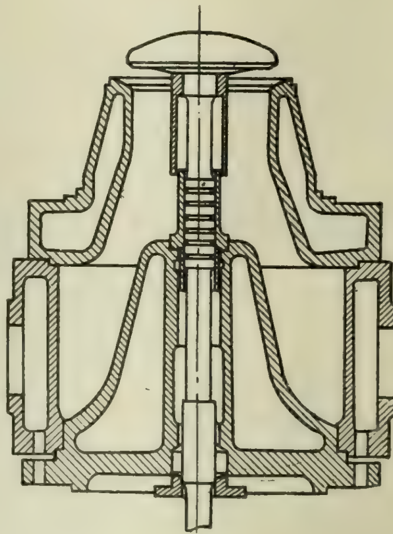


FIG. 1.

Fig. 1 shows the construction the Lilleshall Company adopt as standard. Here there is a simple water-cooled casting forming the seating for the valve. The casing and guide are also separate water-cooled castings, all three being jointed together with male and female joints in such a way that they cannot move relatively to one another, and so get out of line. An additional advantage is that very much better control of the temperature of these vital parts is assured by the separate cooling-water circuits employed.

COUPLINGS.

The intermediate coupling of a large gas engine is of great importance, since it connects the front and back piston rods. It has several difficult and, to some extent conflicting, functions to perform. It must be as nearly as practicable impossible for it to work loose. It must not be too rigid, otherwise the threads on the piston rods will suffer, and sometimes the rods themselves fracture. The coupling must be easily and quickly taken apart and put together again, and the stress in the piston rod threads must be kept unidirectional and not allowed to reverse, so that there may be no danger of failure due to fatigue. All these requirements are fulfilled in the coupling (*see* Fig. 2). A short description will, perhaps, make the illustration clearer. The nuts *G* being in halves, and pinched hard down by the cap *D*, prevent any movement longitudinally between the rods and nuts, and also prevent the back rod from turning. The nuts *G* are attached firmly to the main body of the coupling by means of taper grooves *J*, into which suitable tapered projections on the portions *C* and *D* fit. These projections, however, are so made that they cannot bottom in the grooves *J*, thus securing that the projections and the grooves *J* are bearing hard on their tapered sides. In order to prevent any reversal of stress in the threads, a taper plate, *L*, is fitted into a recess into the end of one of the piston rods, and a wedge plate and screw *M* is placed between the ends of the rods. By screwing down the nut *N* any compressive stresses occurring are taken by the wedge-plates and not on the threads.

TESTS.

A considerable number of figures have been published giving results of tests on various installations; but the following will be sufficient to indicate the reliability and advantages of these plants, viz. :—

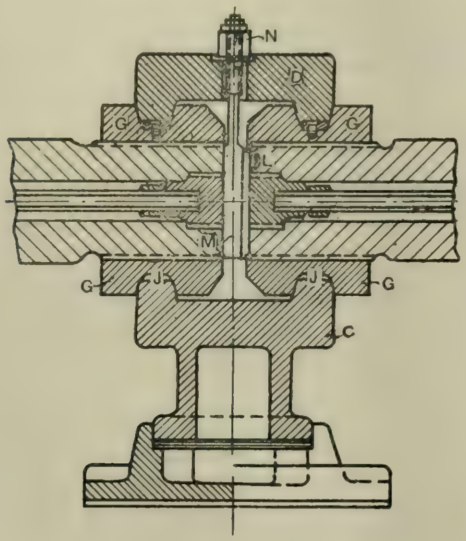


FIG. 2.

NON-RECOVERY PRODUCER GAS. TWO-CYCLE ENGINES, SINGLE-ACTING.

Duration of test, 12 hours.
Consumption B.T.U. per B.H.P.-hour, 10,500.
Heat to cooling water, 20·6 per cent.
Heat used in pump work, 3·7 per cent.
Heat used in engine friction, 2·4 per cent.
Heat to exhaust, 48 per cent.
Heat appearing as work at crankshaft, 25·3 per cent.
M.E.P. at full load, 55 lb. per square inch.
Mean piston speed, 800 ft. per minute.

Producer efficiency 70 per cent.	0·15 lb. of coal used per B.H.P.-hour for steam raising for producers, making overall efficiency on test 15·5 per cent. (No exhaust boiler on test engine.)
Load factor 94 per cent.	Ran 94 per cent. of total possible hours. Stops due to outside causes, 4 per cent. Stops due to engine causes, 2 per cent.
Load factor 31 per cent.	Ran 92 per cent. of total possible hours. Stops due to outside causes, 4 per cent. Stops due to engine causes, 4 per cent.
Of the engine stops	27 per cent. were due to pump valves. 10 per cent. were due to plugs or ignition.

In ordinary running, 11,000 tons of coal were used per year, of which 1,800 tons were used for raising steam, and produced 40,270 engine-hours. Average load =360 B.H.P. Hence average consumption =1·7 lb. bituminous slack of 12,000 B.T.U. per lb. per B.H.P.-hour, or the overall thermo-dynamic efficiency of the plant was 12·5 per cent.

COKE-OVEN GAS.

F 14,600 B.H.P. direct coupled to three-phase dynamos. Engine tested was a double-acting twin-tandem of 2,400 B.H.P. Heat consumption per kw.-hour on a mean load of 1,554 kw. was 10,900 B.T.U. This gives a thermal efficiency of 31 per cent. The consumption per indicated horse-power was stated to be 6,865 B.T.U., which is a thermal efficiency of 37 per cent. The mean piston speed was 800 ft. per minute, and the M.E.P. at full load rating 65 lb. per square inch.

The average overall thermo-dynamic efficiency of 8 gas-driven stations was 13·95 per cent.; these stations generated 30,000,000 units per annum, the lowest efficiency being 12·4 per cent., and highest 15·05 per cent. Average load factor 44·5 per cent.

RECOVERY PRODUCER GAS.

Fuel, bituminous slack having calorific value of 12,750 B.T.U. per lb.
Mean piston speed, 800 ft. per minute.
Mean effective pressure, 65 lb. per square inch.
Duration of test, 100 hours.
Calorific value of gas, 135 B.T.U. per cubic foot.
Coal per kw.-hour in producer, 1·38 lb.
Coal per kw.-hour in boilers, 0·35 lb.
Total coal consumption per kw.-hour, 1·73 lb.

B.T.U. per I.H.P.-hour	7,170
B.T.U. per B.H.P.-hour	8,550
B.T.U. per kw.-hour	12,170

DYNAMIC EFFICIENCY.

Producer efficiency on higher calorific value of gas	78 per cent.
Producer efficiency on lower calorific value of gas	65 per cent.
Efficiency of recovery plant	98 per cent.

KAMATA POWER STATION TESTS.

Full load	4,798 kw.
Duration of test	12 hours.
Mean piston speed	800 ft. per minute.
Calorific value of coal	11,221 B.T.U. per lb.
Consumption, B.T.U. per kw.-hour	12,444
Coal consumption in lbs. per k.w.-hour	1·8
Thermal efficiency of engine & alternator	27·4 per cent.
Overall efficiency of plant	16·6 per cent.

The Present Position of Electrically-Driven Rolling Mills.

By C. A. ABLETT, M.Inst.C.E.

IN considering the various articles which are appearing in this number of THE ELECTRICIAN, one cannot fail immediately to be struck by the amount of evidence which has been brought forward as to the ever-increasing adoption of the electrical drive in rolling mills.

EARLY ATTEMPTS.

The first electrical plant for driving a reversing rolling mill was installed not more than 14 years ago at Teschen in Poland. Then followed the plant at Georgsmarienhütte in Germany. The first attempt to drive a reversing rolling mill electrically in England was made at the works of Sir Alfred Hickman, near Wolverhampton. Later, in 1908, the Skinningrove Iron Company gave a great impetus to the electrical driving of reversing rolling mills by deciding to install a very powerful plant embodying the special features necessary for the purpose.

The situation at the present time is described by Mr. Rothera in his article, in which he calls attention to the fact that in this country there are now supplied or under construction 28 reversing rolling mill equipments, in America up to the end of 1919 there were 28 equipments, and on the Continent and abroad 50 equipments, that is to say altogether over 100 electrically-driven reversing rolling mill equipments have or are being installed to date. The list printed in this number of THE ELECTRICIAN contains details relating to these and other electrically-driven rolling mills in Great Britain, and shows what great progress has been made of late. It constitutes a really marvellous record of development during the period of 14 years, of which four years have been interrupted by war.

I am of opinion that whenever a proper comparison is made, on sound economic lines, between the steam and the electrical drive of reversing rolling mills, it will be found in the vast majority of cases that the correct course is to adopt the electrical drive, and that in the future the conditions which will warrant new steam engines being put down to drive reversing rolling mills will be very few and far between.

The steady upward movement in the price of fuel for years past, together with the considerable recent increases making up the present price of fuel, tend ever to increase the advantage which the electrically-driven reversing rolling mill has from the point of view of saving of fuel.

Mr. Orsettich in his article on electricity in American Steel Works deals with the economic view of American conditions in a very interesting manner, and points out how in America the high cost of labour which prevails has necessitated the use of mechanical appliances to a much greater extent than has been the case in Great Britain. My own experience of American conditions extends back to over 20 years, as I served my time in an American works, and can very fully endorse Mr. Orsettich's remarks, I would like, therefore, to call special attention to the very pertinent statement which Mr. Orsettich makes about the high cost of American labour.

THE EFFECT OF LABOUR AND LABOUR SAVING.

In Great Britain, since the war, we are also faced with very high cost of labour, and it must generally be realised that we cannot continue to compete in the world's markets by continuing to use labour here in the wasteful manner in which it has been used in the past, and by merely increasing our selling prices to correspond with the increases in wages granted to labour. Such a policy would merely bring about stagnation. We must exercise the greatest economy in labour not only by adopting labour-saving devices to the extent which they have been adopted in America, but by constantly endeavouring to go one better.

We must also pay attention to the personal element by getting the British trade unions to take a more enlightened view of labour-saving appliances as has been done by American trade unions, who fully realise that labour-saving devices work for the benefit of labour, and not to its detriment.

The question of labour saving is a very important one at the present time, because the Americans in spite of their ever-increasing rates of wages and their handicap owing to rates of exchange being against them, are now showing a very lively disposition to put goods on the export market at cheaper prices than can be done by Great Britain. These remarks, while they apply to industry generally, apply very strongly to iron and steel works. One has only got to go into an American mill and count the number of men on the mill floor and then go into an English mill and do the same thing, to realise what savings can be made on this one item alone.

TIN PLATE MILL COSTS.

Both the mechanical engineer and the electrical engineer have their proper function in assisting in bringing about an economy in labour. For instance, the great majority of tin mills in America are driven electrically. We know very well that the great majority of tinplate mills in this country are not driven electrically, but usually by steam plant of a particularly antiquated character. The total number of tinplate mills in this country approaches 700. Those, however, which are driven electrically can almost be counted on the fingers of one's hands. My own experience is that many tinplate makers with whom I have come in contact have not made any proper tests to ascertain the cost of driving their mills, and do not really know the cost. They are frequently very ready to make statements about the cost, which, by their very character, reveal themselves as the merest guess work.

It is my private opinion that if tinplate makers generally went to the trouble of ascertaining what the cost of driving their mills really is, they would obtain some results which would cause them considerable surprise, for what has been allowed to pass under pre-war conditions will present a very different aspect under the conditions which exist at present. It must be admitted, however, that there are grounds for feeling doubtful whether even those mills which are at present electrically driven in this country, are obtaining the best results for various reasons, and I cannot help thinking there is room for improvement.

DIRECT VERSUS ALTERNATING CURRENT.

Mr. W. E. Swayle raises in his article the question of direct current versus alternating current in steel works in a very interesting manner. I feel, however, compelled to take exception to his statement that in America and on the Continent the induction motor has become all but supreme. Investigation will show that on the Continent the number of steel works who use alternating current and the number of those who use direct current are very nearly equal, while further investigation will show that where alternating current is used there is some very strong reason for its adoption, such as in the case of Peine, near Hanover, where the blast furnaces are something like 5 miles from the steelworks.

The probable reason why alternating current has admittedly found such a wide adoption in America is because, as Mr. Orsettich points out, the American tendency is to confine a very small range of product to each mill, so that the demand for variable speed is not so insistent, and secondly because the American manufacturers have always been behind British and Continental manufacturers in making direct-current plant. The Americans, however, have always very fully realised the advantages of direct-current motors for live roll gear, and for auxiliary drives, and in America direct current is now gaining ground for the main mill drives.

Mr. Swayle refers very particularly to the possible development of variable speed three-phase motors, and this is a very important question, for if a really satisfactory variable speed three-phase motor for mill driving could be developed, it would have a very great influence on the question of whether alternating current or direct current should be used for electrical driving in steelworks, and would enable many of the difficulties to be overcome which occur in those steelworks where, for various reasons, three-phase alternating current power has had to be adopted.

In regard to the system in which a plain induction motor is used with a three-phase commutator motor auxiliary, I have myself had practical experience of the three-phase commutator motor, dating from nine or ten years ago, and I consider that this would make a very excellent machine could some of the inherent difficulties be overcome. I do not wish to make too much of these inherent difficulties because no doubt the progress of engineering knowledge will, in due course, overcome them, but the difficulties in question appeared to have been mainly caused by the fact that up to the present rotors of three-phase commutator motors have only been built for comparatively low voltages, with the result that the commutator is unduly large, and the brush gear is very complicated, both eventually tending to increase the capital cost and the running and maintenance charges of the machine. I think that the real solution of this difficulty lies in finding means of improving the commutating conditions of the three-phase commutator motor, so that the rotor can be wound for a voltage of 500-600 volts and a commutator and brush gear of reasonable dimensions can be employed.

Very great interest attaches to the remarks made about the frequency changer. A frequency changer—on paper—is a very interesting machine, and, if employed successfully, opens the possibility of bringing about some important developments in three-phase plant, but a frequency changer is a machine with a commutator and in the past has suffered from similar disadvantages to the three-phase commutator motor.

It is to be hoped that these disadvantages may soon be satisfactorily overcome, and that further articles may be contributed to THE ELECTRICIAN dealing with the manner in which they can be solved.

Mr. Swayle, in comparing the various methods of obtaining variable speed from the three-phase system, has referred only to the overall full load efficiency. As in the rolling mill work the load is generally of a very variable character, and the average may easily be half the full load or less, it is to be hoped that Mr. Swayle will, at some future date, add to his remarks by instituting a further comparison, say at half load and quarter load, as the true comparison in most cases probably lies between these points.

[We take this opportunity of recording our appreciation of the advice and assistance given to us by Mr. C. A. ABLETT in the preparation of this issue.—ED. *E.*]

Electricity in U.S.A. Industries.

In a memorandum recently issued by the Guaranty Trust Company of New York on Hydro-electric Development in the United States, it is suggested that hydro-electric works might be co-ordinated with the generation of electricity by steam engines at the mouth of the coal pits, and that electrical energy might be distributed without the necessity of carrying coal by railways. Coal represents more than one-third of the country's total freight, and much of it has to be carried very long distances. The steam railways consume more than 160,000,000 tons of coal annually, while under existing conditions of power generation the greater the progress in manufacturing the greater becomes the burden upon the transportation systems in the way of haulage of fuel. The petroleum supplies will eventually fail to satisfy requirements, and will necessitate the supplementing and, in large measure, the supplanting of coal and petroleum through the development and utilisation of the nation's vast water power. Once installed, hydro-electric plants are operated at comparatively low cost, the chief charge being the interest on the investment. By linking steam generating plants at the coal mines with hydro-plants, great areas may be supplied with power economically. The potential water power of the States is given as 59,360,000 h.p., of which only 16·6 per cent. is developed.

Electricity in Agriculture.

In the Pacific States there has been a remarkable development in the construction of long-distance power lines fed with current from a great number of stations. Through the consolidation of utilities and the interconnection of systems there is now, from a practical operating point of view, but one vast system, with lines reaching from the Oregon border to Mexico, over a distance of 800 miles, with 75 hydro-electric and 47 steam plants and 7,200 miles of transmission lines. The installed capacity is 785,000 kw., with approximately 600,000 consumers.

The applications of electricity outside the field of transportation and lighting are rapidly extending. In the south-west, where irrigation over so large an area is essential to agriculture, electricity is playing an important part. The California rice industry, which is almost wholly dependent upon electric pumping, had its beginning in 1912, and last year the crop was valued at £27,000,000. The Kansas wheat fields provide another example of the use the farmer is making of electricity. This summer wheat in at least a dozen counties was threshed by electricity. One company supplies power to 60 towns and 500 farms. Electrified mines in Montana, Idaho and elsewhere have demonstrated the advantages of electricity in the industry, while the north-west paper mills are resorting to electricity and many saw mills are electrified.

Electricity Supply Districts.

The Electricity Commissioners notify that the date for submitting proposals for the re-organisation of electricity supply in the West Riding (Aire and Calder) Electricity District, and for making representations or objections to the area as provisionally determined has been extended until the 31st December, 1920.

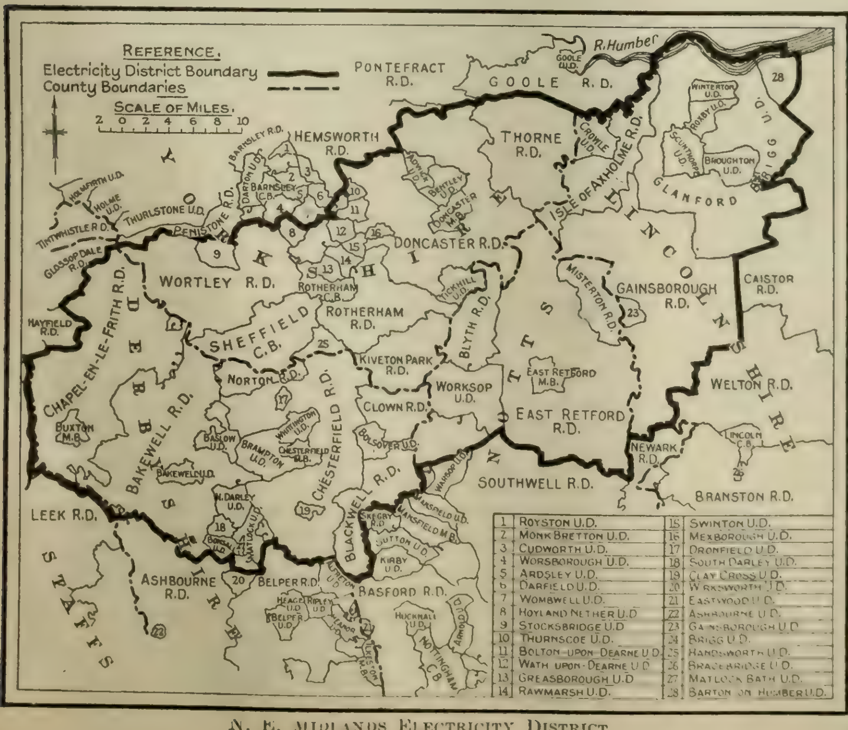
Two additional electricity areas have been provisionally defined, viz., the South Wales and the East Midlands electricity districts.

The East Midlands Electricity District includes so much of the county of Derby as is included in the county borough of Derby, the municipal borough of Ilkeston, the urban districts of Alfreton, Alvaston and Boulton, Ashbourne, Belper, Heage, Heanor, Long Eaton, Ripley, Swadlincote district and Wirksworth, and the rural districts of Ashbourne, Belper, Hartshorne and Seals, Repton, Shardlow and Sudbury; so much of the county of Leicester as is included in the county borough of Leicester, the municipal borough of Loughborough, the urban districts of Ashby-de-la-Zouch, Ashby Woulds, Coalville, Melton Mowbray, Oadby, Quorndon, Shepshed, Thurmaston and Wigston Magna, and the rural districts of Ashby-de-la-Zouch, Barrow-upon-Soar, Belvoir, Billesdon, Blaby, Castle Donington, Loughborough, Market Bosworth and Melton Mowbray; so much of the county of Nottingham as is included in the City and county borough of Nottingham, the municipal boroughs of Mansfield and Newark, the urban districts of Arnold, Beeston, Carlton, Eastwood, Hucknall, Torkard, Huthwaite, Kirkby-in-Ashfield, Mansfield Woodhouse, Sutton-in-Ashfield, Warsop and West Bridgford, the rural districts of Basford, Bingham, Leake, Newark, Skegby, Southwell and Stapleford; and so much of the county of Stafford as is included in the county borough of Burton-upon-Trent, and the rural district of Tutbury, except Tutbury Rural District detached Nos. 1 and 2.

The South Wales Electricity District comprises the counties of Brecknock, Carmarthen, Glamorgan, Pembroke and Radnor; so much of the county of Cardigan as is included in the municipal boroughs of Cardigan and Lampeter; the urban districts of Aberayron and New Quay; and the rural districts of Aberaeron, Cardigan, Lampeter, Llandyssul and Tregaron; and so much of the county of Monmouth as is included in the county borough of Newport; the municipal borough of Abergavenny; the urban districts of Abercarn, Abersychan, Abertillery, Bedwas and Machen, Bedwellty, Blaenavon, Caerleon, Ebbw Vale, Llantarnam, Llanvrechva Upper, Mynyddislwyn, Nantyglo and Blaina, Panteg, Pontypool, Rhymney, Risca, Tredegar and Usk; and the rural districts of Abergavenny, Magor, Pontypool and Saint Mellons.

Any objections or representations in regard to the East Midlands area must be made to the Secretary of the Electricity Commission by March 31, 1921, and in regard to the South Wales area by April 30, 1921.

The accompanying map shows the area of the North East Midlands Electricity District which was recently provisionally determined by the Commissioners.



N. E. Midlands Electricity District

Legal Intelligence.

P.O. Telephone Claim.

At the City of London Court, last week, Assistant Judge Jackson heard a claim by the Postmaster-General for £2 14s. expenses from Mr. A. H. Hastie, for removing a telephone from a house in Adelphi-terrace to another in Ennismore-gardens. On changing his residence Mr. Hastie gave orders for the removal of an instrument and undertook to pay £2 14s., the standard charge. The Postmaster-General refused to comply with the order, and instead put in a new installation and claimed that he was entitled to make a charge of £4 for a new installation, although only £2 14s. was actually claimed. A witness from the G.P.O. said that although only £2 14s. was claimed, it had been the invariable practice since 1915 to make an applicant for a telephone pay £4 before he was allowed to have a telephone at all, but he could not say whether there was any authority for that now permanent charge.

Assistant Judge Jackson held that the Postmaster-General had failed to carry out Mr. Hastie's orders and dismissed the action, with costs on the higher scale.

Employers' Liability Act.

At Aberdare County Court last week Judge Rowlands gave his decision in a claim by Mrs. M. Priest for damages against the Bwllfa & Merthyr Dare Collieries, for the death of her husband, James W. Priest, electrician, who was killed at a transformer sub-station at the company's colliery in May last. Deceased had been ordered to remove temporary connections at the transformer sub-station. The chief electrician had switched off the current, but no further steps were taken to ensure that the current was not restored while Priest was working. Soon after another electrician named Jenkins arrived and was instructed to remove certain connections in another place. Jenkins inadvertently switched on the current, and Priest was found dead at the transformer station. For plaintiff it was contended that Mr. Dyer (the chief electrician) had been guilty of negligence because he did not take steps to prevent interference with the switch, and that he failed to open the isolating switches, which would have prevented the power being restored by interference. The claim was for £1,000, and in giving judgment for £642. 15s. 8d. (three years' earnings), his honour said he found that Mr. Dyer had been negligent in his supervision between the time deceased left for the transformer sub-station and the arrival of the man Jenkins, in that he did not take proper measures for non-interference with the switch.

Commercial Topics.

The Export Credits Scheme.

In consequence of the recent representations of the Federation of British Industries, the Board of Trade have decided that in future the Export Credits Department may, at its discretion, give advances to exporters up to 100 per cent. of the cost value of shipments, but with recourse to the exporter in respect of 20 per cent. in case of default.

Bulgaria has been added to the list of countries to which the Export Credits Scheme is applicable. The full list of countries now covered is as follows: Finland, Latvia, Esthonia, Lithuania, Poland, Czecho-Slovakia, Serb-Croat-Slovene State, Rumania, Georgia, Armenia and Bulgaria.

* * * *

The Brazilian Market.

The demand for machinery, engineer's stores, &c., in Brazil remains very good and it is reported that it will be many years before the country can supply its own requirements. All kinds of industrial plant, agricultural machinery and engineering supplies are required, including windmills, pumps, internal combustion engines, sugar-crushing machinery, electric lighting plant, mining equipment, tramway material, motors, &c. The plans for further developing the water power of the country also open up great possibilities for the sale of generating plant.

* * * *

Trade and Industry in Australia.

On the 28th ult. an interesting address was given by Mr. S. W. B. McGregor on "British Trade and Industry in Australia." The three main channels were wool manufacturing, the steel industry and the boot and leather trades, for all of which Australia had raw materials in plenty. In regard to the steel industry, he said, that people in this country had no idea of the great beginnings of a large industry which had already been made. Last year the principal steel works turned out 162,000 tons of pig iron and 185,000 steel ingots; 4,835 men were employed and a capital of over 4½ millions was involved.

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Trade Marks in Argentine.

Under the Argentine law relating to trade marks the right of priority is given to the first applicant for registrations and as a consequence the piracy of marks is very common. Manufacturers should, therefore, remember that there is danger in advertising or selling their products in the Argentine without having taken the precaution of registering their trade mark beforehand. At least an application should be filed for registration of trade marks before the goods are advertised or placed on this market; otherwise it may be found, upon attempting to sell the goods, that some unscrupulous person has already registered the trade mark with a view to selling the right of use later to the original owners, at an exorbitant profit.

* * * *

Water Power in Spain.

According to recent statistics, prepared by the Union Eléctrica Española, the existing hydro-electric works in Spain represent a capacity of about 620,000 H.P., compared with 348,297 H.P. in 1917 and 281,490 H.P. in 1914. Though these figures represent a fairly rapid increase in the use of electricity generated by water power, yet only about 10 per cent. of the country's available water power has been developed. The scarcity and high price of coal and other fuel are compelling engineers to devote more attention to the investigation of water power and many concessions have been granted this year. In view of these developments British manufacturers and exporters would do well to keep in close touch with events, as large orders are likely to be given out for turbines, electric generators, switchgear, transformers, transmission lines, motors, instruments, &c., and with foresight a good portion of these contracts should be secured.

* * * *

The U.S.A. Export Trade.

Complaints by colonial and foreign buyers of delay in the delivery of goods are not confined to British manufacturers and exporters. Conditions appear to be equally bad in America, for some South African dealers recently protested against the long time taken by U.S.A. manufacturers to supply electrical goods, which in some cases had been 12 months on order without any promise of delivery. An appeal has now been made to electrical manufacturers by Dr. R. S. MacElwee, director of the U.S.A. Bureau of Foreign and Domestic Commerce, urging that special effort be made to fill foreign orders. "If they do not, much harm will result to American business, not only in the electrical trade, but in other lines as well. Indifference to the needs of foreign customers in one line of goods readily affects the sale of other American products in the same section. Manufacturers do not appreciate the importance of the subject, and do not seem to realise the national harm which may result." This is sound advice, and might very well be noted by British manufacturers.

Notwithstanding the difficulty in supplying goods, American bankers and merchants are proceeding with the development of their organisation for the expansion of their export trade. It appears that the latest indication of the trend of events is the approval by the American Bankers' Association of the report of its Committee on Commerce and Marine, which recommended the organisation of a corporation with a capital of $100,000,000 to provide means for the extension of American trade abroad. This scheme, formulated under the Edge Law, contemplates the sale in the United States of $1,000,000,000 of debentures to provide foreign credits, and it is hoped to begin operations on Jan. 1. The committee reported that the economic future of the United States is bound up with the country's trade relations with foreign nations.

Electricity Supply.

Sanction to borrow £19,800 for extensions of the electricity undertaking has been granted to the ALDERSHOT Urban Council.

The maximum price of electricity at TAUNTON has been increased to 1s. per unit, with a minimum of 15 units per quarter in the winter and ten in the summer.

The Electricity Commissioners have approved a scheme of electric supply extensions by the MARYLEBONE (London) Borough Council at an estimated cost of £250,000.

BIRKENHEAD Corporation has sanctioned the erection of a new high-tension sub-station in Marshall-street, and sanction to borrow £44,000 for this and other work has been applied for. A bulk supply will be obtained from Wallasey.

COLNE ELECTRICITY COMMITTEE has received sanction to borrow £19,636 for their undertaking. Of this sum, 80 per cent. is required for buildings and the Electricity Commissioners intimate that they will be prepared to consider an application for further sums when the actual cost is ascertained.

The STEPNEY (London) Electricity Committee reports that the revenue of the electricity undertaking for the year ended March 31 was £208,328, and the expenditure, capital charges, &c., amounted to £184,952, leaving a surplus of £23,376. The total capital expenditure is £671,399, of which £474,734 is outstanding.

Accrington Electricity Committee is supporting the resolution from the LANCASHIRE AND CHESHIRE ELECTRICITY UNDERTAKINGS ASSOCIATION suggesting that the salaries and conditions of employment of electrical staffs should be referred to their representatives on the District Whitley Council, with a view to arriving at a just settlement.

At the meeting of the NAVAN Urban Council last week a letter was read from Mr. J. McCann, Dublin, intimating that he had no money available for the loan of £10,000 in connection with the proposed electric lighting scheme. The L. G. Board have intimated that no further grant would be made to the Council till it compiled with the legal requirements, and so the scheme will probably be dropped.

The Committee of Tynwald, which has been considering the applications of the DOUGLAS (ISLE OF MAN) Corporation and the local Electric Light Company for electric supply powers, has reported in favour of the Corporation, subject to the Corporation paying the Company £500 compensation for expenses incurred and £25, the expenses of the Gas Company in applying for a clause to be inserted to prevent unfair competition. As soon as the Corporation obtain their Bill the Electric Supply Committee will prepare a supply scheme.

At a Ward Meeting last week, Mr. N. M. Brown, convener of the GREENOCK Electricity Committee, stated that the town would probably become the power centre for Renfrewshire in connection with the proposals for the re-organisation of electrical supply. The Electrical Commissioners had promised that they would give Greenock power to put down a new station, which would have a capacity of at least 10 times that of the existing works at Dellingburn, and might cost something like £2,000,000. The station would supply a wide area and include the electrification of the railways between Greenock and Glasgow.

On Friday last a conference was held of representatives of the County Councils and of local authorities in the WEST RIDING OF YORKSHIRE in order to consider the question of the formation of Joint Electricity Authorities. Ald. E. J. Crossley, chairman of the West Riding Law & Parliamentary Committee, presided, and said they wished to consider whether any joint action could usefully be taken in regard to the proposed constitution of electricity districts in the West Riding. The Electricity Commissioners had provisionally constituted three districts affecting the West Riding, the Aire and Calder, the North-East Midlands, and the South-East Lancashire districts. Except for a small rural portion in the north-west, the whole of the West Riding was included in one or other of these three districts.

Mr. Pindar, secretary of the District Councils Association, said that generally speaking, there was no strong objection to the proposed area of the electricity districts. The question of the financial arrangements was much more vital. A sub-committee was formed to consider the proposals of the Electricity Commissioners.

HAMMERSMITH (London) Borough Couuncil have applied to the Electricity Commissioners for sanction to a loan of £37,638 for the electricity undertaking, including expenditure in connection with the bulk supply to the Chiswick Electricity Supply Corporation.

Owing to the high cost of extending the gas mains to the Wormholt housing estate and to the fact that the gas company has suspended the hiring of gas stoves the Hammersmith Housing Committee is considering the question of introducing electric stoves into the new houses. The mains for supplying electricity for lighting will be large enough for supplying a hot-plate or boiling ring in each house, and for an expenditure appreciably below the proposed outlay for gas supply the committee think a supply of electricity can be given for a cooking range in each house. It would be possible to put into each house a small oven and two boiling rings complete with necessary wiring at a reasonable cost, and this apparatus would do all the work necessary for cooking meals. The Electricity Committee has, therefore, been asked to supply an estimate of the cost of furnishing a supply of electricity for cooking to between 40 and 50 of the brick and concrete houses which are nearing completion in order that this method of supply may be tested, and subject to the estimate comparing favourably as regards capital expenditure, and generally with the gas company's proposal, the Town Clerk will submit the same to the London Housing Board for their approval.

Electric Traction.

Bredbury & Romiley Urban Council are to lease to Stockport Corporation until Oct. 16, 1931, a local tramway of about 2½ miles in length.

The revenue on the Preston tramways for the year ended March 31 was £89,301, and gross profit was £23,369. Capital charges required £17,446, and net balance, including £6,530 brought forward, was £12,454.

The Tramway Charges Advisory Committee will open an inquiry on Tuesay next under the Statutory Undertakings (Temporary Increase of Fares) Act, 1919, into the question of increased fares. Communications and representations should be addressed to the Secretary.

On Thursday last Mr. C. F. Critchley, chairman of St. Anne's-on-Sea Council, handed a cheque for £144,936 5s. 5d. to the chairman of the Blackpool, St. Anne's and Lytham Tramway Company, the amount agreed upon for the purchase of the Company's undertaking, which has now passed into the control of the Council.

The Leeds Corporation is recommended by the General Purposes Committee to commence at once the construction of a ring road round the city for the purpose of running a service of express tramway-cars. The scheme will find work for the unemployed and the Ministry of Transport will pay half of the cost.

The accounts of Keighley Tramways department for the year ended March 31 show traffic revenue £17,064 and working expenses £13,767, and the net surplus, after providing for capital charges, was £1,675, compared with £2,011 last year. Passengers carried were 4,044,607 (3,626,176). The revenue on the trackless trolley cars was £2,320, and the working expenses £3,066.

The directors of the Lancashire and Yorkshire Railway Company are being urged to adopt Electric Traction on the Manchester-Rochdale Line. At the last meeting of Crompton Urban Council a member said that at present it took 40 minutes to travel 10 miles and it was decided to urge every district in the area to press for an early change in the present method of traction.

A question of importance to tramway travellers has arisen on the London United Tramways. It appears that passengers sometimes travel beyond the stage for which they have paid, and the Company maintains that when a passenger pays a fare his contract is up at the point at which the fare expires. If he continues to travel on a car beyond that point, a fresh contract is necessary. As the minimum for any single contract is 1½d., an additional fare of not less than 1½d. is required where the journey is continued after the expiry of the original contract.

Durham County Council is to consider the expediency of promoting a Bill for power to authorise the construction of an extensive network of tramways in the County. The most important of the routes to be constructed are :—From the terminus of the Gateshead tramways at Low Fell through Chester-le-Street, Durham City, Langly Moor and Sunderland Bridge to Spennymoor ; from Gateshead tramways terminus at Heworth, through Hebburn, to the Jarrow light railways ; from the junction of Albert-road and Bede Burn-road, Jarrow, to Boldon Colliery and thence to a junction with Whitburn-road near Cleadon ; from the termination of the authorised S. Shields light railway, near Cleadon Laws, to Sunderland Corporation Tramways at North Bridge-street. Power will also be sought to provide and work numerous trolley vehicles.

A Special Committee has been appointed by the Minister of Transport to report on the question of automatic train control. The terms of reference are "to enumerate the possible functions of automatic train control in relation to railway conditions in the United Kingdom, and to prescribe the requisites which the devices should fulfil ; to examine automatic train control devices under trial, and to recommend for further trial or for experimental installation any devices which are or may become valuable during investigation, and to form conclusions on the adoption of automatic train control in respect of all or any of its possible functions having regard to the advantages which would be obtained and the cost involved."

The chairman of the Committee is Col. J. W. Pringle, chief inspecting officer of railways, and the other members are : Major Hall, Mr. J. H. Thomas, M.P., Sir Robt. Turnbull, Major A. Edmunds, Mr. W. C. Acfield, Mr. G. E. C. Cox, and Mr. E. Gresley.

An interesting proposal is made by Mr. Alex. Ross, a past president of the Institution of Civil Engineers, for the construction of an outer circular electric railway in London for the purpose of co-ordinating the railway and street traffic of London, relieving street congestion, &c. The suggested line, which would coincide with the limits of the 12-mile radius from Charing Cross, would pass over the Thames by a bridge at Kingston and under it by a tunnel at Purfleet ; it would connect Hounslow in the west, Potters Bar in the north, Dagenham in the east, and Croydon in the south. It would pass under or over all the main lines entering London, and at the points of crossing junctions would be provided in two directions, so as to permit trains to be received from any route and passed on to any other. The exchange of traffic would thus be effected outside the suburban zone, where there would be ample room for the construction of exchange stations, and where land would be less expensive than nearer London.

The total mileage would be about 85 miles, and Mr. Ross thinks that a complete double track could be provided at a cost of from £16,000,000 to £17,000,000. The line need not, however, be constructed in its entirety all at once ; selected portions might be built from time to time, as demanded by the requirements of the traffic. While one double line of railway would be sufficient to start with, it would be prudent to secure land for three double lines.

Institution Notes.

The Secretary of the Electrical Contractors' Association of Scotland is now Mr. Walter Finlay, of 55, Frederick-street, Edinburgh. Mr. J. M. Davies, Junr., having resigned this position.

The following publications have been issued by the Bureau of Standards (Washington, U.S.A.) :—Paper No. 391 on "The Measurement of Diffuse Reflection Factors and a New Absolute Reflectometer," and Paper No. 392 on "A Photographic Method of Detecting Changes in a Complicated Group of Objects."

Prof. O. Bower has been elected President of the Royal Society of Edinburgh for the ensuing year. The Vice-Presidents are Prof. D. N. Paton, Prof. A. Robinson, Sir G. A. Derry, Prof. W. Petty, Sir J. A. Ewing, and Prof. J. W. Gregory. Dr. G. C. Knott has been re-elected general secretary.

The King's College (London) Old Students' Association (Engineering Faculty) gave a Lunch at the Holborn Restaurant on the 27th ult. Fifty-four members attended, and many distinguished King's engineers were present, including the Chairman (Mr. C. H. Wordingham, C.B.E.), a past President of the Institution of Electrical Engineers, Mr. Ll. B. Atkinson, President of the Institution of Electrical Engineers, Gen. M. Mowat, C.B.E., Secretary of the Institution of Mechanical Engineers, Mr. E. Fiander Etchells, President of the Concrete Institute, and Mr. J. S. Highfield. Old students interested in the activities of the K.C.L.O.S.A. are requested to communicate with the Hon. Assistant Secretary, Mr. D. H. Kendon, King's College, Strand, W.C.2.

At the recent meeting of the South African Association of Municipal Electrical Engineers, the new President (Mr. T. C. Wolley Dod) delivered his address, in the course of which he expressed the belief that while municipal control of electricity supply would continue in South Africa for many years to come, the tendency of the future must be towards super-power stations more under catholic control. The electrification of railways in certain districts would entail the establishment of power stations under the joint control of the local authorities and the railways, or more probably controlled by some body independent of either. South Africa was not a country where hydro-electro stations were likely to be of any importance, and it was upon steam-driven plant that they must rely for the generation of electricity.

Personal and Appointments.

Dr. Angus Fulton, lecturer on engineering at Dundee University College, has been appointed to the vacant chair in engineering at the College.

Mr. G. C. Allingham, M.B.E., M.I.E.E., who was until recently chief engineer of the Tudor Accumulator Company, Ltd., has joined the staff of Mr. C. F. Elwell, radio engineer, Craven House, Kingsway, W.C. 2, and 138, Gordon-road, Peckham Rye.

Stepney (London) Council agreed on Monday to appoint Lieut.-Col. G. G. Ewer D.S.O., as sales engineer at £600 per annum, rising by one annual increment to the rate scheduled for Grade 3 (Class F.) in the schedule of salaries for technical engineers issued by the National Joint Board. The appointment will date from July 12, the date on which Lt.-Col. Ewer, after service in H.M. Forces since August, 1914, resumed his duties in the department.

Mr. Wm. A. A. Burgess, M.I.E.E., late resident electrical engineer for the British Dyestuffs Corporation, Huddersfield, has been appointed Chief Electrical Engineer to the Corporation, with charge of the electrical equipment at all their factories. Mr. Burgess, whose headquarters remain for the moment in Huddersfield, has had charge of the electrical department of the Corporation there for the last five years, and previous to that was for nine years with Messrs. Merz & McLellan.

Mr. William Frederick Ingamells, who has resigned his appointment as Advertising Manager with the Edison Swan Electric Company, was on Friday last presented with a diamond-and-pearl scarf-pin by the general staff at Ponders End Works. The presentation was made by Mr. H. V. Richards, Chief Assistant in the Advertising Department, the gift being accompanied by a tastefully printed address with the list of subscribers. Mr. Ingamells was also presented with a silver card-case by Mr. J. Thom, on behalf of the Stationery Department.

There was an interesting function at Messrs. Simplex Conduits, Ltd., on Friday last, when a handsome presentation of books was made to Mr. T. Birkett upon the occasion of his resigning the position of Publicity Manager to the Company and Chairman of the Welfare Club, in order to take up the position of Sales and Publicity Manager of the Midland Electric Manufacturing Company, of Birmingham. Capt. McLoughlin, joint general manager, who made the presentation, said the publicity work done by Mr. Birkett was of a distinctive order, and he would be missed by everyone on the firm by reason of his work on the Welfare Club.

Bankruptcies and Liquidations.

A meeting to receive an account of the winding up of Accumulators, Ltd., will be held on Nov. 29 at 11d, Regent-street, London, S.W.1.

Claims against Commercial Electrical Accessories, Ltd. (in voluntary liquidation), are to be sent by Nov. 26 to Mr. Norman Bell, 79, Wool Exchange, Coleman-street, London, E.C.

The first meeting of the creditors of Harrison & Son, electrical engineers, 93, Princes-street, London-road, Southend-on-Sea, will be held on Nov. 9 at 14, Bedford-row, London, W.C.1, and the public examination on Dec. 1 at the Shire Hall, Chelmsford.

Miscellaneous.

A licence has been issued by the Board of Trade to the British Motor-Cycle & Cyclecar Research Association, which has been approved by the Scientific and Industrial Research Department as complying with the conditions laid down for the encouragement of industrial research. The Association may be approached through Major H. R. Watling, "The Towers," Warwick-road, Coventry.

A South Wales "Health and Home" Exhibition will be held in the Drill Hall, Cardiff, from Jan. 26 to Feb. 5 next. The principal feature will be the display of domestic labour-saving appliances including demonstrations of the latest house lighting and heating systems, and the most modern methods in the preparation and cooking of food. The organising manager is Mr. E. Watson, of 37, St. Mary-street, Cardiff.

The Unemployment Insurance Act of 1920 comes into force on the 8th inst. Every employee over 16 years of age not receiving £250 per annum, with certain exceptions, is covered by the Act. The weekly contribution is 8d. for men (4d. from the employer and 4d. from the employee) and 6½d. for women (3½d. and 3d. respectively). For boys and girls the weekly contributions are 4d. and 3½d., of which the employer pays 2d. in each case.

Messrs. D. Harper & Company, Ltd., 258-262, Holloway-road, London, N.7, publish a variety of useful Pocket Diaries for commercial and business men. As everyone needs a diary for keeping records of appointments, &c., and as the firm offer a wide choice, ranging in price from 9d. to 7s. 6d. each, the requirements of all classes are fully met. The diaries, which are well printed on good paper, contain 30 pages of commercial information, post and telegraph regulations, &c.

We regret that two small errors occurred in Mr. Raymond J. Mitchell's article on "Olympia and British Progress in Electric Vehicles," which appeared in our last issue. The battery exhibited by Messrs. Batteries, Ltd., is referred to "as an English edition of the Swedish Funguen." This should read "an English edition of the Swedish Jungner." The battery is also referred to as being for a two-ton vehicle, while in reality the one shown at the Exhibition was designed and has been used on a 3½ ton vehicle.

An agreement has been made between the London District Committee of the Electrical Trades Union and the National Federated Electrical Association for an increase in the wages of electricians' mates, electrical and mechanical fitters' mates, wiremen's, overhead linesmen's and jointers' mates, &c. Under the agreement, which is dated Oct. 29, 1920, the minimum rate for auxiliary workmen over 21 years (other than apprentices) employed in assisting journeymen is 80 per cent. of the rate paid to fully qualified journeymen. The increased rate of pay is payable on the first pay-day in November. By the agreement 2s. per hour is payable to all mechanics' mates employed by contractors and other establishments, and the rate for electrical and mechanical fitters' mates, electricians' mates, &c., is 1s. 11½d.

The dinner which was given at the Savoy Hotel on the 27th ult. to celebrate the Centenary of W. H. Smith & Son marked a unique occasion in the history of the printing and publishing trades of Great Britain. Viscount Burnham outlined the story of the growth and present multifarious activities of this immense business, and a very distinguished gathering, including Mr. John Douglas, a director of Benn Brothers, Ltd., was in attendance, representing the various trades and professions—painting, journalism, printing, bookbinding, publishing, &c.—with which W. H. Smith & Son are connected. Viscount Hambleden, a grandson of the founder of the firm, paid a great tribute to the memory of his father and grandfather, and mentioned that at present the firm's bookstalls handle 23 London daily papers and between 500 and 600 London weeklies, in addition to 75 provincial publications, and that something like 20 tons of books and magazines are issued daily rom the central buildings in London.

An engineering pupil named Wm. John Orr was accidentally killed by electric shock at Messrs. Vickers' Works, Sheffield, on the 27th ult. Orr was engaged in testing a rotary converter. A witness stated that "the motor went wrong; Orr put his hand into the brush-box and got a shock. Current was cut off and Orr fell backwards." Mr. J. Middleton, who was in charge of the testing of the machine, said that when the motor went wrong he switched off the current, but the machine ran on its own momentum. He was removing the insulating plugs when he heard a shout, and saw Orr on the floor. In reply to a juryman, he said it was not customary to wear rubber gloves, as they bred a sense of false security, and wore out quickly. A verdict of "Accidental death" was returned.

An After-War Reunion of the directors and staffs of the Central Electric Supply Co., Ltd., the Westminster Electric Supply Corporation, Ltd., and the St. James's & Pall Mall Electric Light Company, Ltd., was held at the Queen's Hall, London, W., on Thursday of last week.

Capt. E. I. Bax, Chairman of the Westminster Electric Supply Corporation, in an address of welcome, explained that the gathering was somewhat belated, because last year, when the subject was mooted, demobilisation was not complete, and when the matter was considered early in the present year it was decided to wait till after all those interested had returned from their holidays. The Board sympathised deeply with the relatives of those who had fallen and with those who had been wounded or suffered in health by the troubles and tribulations of the Great War.

An excellent concert was provided, the performers including the Vale Lane Orchestra and many vocalists. A tempting array of refreshments, solid and liquid, was also available.

Catalogues, Price Lists, &c.

A leaflet issued by the "Z" Electric Lamp & Supplies Company, Ltd., Standen-road, Southfields, S.W.19, gives a description of the "Electrolux" Suction Cleaner which is claimed to be exceedingly novel but simple in design and efficient in service. The motors are suitable for d.c. or a.c. circuits (40-60 periods) from 50 to 250 volts.

Messrs. Thos. Firth & Sons, Ltd., Sheffield, have issued a revised edition of their Handbook on Carbon and Alloy Steels. The firm have an excellent reputation as manufacturers of high class steels, and those interested will find much useful information about their products in the new edition which is arranged in such a way as to permit of easy reference. There are notes on mechanical testing, case-hardening, steels for special purposes, useful tables, &c.

The recent trade literature of the General Electric Company Ltd., include a new Osram folder bearing on the front the popular "Hornbill" design, and a four page leaflet dealing with the "Geeko" accumulators for ignition, lighting and starting purposes on motor cars, launches, stationary engines, &c. Particulars of the principal features and advantages of these accumulators are given and it is stated that the capacities stated for each size are "actual" and not based on ignition discharge.

A number of descriptive pamphlets recently issued in a standard binder by Marconi's Wireless Telegraph Company, Ltd., give a very good idea of the activities of the Company in the Development of Wireless Apparatus. Since the Armistice the Company have prepared 65 of these pamphlets describing their post-war productions, and it has already been found necessary to revise 18 of them owing to the continual improvements in designs. This is a good index of the progressive character of the Company's operations and activities. We hope to refer more fully to some of these pamphlets in an early issue.

Engineers concerned with steam-raising plant, as well as steam users generally, will be interested in the new catalogue of Messrs. Holdsworth & Sons, Ltd., Bradford. The publication gives particulars, technical data, the results of tests, &c., relating to the Lancashire, Yorkshire, Cornish and other boilers, as well as the other products of the firm. It is about 13 years since the Yorkshire boiler was introduced, and the results seem to have justified the optimistic expectations then formed. The details of evaporation of Lancashire and Yorkshire boilers working under identical conditions are given, and the results are greatly in favour of the latter. The catalogue also contains useful notes on feed-heating, economisers, &c.

The Benjamin Electric, Ltd., of Tottenham, have issued interim list No. 515, which supersedes their section lists Nos. 509 and 511. It is now being generally recognised that correct lighting in factories, workshops and offices is essential in the interests of industrial efficiency and economy, and the Benjamin Company have a long experience in the design and manufacture of all kinds of illumination fittings and accessories. The new list gives particulars and prices of the Benjamin Industrial Lighting Fittings and Specialities, and a great variety of fittings, including several new designs, are listed and described. These include a number of reflector fittings for both indoor and outdoor use, steel reflectors, outside lanterns, semi-indirect, indirect and shop-window fittings and many other specialities. The list prices include all advances in prices to date, except the last advance made on February 24th last.

Business Items, &c.

We learn that the British-Thomson-Houston Company are about to establish lamp works at Chesterfield, and have purchased a site of about 13 acres in extent from the Corporation.

Mr. W. E. Highfield has resigned his position with the English Electric Company, Ltd., to enter into partnership with his brother, Mr. J. S. Highfield, consulting engineer, at 36, Victoria-street, Westminster, S.W. 1.

In reference to the Apex ironclad switchgear, referred to in our last issue, we ought to have stated that this switchgear is being manufactured in London, and the sole selling rights are vested in the Sun Electrical Company, the Foster Engineering Company, Drake & Gorham Wholesale, Ltd., and Downs & Davies.

We are informed by Messrs. Escher, Wyss & Company that as from Nov. 1 their offices will be at 20, Grosvenor-gardens, London, S.W. 1, instead of at 109, Victoria-street, where they have been established since 1909. The telephone number of the new office is Victoria 9120, and the telegraphic address Eswysco, Sowest London.

The "Z" Electric Lamp & Supplies Company, Ltd., has been formed to carry on the sale of "Z" vacuum and gasfilled lamps and electrical appliances, including "Electrolux" suction cleaners, on similar lines to that hitherto carried on by the "Z" Electric Lamp Manufacturing Company (in liquidation), and by arrangement with the liquidator the new Company is trading from the factory at Southfields until such time as its London offices and showrooms at 73, Newman-street, W.1, are ready for occupation. Arrangements have been made by which the company will act as sole selling agents for the sale of the old Company's finished lamps and accessories. The active management will be in the hands of the old officials and as the Birmingham, Bristol and Dublin depots will be retained, there will be a continuity of business. New depots in other territories will be opened as opportunity offers.

Tenders Invited and Accepted

TURTON Urban Council require tenders by Nov. 10 for overhead lines and underground cables. Specification from the Electrical Superintendent, Bromley Cross, near Bolton.

GLASGOW Corporation require tenders by Nov. 12 for electric wiring in connection with the Greenhead Housing Scheme. Forms of tender from the Electrical Engineer, 75, Waterloo-street, Glasgow.

FALKIRK Parish Council require tenders by Nov. 13 for six months' supply of electric lamps, &c., to the Blinkbonny Home. Forms of tender from the Governor, Blinkbonny Home, Falkirk.

The **SLIGO, LEITRIM and NORTHERN COUNTIES RAILWAY COMPANY** require tenders by Dec. 1 for 12 months' supply of telegraph materials, castings, oils, &c. Forms of tender from the Secretary, Enniskillen.

ECCLESALL BIERLOW Guardians require tenders by November 10th for the electric lighting of hospital and infirmary blocks. Particulars from the Clerk, Union Offices, The Edge, Sheffield.

The **GREAT NORTHERN RAILWAY COMPANY (IRELAND)** require tenders by Nov. 16 for 12 months' supply of stores, including electrical fittings, lamps, &c., electric cable and wire, metals, rubber goods, oils, &c. Forms from the Secretary, Amiens-street Station, Dublin.

Amongst the requirements of the **ALBERTA GOVERNMENT** Telephone Dept. during 1921 will include copper clad wire, iron wire, staples insulators, bolts, screws, &c. Specifications can be seen at the Dept, of Overseas Trade, Westminster, S.W.1.

MANCHESTER Electricity Committee invite tenders by November 22nd for supply and erection of motor-generators, battery boosters, switchgear, &c., at Barton power station. Specifications from Mr. F. E. Hughes, Town Hall, Manchester.

BRADFORD Tramways Committee require tenders by Nov. 20 for one year's supply of stores, including lamp fittings, insulating material, controller contacts, rubber, vulcanite fibre, &c. Conditions of tender from the General Manager, Hall Ings, Bradford.

The **VICTORIAN RAILWAY COMMISSIONERS** require tenders by Jan. 19 for the supply and erection or, alternatively, the supply and delivery only of an electric furnace for their Newport workshops (contract 33,419). Specifications may be seen at the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W.

The Deputy Postmaster-General, Melbourne, will receive tenders until 3 p.m. Nov. 23, for the supply of telephones and telephone and switchboard parts (Contract No. 1650) for the **AUSTRALIAN COMMONWEALTH** Postmaster-General's Department. Specifications from the High Commissioner, Australia House, Strand, London, W.C 2.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the **AUSTRALIAN COMMONWEALTH** Postmaster-General's Departments: New South Wales: Telegraph and telephone instruments and switchboard parts, schedule 753 (Nov. 25) Queensland: Protectors, schedule 505 (Nov. 30); iron poles, schedule 506 (Nov. 24); and protected cable terminals and cable distributing boxes, schedule 507 (Nov. 24). **WESTERN AUSTRALIA** of telegraph and telephone instruments and parts, Schedule 689. (Dec. 8.) Tenders forms from the High Commissioner for Australia, 406, Australia House, Strand, W C.2.

Hythe Council have accepted the tender of J. Pain & Company for wiring the Municipal houses at 38s. 6d. per point.

LAUNCESTON (Tasmania) Council has accepted the tender of the Australian General Electric Company for a 1,000 k.v.a. water turbine driven set.

BLACKPOOL Electricity Committee have accpted the tender of British Niclausse Boiler Company for the supply and erection of two boilers, subject to the Electricity Commissioners approving a loan of £42,500.

NUNEATON Council has accepted the tender of the General Electric Company for the supply and erection of h.t. and l.t. switchgear at £4,161. There were 12 tenders varying in amount from that of the accepted to £6,412.

Tenders were recently received for the electric lighting of the Eastville Institution, Bristol, and efforts were made to pass over the lowest tender, that of the Imperial Electrical Co. (at £1,619), in favour of a tender by the Bristol Electricity Department (of £2,114). The usual reason was alleged, viz., that they would be spending the money in Bristol, and it would benefit the people and shopkeepers. It was stated that 30 tenders were received, the average being £2,311. The amendment in favour of Bristol Corporation was, however, defeated by 24 votes to 13.

The following tenders have been accepted by **MANCHESTER CORPORATION**: *Electricity Committee*—Chamberlain & Hookham, Ferranti Ltd., Aron Electricity Meter, Ltd., and Metropolitan-Vickers Electrical Company, meters; Ferranti Ltd., current and potential transformers; Venner Time Switches, Ltd., time switches; Veritys Ltd., A. Reyrolle & Company and Compression Starter & Switchgear Company, motor starters; Geo. Ellison, a.c. star-delta switches; Veritys Ltd., English Electric Company, Metropolitan-Vickers Electrical Company and British Thomson-Houston Company, motors; Babcock & Wilcox, 75-ton and 15-ton cranes (including E.C.C. motors, Allen West controllers and switchgear and Ellison electric brakes). *Housing Committee*—J. Armstrong & Company, wiring houses in Mount-road Estate. *Rivers Committee*—Electric Construction Company, motors and accessories; Walter Scott, Ltd., steel tramrails; Titan Trackwork Company, Hadfields, Ltd., and Edgar Allen & Company, special trackwork.

Patent Record.

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SPECIFICATIONS PUBLISHED

The following abstracts from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1914 SPECIFICATIONS.

11,08) SOC. ANON. DES AUTOMOBILES ET CYCLES PEUGEOT. Dynamo [illegible] (6/5/13.) (Addition to 7,840/13.)

1919 SPECIFICATIONS.

150,008 COMPAPPI WIRELESS CONTROL SYNDICATE & COMPARE.—Wireless [illegible] or other wireless control systems. (7/3/19.)

150,025 CREED & CO. & MCLENNAN. Electrical receiving apparatus for amplifying and recording weak electric current impulses. (14/5/19.)

150,037 ROUND. Wireless telegraph and telephone transmission. (21/5/19

Relates to valves and other interrupting devices used in wireless telegraph and telephone transmission, and consists in applying to the grid of a valve a [illegible] voltage of a "square" form and arranging for the absorption or taking up of the energy developed in the higher harmonics.

150,045 FELLOWS. Magnetos. (23/5/19.)

150,046 LEFLON & HUMBERT. Electric igniters for lighting burners, cigars, pipes and the like. (23/5/19.)

150,060. KILBURN. (Ford Instrument Co.) Electric step-by step signalling apparatus. (26/5/19.)

150,063 COWPER-COWLES. Process for the continuous production of copper wire by electrolytical methods. (26/5/19.)

150,072 AUTOMATIC TELEPHONE MFG. CO. (Automatic Electric Co.) Electrical [illegible] controlling devices. (27/5/19.)

150,096 WINN. Electric condensers. (6/6/19.)

150,108 BRECKNELL, MUNRO & ROGERS & WILLIS. Trolley heads for overhead wire systems of electric traction. (13/6/19.)

150,109 MYERS. Electric switches. (13/6/19.)

150,111 TUCKER & CO. & TUCKER. Electric switches. (16/6/19.)

150,120 BRITISH INSULATED & HELSBY CABLES, LTD., & ASTLEY. Electricity collectors. (20/6/19.)

150,128 BREEZE & WEST & CO. Electric contact or switches. (23/6/19.)

150,165 B.T.-H. CO. & YOUNG. Magneto-electric machnes. (8/8/19.)

132,240 SCINTILLA. Bearing-end plates for the ignition apparatus of internal-combustion engines. (3/9/18.)

150,170 RAILING, SAUNDERS & COLLINGS. Locking device for electric and gas fittings. (22/8/19.)

150,171 GARDINER & DUGGAN. Electric storage batteries. (26/8/19.)

131,908 ARIOLI ET CIE. Magnetos. (29/8/18.)

150,195 HANDS, ROBINSON & HANDS ELECTRICAL COMPANY. Holders for electic lamps. (28/10/18.)

150,204 IMRAY. (Eisemann Magneto Corporation.) Combined magneto and dynamo-electric machine. (15/11/19.)

150,214 PESTALOZZA. Electrolytic apparatus for the direct production of hypochlorites. (19/12/19.)

138,081 BOSCH AKT.-GES. Magnetos for igniting in internal-combustion engines. (21/11/18.)

141,328 AMERICAN BOSCH MAGNETO CORPORATION. Magneto-electric ignition-apparatus for internal-combustion engines. (8/4/19.)

138,639 DEUTSCHE GASCLUHICT ASK-GES. (in liquidation). Method of evacuating the bulbs of electric incandescent lamps and other glass vessels. (18/5/18.) Addition to 101,621.)

Consists in heating the ends of the nipples so highly that the glass of the nipples runs, whereupon the nipples are removed from the heating zone after the exhausting operation. A very reliable closure of the lamps is obtained with the formation of a rounded pipe not easily damaged.

150,231 SIEMENS BROS. DYNAMO WORKS & BOLTON. Protective arrangements for alternating-current electric circuits. (9/2/20.)

139,822 SIEMENS SCHUCKERTWERKE GES. Meters used in connection with the batteries of electrically-driven submarines. (5/12/14.)

141,682 FABRIK ELEKTR. APPARATE F. SAUTER. Electric time switches. (15/4/19.)

140,769 BILLIEUX. High-frequency alternator. (22/11//17.)

150,254 ANDERSON & BUCKNALL. Combined electric switch and terminal. (30/4/20.)

146,941 METROPOLITAN-VICKERS ELECTRICAL COMPANY. Electrical fuses of the cartridge type. (5/7/19.)

145,784 SACHS. Electric switches. (13/3/19.)

APPLICATIONS FOR PATENTS.

May 12, 1920.

13,154 SIEMENS & HALSKE A.G. Telegraphic transmitter. (28/2/19, Germany.)
13,159 RAMSEY. Electric generators and motors.
13,160 WRIGHT. Radiogonometers for wireless direction finding, &c.
13,166 BENTLEY & SCOTT. Electric cranes, hoists, &c.
13,171 LARSEN. Time-control switches.
13,182 MANSELL. Switches.

May 13, 1920.

13,194 AUTOMATIC TELEPHONE MFG. CO., HARRISON & SMITH. Telegraph printing systems.
13,216 HALL. Switches.
13,217 CRESER. Short-circuiting electrical devices.
13,240 HESS & KIRSCHNER. Electro-plating by electrolysis thermic means. (10/10/17, Austria.)
13,245 ALLBRIGHT. Electric burglar alarm.
13,257 BERGERY. Incandescent lamps.
13,262 FULLER. Galvanic batteries.
13,272 COWPER-COLES. Electro-deposition of metals.
13,275 SOC INDUSTRIELLE DES TELEPHONES. Self-induction coils. (22/5/19, France.)
13,277, 13,278, 13,279 & 13,280 FRANCIS, WATKINSON & QUINNELL. Resistance switches
13,281 HUGHES. Receiving apparatus for wireless telegraphy.
13,300 WILSON. Thermo-electric apparatus.

May 14, 1920.

13,327 HANSA-LLOYD WERKE. Electric motor vehicles. (8/7/19, Germany
13,352 WESTERN ELECTRIC CO. Thermionic devices. (1/11/16, U.S.)
13,359 MURRAY & SHOTTER. Switches. (14/5/19, U.S.)
14,340 ROMER. Wireless telegraph and telephone circuits.

May 15, 1920.

13,410 VERITYS & THORPE. Electric lanterns, &c
13,417 BAKER & PARSONS. Switches.
13,418 BENTLEY. Portable electric lamps.
13,428 CAMPBELL. Electric heater for perforating, &c., devices.
13,437 B.T.-H. CO. (G.E. Co.) Switches.
13,438 PIRELLI GENERAL CABLE WORKS & BEVIS. Multiple electric cables

May 17, 1920.

13,487 ROSS. Electric distributing systems.
13,490 MANN. Variable resistances.
13,491 GARRARD, WILSON & SOLOMON. Motor-controlling switchgear.
13,516 UREN. Fuses.
13,518 REYROLLE & CO. & LEESON. Switches, &c.
13,538 WESTERN ELECTRIC CO. Thermionic devices. (1/11/16, U.S.)
13,572 CHILE EXPLORATION CO. Electrodes. (21/1/20, U.S.)
13,587 GORDELIER. Amplifying sounds of telephone receivers or transmitters
13,602 HABICHT. Storage and supply of electrical energy..

Companies' Reports, &c.

The directors of Doulton & Company, Ltd., have declared a dividend of 5 per cent. on the preference shares for the year 1919.

An interim dividend of 8 per cent. per annum has been declared by the Brisbane Electric Tramways Investment Company, Ltd., for the past half-year.

The directors of the Calcutta Electric Supply Corporation, Ltd., have declared an interim dividend of 8 per cent. per annum (4s. per share) on the ordinary shares for the half-year.

The following companies will be struck off the Register of Joint Stock Companies unless cause to the contrary is shown before Jan. 12 : Coke Ovens & By-Products Company, Hemming Conduit Grip, Llanelly Motor & Electrical Engineering Company.

The past year's profit of the North Melbourne Electric Tramways & Lighting Company, Ltd., was £11,288, of which £8,350 has been absorbed in payment of debenture interest, and the balance of £2,878 transferred to reserve for renewals and upkeep.

The trading profit of Herbert Morris, Ltd., for the past year was £121,266, and a final dividend of 6¼ per cent. will be paid on the ordinary shares, making 10 per cent. for the year. The profits have not materially altered, but the directors find that the sum of money required for carrying adequate stocks and for financing work in progress is greatly in excess of previous figures, due to increased cost of materials and labour.

The report of the Montevideo Telephone Co., Ltd., for the year ended July 31, 1920, states that, after providing for all charges in Montevideo and London and making provision for income tax, excess-profits duty and corporation profits tax, the net profit is £40,179. The interim dividend paid in May absorbed £6,514, leaving £33,666, to which is added £8,963 brought forward, making available £42,629. After transferring £20,000 to reserve, the directors recommend a final dividend of 5 per cent., making 8 per cent. for the year, tax free, leaving £11,772 to be carried forward.

Forty Years Ago.

(The Electrician, November 6, 1880.)

The Government and the Telephones. The trial between these litigants will probably be heard on Nov. 22. We have from time to time expressed our opinion that, whatever is the result of the trial, the Government having the "telegraphs," ought to have the control of the telephonic communication.

Consolation for the Gas Companies.—Messrs. Crossley Brothers have constructed no fewer than 1,250 gas engines, probably even many more, as that number is said to be actually in use in England alone. The gas companies themselves are employing them. This is the beginning of a wiser policy it may be hoped.

London Institution.—Among the numerous lectures to be given in this institution during the winter session, we notice two devoted to electrical subjects—viz., on Dec. 16, at seven, Dr. Oliver J. Lodge, discusses "The Relation between Electricity and Light," and on Jan. 20, 1881, at seven, Prof. W. E. Ayrton is to discourse on "The Production of Electricity."

The "Philosophical Magazine."—The current number of this magazine contains Papers "On the New Action of Magnetism on a Permanent Electric Current," by E. H. Hall; "On Magneto-Electric Induction," by Frederick Guthrie and C. V. Boys; "On the Thermic and Optic Behaviour of Gases under the Influence of the Electric Discharge," by E. Wiedmann; also several notes on electrical subjects.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics."—"The Institute of Transport"; "Night Flying," by Major Cecil Baker, D.F.C., A.F.C.; and "Screw Propellers," by M. A. S. Riach, F.Ae.S., A.I.N.A.

"The Cabinet Maker."—"Pattern and Scale as applied to Furnishings"; "Moulded Detail as Decoration for Furniture"; and "Master Gilders' Annual Dinner."

"The Chemical Age."—"Profiteering in Soda: Heavy Fines"; "Emil Fischer Memorial Lecture," by Dr. M. O. Forester; Annual Meeting of the British Association of Chemists.

"Farm and Home."—"This Week's War on Rats" (special); "Rearing and Feeding Calves"; and "The Chase Tractor described."

"The Fruit-Grower" (Exhibition Number).—"Fruit Commercial Shows" (illustrated); "A National Label" (exclusive); and "Distributive Trade Boards Order."

"Gardening Illustrated."—"Early Tulips in Pots"; "Silver-leaf in Fruit Trees"; and "The Pampas Grass" (illustrated).

"The Gas World."—"Gas Coke in Steam Raising"; "Motor Spirit from Natural Gas"; and "Gas Furnaces in Industry."

"Hardware Trade Journal."—"Simple Display Designs made of Wire"; "Further Examples of Industrial Heating"; and "The Principles Involved in Case Hardening."

"Ways and Means."—"Co-Partnership in the Transport Industry"; by Sir Georges Gibb; "Australian Notes," by "Watchman"; and "Priestman in a Printing Works," by H. Cooper.

Arrangements for the Week.

FRIDAY, November 5th (to-day).

Newcomen Society.

5.30 p.m. At the Patent Office Library, Southampton-buildings, Chancery-lane, London, W.C. Paper on "The Literature of Historical Engineering," by Mr. E. W. Hulme.

Institution of Mechanical Engineers.

6 p.m. At Storey's Gate, London, S.W. Thomas Hawksley Lecture on "Limit Gauging," by Sir Richard T. Glazebrook, K.C.B., F.R.S.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, Westminster, London, S.W. Lecturette on "Some Further Locomotive History," by Mr. E. Hooper.

MONDAY, November 8th.

Institution of Post Office Electrical Engineers.

5.30 p.m. At the Royal Society of Arts, John-street, London, W.C. Paper on "Influence of Traffic on Automatic Exchange Designs," by Mr. G. F. O'Dell.

Institution of Electrical Engineers.—Western Centre.

7 p.m. At the Merchant Venturers' Technical College, Bristol, Inaugural Address by Mr. A. T. Newman.

Institution of Electrical Engineers.—North-Eastern Centre.

7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Inaugural Address by Mr. J. R. Beard.

TUESDAY, November 9th.

Institution of Electrical Engineers.—North-Western Centre.

7 p.m. At the Engineers' Club, Albert-square, Manchester. Address by Mr. Julius Frith.

Institution of Electrical Engineers.—Scottish Centre.

7.30 p.m. At 207, Bath-street, Glasgow. Inaugural address, by Mr. J. E. Sayers.

Institute of Metals (Scottish Local Section).

8 p.m. At the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow. Paper on "Fuel," by Mr. J. A. C. Edmiston.

Société des Ingénieurs Civils de France.

8.30 p.m. At the Royal Society of Arts, John-street, Adelphi, London, W.C.2. Paper on "The Destruction of the Mining District of Northern France, and the Work of Reconstruction," by Monsieur Edouard Gruner.

WEDNESDAY, November 10th.

Paisley Association of Electrical Engineers.

7.30 p.m. At the Y.M.C.A. Buildings, Paisley. Paper on "Paisley Corporation Electricity Undertaking," by Mr. W. B. Smith.

Institution of Automobile Engineers.

8 p.m. At the Institution of Mechanical Engineers, Storey's Gate, London, S.W. Paper on "Some Notes on the Report of the Steel Research Association," by Mr. J. H. S. Dickenson.

THURSDAY, November 11th.

Institution of Electrical Engineers.

6 p.m. At the Institution of Civil Engineers, Great George-street, London, S.W. Inaugural Address by Mr. Ll. B. Atkinson.

FRIDAY, November 12th.

Physical Society of London.

5 p.m. At the Imperial College of Science, S. Kensington, London, S.W. Papers to be read on "Ionisation and Excitation of Radiation by Electron Impact in Helium," by Dr. F. S. Goucher; "Fringe Systems in Uncompensated Interferometers," by Mr. J. Guild; "The Location of Interference Fringes," by Mr. J. Guild; and "A New Relay for Moderately Heavy Currents," by Dr. Guy Barr.

Institution of Electrical Engineers.—Scottish Centre—
Students' Section.

7.30 p.m. At the Royal Technical College, Glasgow. Opening Address by Mr. F. H. Whysall.

Electro-Harmonic Society.

8 p.m. At Cannon-street Hotel, London, E.C. Concert (Ladies' Night).

Junior Institution of Engineers.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Hydraulic Sand Packing and Colliery Workings in India," by Mr. R. H. Squire.

SATURDAY, November 13th.

Manchester Association of Engineers.

7 p.m. At the Memorial Hall, Albert-square, Manchester. Address on "The Education Act of 1918 as it Affects the Engineering Industry," by Mr. S. Hey and discussion on "Liquid Pressure of Iron in Moulds," introduced by Mr. A. H. Goodger.

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Notes.

The Institution of Electrical Engineers.

THE Institution of Electrical Engineers is distinguished from certain of the larger mammals in that it hibernates in the summer time. From May until November, with the exception of a gathering of a more or less holiday character, its members cease from their deliberations and the supply of those outpourings on technical and allied subjects which it is our pleasure to chronicle in these columns is temporarily cut off. With the coming of autumn, however, a certain liveliness is evident, and the session opens with a procession of Presidential and Chairmen's Addresses, the first named, probably on the well-known principle of keeping the best things to the end, being usually the last to entertain members. This outpouring of experience is now in full swing, and, with the delivery by Mr. LLEWELYN ATKINSON of his presidential address next week, we shall reach the climax of personal opinion on matters of interest to electrical engineers, and shall be at liberty to devote attention and space to the Papers which are scheduled to be read by various authors.

A Desirable Change of Policy.

IN examining the programme for the coming session we are glad to detect a change of policy that we have often advocated. There seems to be a tendency to reduce the number of Papers read and to extend the number of meetings entirely devoted to discussion. We hope that this will be carried further, and that it will soon be found possible to have "discussion-meetings," on the lines of the very successful one on "Colloids" recently held by the Faraday Society, when some subject of general interest can be adequately dealt with by allowing as many speakers as possible to express their opinions. We also hope that the authors of the Papers that are to be read will assist in this method of brightening the gatherings by exercising more self-control and care in the presentation of their subject than was always the case last session. A voluminous thesis is properly accommodated in the "Journal." What is wanted at a meeting is a short statement presented in as controversial a manner as possible, so that it engenders discussion. The speakers themselves might also exercise a little more care in preparing and presenting their remarks. To assist those who are young in experience, if not in age, the informal meetings were established and, if last session's proceedings are any criterion, set an example to speakers in pungency and directness which might well be followed at the more formal gatherings. It is not yet realised by many speakers that it is not sufficient to have something to say, but that it is also necessary to know how to say it.

"Power for Nothing"

IN this issue we publish accounts of the addresses delivered by Mr. JULIUS FRITH to the North Western Centre, by Mr. F. FORREST to the South Midland Centre and by Mr. H. DICKINSON to the Liverpool Sub-Centre of the Institution of Electrical Engineers. The complaint has often been made that engineers are now devoting less and less time to engineering and more and more time to financial and labour problems, but this tendency is not directly reflected in the three addresses mentioned, though doubtless both these pressing matters have had something to do with all three chairmen taking the general subject of economies in power generation and supply as their topic. In so doing they show a pleasing variety of presentation. For Mr. FRITH explores the possibilities of new sources of energy and returning from his exploration comes to the conclusion that in this country at any rate combustion is still the best method of obtaining what he wants in spite of the temptations to use solar and even lunar energy. Moreover, he propounds the important corollary that our present methods of using coal for generating steam are so wasteful that only one per cent. of the potential energy in the fuel is usefully employed. This figure could, however, be increased to as much as 19.5 per cent. by the introduction of certain improvements in our methods of employment and a similar figure could be obtained by the use of internal combustion engines. Like us, however, Mr. FRITH pins his faith in ultimate improvement in the use of energy on some compromise such as the Still engine or on some new method like the gas turbine. But we go further than Mr. FRITH. For we consider that this is but another case for that mixture of the open mind and iconoclasm advocated by Mr. LLEWELYN ATKINSON in one of our recent issues or, in other words, for a closer examination of entirely fresh means of carrying out old operations. Some exploration of this kind is certainly abundantly necessary, if we are to realise Mr. FRITH's idea of power for nothing—a very tempting ideal.

Domestic Hot Water.

IN some ways, like a lady's letter, the matter of most current importance in Mr. FRITH's address is to be found at the end, where he discusses the important question of the supply of domestic and industrial hot water as a by-product of central power stations on the lines which have already been suggested by Mr. W. M. Selvey and tried by Mr. S. L. Pearce at Manchester. The weakness of such an arrangement of course lies in the fact that the demand for hot water may be greater than the supply, or, contrariwise, the supply may be greater than the demand. In either event there is a tendency to introduce methods recalling Lamb's receipt for providing roast pig, though there are cases, as Mr. Frith shows, where hot water can be economically supplied on these lines at a reduced rate; and the matter is therefore worth the closest consideration, especially in connection with the use of domestic electricity in the new housing schemes. The idea is we believe, being tried at the Swanpool Garden City and if successful will doubtless receive a wide adoption.

Other Outlets for Economy.

Mr. Forrest, though also recognising to the full the need for greater economies in power generation, favours less drastic methods than does Mr. Frith to obtain his end, and is, moreover, a little pessimistic in that he places the upper limit of the thermo-dynamic efficiency of the future generating station as low as 20 per cent. His address is, however, useful in drawing attention to the fact that it is not only in the boiler-house and engine-room that economies can be effected, and that there is much to be gained by paying attention to the switchgear and network design, a point also mentioned by Mr. H. W. Clothier in his address to the Newcastle Students' Section. As regards the former, we agree with Mr. Forrest that in safety and simplicity lies our best hopes for the future, but we are sorry to see that he still clings to the idea that transmission and distribution can only be effected by underground means, and that overhead networks must always be the exception rather than the rule. The future will expose the fallacy of this statement, though this, of course, is no argument against striving for improvements in cable design and manufacture. He puts in a word for the mercury vapour rectifier as suitable apparatus in connection with domestic supply, and supports Mr. Wordingham in exposing the relative danger of using alternating current in the household. And whether we agree with his conclusions or not, the address is worthy of study as reflecting the views of the progressive station engineer upon whom we have largely to rely in future for electrical development.

The Development of Electric Supply.

Mr. Dickinson's address dealt mainly with the effect of the Electricity (Supply) Act on the branch of the industry with which he is connected. He pointed out the want of logic displayed by some of the opponents of the measure, in that they are prepared to spend money on extensions of existing stations (which would ultimately have to be bought out), and yet who grudge the expenditure necessary to provide a unified scheme of control. We agree that in this matter it is necessary to look well ahead, and not to be guided by ephemeral conditions. He also dealt with the subject of improved efficiency and laid stress on the use of larger generating units, higher steam pressures and the heating of the condensate by steam abstracted from the turbine. Stations running at 500 lbs. steam pressure and a temperature of 750° F. appear probable in the near future. Dr. Ferranti is credited with the anticipation that an overall conversion efficiency of 28 per cent. may be realised—a result that is not so remote if the large generating stations mentioned by Mr. Dickinson fulfil expectations by attaining 24 per cent., indisputably a great advance on efficiencies attainable a few years ago. Mr. Dickinson only allotted relatively small space to distribution problems, but it is evident he agrees with Mr. Forrest that this is a field which will tax the resources and enterprise of engineers possibly to an even greater extent than generation, and we endorse his recommendations that no time is to be lost in reviewing present methods in the light of future experience.

Tramways and Town Planning.

The attack of pessimism which has lately been so evident in the tramways industry has received a check from an unexpected quarter. For it is not often that a President of the Institution of Civil Engineers even deals with such a subject, much less waxes so enthusiastic about tramways as Mr. John Brodie did the other night in his Inaugural Address. Those who think the tramway industry is moribund may take fresh heart from his remarks, and, having done so, may closely consider how far it is possible to carry Mr. Brodie's suggestions into practice. The address itself dealt mainly with the two important subjects of road construction and town planning, but it is evident that closely bound up with these must go a consideration of the means of communication that must be employed to bring the inhabitants of any town into the centre for their daily work, and take them out again when that work is done. Speed and comfort, but especially the former, are the main factors in the question. Under both these headings the suburban electric railway has the advantage over the tramway for any journey over 12 miles; for it is able to reach that distance in the same time that the tramway goes four miles. This, combined with the increased love of country life, gives the curious result of providing an unhabited belt between the business and the residential areas.

"The Tramway-Railway."

To make use of this area Mr. Brodie calls the tramway to his aid. He proposes first to build wide roads, construct on them tramways in such a way that speeds up to 30 miles can be used, erect stations a quarter of a mile apart, and, if necessary, have extra tracks to enable a non-stop service to be worked at busy hours. In this way many of the present disabilities under which tramways suffer can be overcome and corresponding benefits will be conferred upon the passenger. But one drawback to such a policy is that the difficulties to carrying it out are so very evident. For such roads to be made, and we agree the need for them is pressing and the advantages derivable from them great, much destruction would have to proceed any construction. Again, with any such scheme must go improved design of cars, better lighting and an increased attention by tramway engineers to engineering matters at a time when they are fully occupied with labour and kindred subjects. Then there is the even larger bogey of finance. Still, Mr. Brodie's ideal may well be the tramway industry's salvation, if the disadvantages at which we have hinted can be overcome. Up to the present the idea is a dream, and not a new dream at that, but it might come true. It is a way dreams of this kind sometimes have.

The Work of the Pacific Cable Board.

The accounts of the Pacific Cable Board for the year ended March 31 last show that this Government undertaking is now on a definite profit earning basis. The total receipts during the year amounted to £643,000, or £88,400 more than during the preceding year, which was in its turn a record one. After paying all expenses and placing £353,000 to the reserve and renewals fund, there was a balance of £97,129 to meet the interest and sinking fund on the £2,000,000 advanced by the National Debt Commissioners and to provide for the reserve and renewal fund on the Sydney-Auckland and Doubtless Bay-Auckland sections of the cable, leaving a balance of £10,434 to be carried forward. The Board was constituted by an Act passed in 1901, and at first there was a large but decreasing deficit every year until the outbreak of war. Since then the receipts have greatly increased; the previous deficits have been wiped out and a reserve fund of over £750,000 has been created. The improvement between 1914 and 1918 was mainly due to the heavy Government traffic, which increased from 215,000 words in 1913-14 to 3,501,300 in 1918-19. During the present year there was a drop in the Government work (to 2,219,240 words), but this was more than made up by the increase in the number of private and Press messages. The total number of paying words transmitted was 9,084,745 compared with 8,329,576 in 1918-19.

A Link in Imperial Intercommunication.

The Board has improved the landline facilities in Canada by acquiring an alternative route between Vancouver City and the Bamfield terminus of the cable, and in October, 1919, through working was introduced between the terminus of the Imperial Cable at Halifax and Bamfield, thus avoiding retransmission at Montreal and reducing the time of transit. The landline between Melbourne and Sydney is to be equipped for fast-speed Wheatstone working, with Creed printing apparatus at the Melbourne end. We congratulate the Board on its year's record, and we hope that the new Imperial Cable, about which there seems to be a singular dearth of information, will be able to show equally satisfactory results. Government departments do not usually shine in business, but we freely admit that the Pacific Cable Board has fully justified its existence by providing an essential link in Imperial communication, which was of the highest value during the war. It is imperative that the whole of the Empire should have a good and uninterrupted chain of communications at all times, and the provision of this is assisted by the new Imperial Cable and the Pacific Cable Board.

Electricity Supply Districts.

Steady progress is being made by the Electricity Commissioners in their task of dividing up the country into electricity districts and already ten of these areas have been provisionally determined. In all cases the Commissioners have decided that a re-organisation of electricity supply is necessary, and local inquiries will be held into proposals for improving or extending existing methods of carrying this out. So far, however, no local inquiry has been held, and the work of constituting Joint Electricity Authorities is proving more troublesome than was anticipated. In only one case—the West of England area—has the draft of a Joint Authority been prepared, but local municipal jealousy and obstruction emanating from the neighbourhood of Bath have proved too strong to admit of the details being settled. In some other cases complications have arisen, notably in West Yorkshire, owing to a clash between the supply companies' interests and the municipal undertakings, and, consequently, the Commissioners have had to extend the time for sending in schemes and representations regarding the necessary re-organisation of electricity supply. We notice that in the two areas recently determined, viz., the South Wales and East Midlands districts, periods of five and six months respectively have been allowed for submitting schemes. In our opinion this is ample time to enable the supply authorities in any district to come to an agreement upon the general principles which should govern a Joint Authority, and it might not be a bad thing if the Commissioners exercised a little gentle pressure upon some of the recalcitrant councils and companies in order to get them to make some progress.

The Coal Dispute.

It will not be certain for some months whether the settlement that has been reached in the coal dispute is to be peace or only an armistice. Much must depend on the composition of the national and district committees that are to be set up to prepare a scheme for wage regulation, and more upon the spirit in which these bodies set about this important task. The position is one of some difficulty. It is clear from the result of the latest ballot that a majority of the miners are opposed to any arrangement that makes wages dependent on output. Indeed, the opposition to this course may well be a good deal stronger than the figures indicate, considering that those voting were choosing between the continuance of an unpopular strike and the acceptance of an unpopular method of payment. Apart from this, however, there is a large and vocal element on the miners' side who do not desire peace of any sort, while on the mine owners' side there is an element that considers a permanent settlement can only be obtained by breaking the men's organisations. These two elements are at once enemies and allies; and constitute a real danger which must somehow be removed before really settled conditions are possible. We hope, therefore, that the output committees which are to be formed at once to cooperate in the discovery of some means of increasing output will display a true spirit of amity in their deliberations and work hard to find some methods whereby, other things being equal, a miner's wages will depend more than anything else upon his own personal efforts. These are the lines along which we feel sure a real solution can be found to a peace much more permanent than that likely to have been provided by the now discredited datum line or by any other system of payment based solely on either national or district output. Conditions in individual mines vary so greatly that this is the only fair way, and it would have the further advantage that the evils of over-centralisation in trade matters, of which during the last week or two we have had so striking an example, would be very greatly mitigated. Care, clear-headedness, tact and a desire to build a structure of peace on sure foundations is what the public now have a right to expect from both sides.

Wanted—An Industrial Policy.

It is not going too far to say that any engineering or administrative problem connected with the electricity supply industry can be adequately dealt with by those now employed in the industry. We might indeed go further and state that the industry is particularly well off in those who work for it in these fields. On the industrial side, however, just the reverse is the case, for we can think of no director, engineer, or manager of any electricity supply company who has been responsible for any really constructive thought in the way that men like Sir Robert Hadfield, Lord Weir, Lord Leverhulme have been in other industries. There is plenty of earnest journeyman work, and it would be very unjust to belittle the vast amount of able and largely voluntary effort, which is being done on the employers' side of the Industrial Councils. Nevertheless true leadership in economic thought as applied to the great reconstructive problems with which the industry is faced to-day is absent. This is mainly due to lack of appreciation of the facts. There seems to be a prevalent idea on the part of the employer that to preserve the present *status quo* in industrial conditions (as if anyone wants to do that), all that is necessary is to sit tight, when things will automatically become in the future what they were in the past. Nothing could be further from the truth. Influences are at work in every direction, both inside and outside the industry, which are steadily changing its whole industrial basis.

Where are the Men?

THE fact that the electric supply industry is industrially so highly organised means that it at once responds throughout to any impressed force. It is therefore probably only a question of time before the organisation of the industry is so complete that it can be made to act as automatically as a machine. But the question is in whose hands should the handling of this vast apparatus be. For as a key industry, its control is vital to the industrial world as a whole. The answer is obvious. In the joint hands of the employers and employed. This can only be achieved through the Industrial Councils, where such dual influences are already finely balanced. But to ensure efficient control the Councils must themselves be powerful bodies. They must acquire a position of authority, and this is where the need for constructive thought comes in. The present Industrial Councils of the industry must be strengthened and consolidated. This is the task of sage statesmanship and of considered policy. Where are the men with the qualities to frame such a policy?

Commercial English.

THE need for expressing one's thoughts in simple and direct language is equally important for engineers and for those engaged in commercial pursuits. The need increases when the matter to be dealt with is complicated and simplicity in expression is more and more required the greater the confusion in the writer's brain in order that he may “get over” his ideas as clearly as possible. Doubtless owing to the rush in which we now live, there is obvious an involution and ambiguity in correspondence and writing of all kinds, accompanied by an actual misuse of words. We blame the typewriter and stenographer for this state of affairs, and, from a communication that we have received, we are glad to learn that Mr. C. E. TOWN, assistant secretary to the London Chamber of Commerce, takes the same view. Most correspondence is nowadays dictated to a stenographer who faithfully transcribes all the grammatical errors, hesitancies and redundancies for the principal to sign without reading it. The remedy is obvious; either abolish or educate the stenographer. The Commercial Education Committee of the London Chamber of Commerce takes the view that the latter is the better course, and have therefore been redoubling their exertions to encourage the study of English. They are now with this end in view in view offering additional prizes for success in the examination conducted by the Chamber. We hope that the result will be an improvement in the literary character of commercial writings.

The Control of Wiring.

We are among those who consider the introduction of electric lighting into the houses which are now being erected either by public or private interests to be absolutely essential. We are of this opinion not only because we think that electric lighting offers advantages of cleanliness and convenience provided by no other system, but because by its employment consumers will be led to a wider use of electricity for domestic purposes, and thereby bring advantages not only to themselves, but to the electrical industry. There is only one thing that can prevent this; and though it can be easily avoided it is more often than it should be disregarded with unfortunate results. That one thing is lack of proper care in putting in the wiring, erecting the apparatus and generally in carrying out the work with due regard to the safety of those who have to use it.

SAFETY A NECESSARY CONDITION.

That safety is a necessary condition to the proper use being made of an electrical installation is so axiomatic that the average Martian would presume that steps would long ago have been taken to formulate and administer regulations designed to secure it. But this is not the case. There are regulations in plenty, it is true, most of them excellent in parts, but chiefly distinguished by the ways in which they differ from each other; and lacking owing to their number the force that should be inherent in any national or international code. The corollary is that the best of them are permissive rather than compulsory, and that in this county at least there is nothing to prevent installations being erected which comply with no rules, except those conceived in the agile brain of the particular contractor carrying out the work. So much is this the case that with a few exceptions even the supply authority, which is, of course, often the municipal authority as well, has very little control over the apparatus used and the way the work is done once a certain exiguous figure for insulation resistance has been exceeded, often for the one and only time in the installation's necessarily brief existence, and other easy tests prescribed by the B.O.T. Regulations for Securing the Safety of the Public have been passed. Indeed, so much is this the case that by section 18 of the Electric Lighting Acts, 1882, undertakings are expressly forbidden to control the way in which the installation is erected or the type of apparatus used.

CANADIAN PROCEDURE.

We are led to these reflections by a perusal of the rules and regulations for “inside” electrical installations, which have recently been issued by the Hydro-Electric Power Commission of Ontario, which, be it noted, is a supply authority, but yet has power to impose conditions on its consumers apparently as a preliminary to connection; and even to charge fees for making the necessary tests. A comparison of the rules themselves with those issued by the Institution of Electrical Engineers, which may be taken as representing good practice in this country, discloses some wide differences from which some interesting deductions may be drawn.

EARTHING.

For instance, the question of earthing has received a good deal of consideration over here, it being rightly presumed that proper contact with earth of all non-current carrying metal is an essential to the safety of any electrical installation. It follows naturally that the connection of conduit, switch covers and other metal apparatus, which may become electrically charged, with gas piping is hardly carrying out the spirit of this idea, and most of the electrical rules in this country therefore ensure that to do so shall not carry it out in the letter either. It is therefore somewhat of a shock to find that in the Ontario rules earth connection to gas pipes is permitted, provided the connection is made on the street side of the meter, though this hardly seems to square with another of the company's own rules, which states that “the neutral wire of a three-wire system must be grounded,” and that the “ground connection must include all available water and gas pipe systems, and must be made at the central station.” The rule that in underground systems the neutral wire must be earthed at each distributing box through the box will also be of interest to station engineers, but this again is marred by the partial inconsistency that short lengths of tubing used to protect exposed wiring need not be earthed. This forms a deviation from British practice as reflected in the I.E.E. rules, and introduces risks to really safe working.

WOOD MOULDING.

Another point of interest is that the use of “wood moulding” is prohibited, apparently owing to the fact that pressures up to 650 volts may be used. It is not quite clear whether this covers the use of the casing often employed in this country. But should this be the case it would seem a rather drastic condemnation of a system which, given good workmanship, has operated well with pressures up to 250 volts in much damper atmosphere than what we believe is usual in Canada.

"OPEN" SYSTEMS.

We have dealt with these two particular points, as they indicate the chief difference between the practice in Ontario and in this country, though it must be added that the rules themselves are extremely comprehensive, dealing in detail with all kinds of electrical installations, and also lay down the procedure which is to be followed in case of electrical shock, an addition which will perhaps give rise to cynical reflection of an obvious kind.

The rules are, however, interesting in another way. They deal largely with open systems of installations which are obtaining an increasing amount of support over here owing to the cost bogey, especially in connection with the erection of working class dwellings, which are now about to be supplied electrically for the first time. And this raises yet another point. These rules if properly complied with certainly make for safety, but if such meticulous care is necessary under such conditions it rather points to the fact that it would be better to retain our present system than to make any change. In any event, however, a multiplicity of rules can have really little effect on either good or bad workmanship. What is required is one influential code or, better, a general realisation that bad workmanship is bad business. It is along these lines that we should work. And this is all the more necessary at a time when a great deal of bad work is being put in.

Education and Technical Societies.

Education is a subject which is now attracting a great deal of both voluntary and compulsory attention, when administrators are urging the necessity for its improvement, teachers are demanding better conditions of living, and parents are being asked to pay ever increasing sums for the facilities which are, at least theoretically, being provided.

THE AIM OF EDUCATION.

Now the aim of the thinking parent is to provide the child with such an education that he will not only be enabled to earn a more or less comfortable living, but will have his mental equipment trained to appreciate the higher, if less commercial, branches of knowledge that are conveniently classed under the headings of science, literature and philosophy. Or, in other words, to be in a position to steer his course through life, not entirely by picking up financial buoys, but by employing those other indications of the right course which, if not so easily recognisable, are at least equally valuable to those who know how to read them. It is clear that this high ideal cannot be approached with any closeness unless the child is not only taught, but learns to teach himself; and unless he becomes not a more or less willing lump of clay upon which the parent and teacher works with greater or less success, but an active partner in a combination whose ultimate progress depends, perhaps, more upon his own endeavours than upon any one factor.

A NEVER ENDING TASK.

If this conclusion is accepted, it follows that at no period in our human existence can our education be said to be finished and all administration of educational facilities should therefore be directed with this important point constantly in view. For this is an obvious deduction which does not seem to be sufficiently recognised either by our educationalists or our parents, and it is failure to recognise it which is responsible for the extraordinary views which we sometimes hear expressed on the aims and objects of educational politics.

It will be agreed that to no one is the continuance of education through life more important than to the engineer. His education is, in truth, never finished, or, if it is, he may be written down as something very like a failure. If, therefore, we are to consider this subject from the point of view of engineers, we must go a step further than educationalists generally, and decide how the education of an engineer can be best continued from the important time when his formal instruction ends and what may be called his real education begins.

THE INFORMAL EDUCATION OF LIFE.

This interesting question is ably discussed by Mr. ERNEST DOXFORD in his presidential address to the North East Coast Institution of Engineers and Shipbuilders, but before dealing with his arguments in detail some fundamentals of the subject may briefly be mentioned. The informal education of life differs from the formal education of the school in the important respects that the student is himself both the teacher and taught and must derive his knowledge from books and other literature or from his experience with the men and materials of his occupation rather than by the methods of class room. It follows then, as Mr. DOXFORD very rightly points out, that the technical institution may be a very important factor in this education, for through its membership may be imparted knowledge not only by perusing written papers, but by the discussions, both formal and informal, in which its members are able to take part. As an instance of this he gives the information that has been published by the Institution of which he is President on the development of the internal combustion engine and similar examples could doubtless be obtained from the Proceedings of the Institution of Electrical Engineers and other bodies of like character. Such information has the advantage not only of being up-to-date when it is published, in this way corresponding to an article in a technical journal but differing from the text book, but of having been forged by the inter-play of a number of intellects in consultation, though not always in agreement.

INCREASED SUPPORT NECESSARY.

It will be argued that all this is well known and that it is for just these reasons that engineers and others belong to professional societies. But while we may agree that this is so, it is equally true that there are degrees in activities of the members of these societies and that most professional institutions do not receive, even in these days, the support they deserve and require. This applies not only to large Institutions like the Institution of Electrical Engineers, but to smaller bodies like that of which Mr. DOXFORD is president. Considering their educational value this is a matter that should be remedied.

We cannot, however, agree with Mr. DOXFORD that the best method of giving these bodies financial stability is to be found in Government grants. It is unfortunate for many reasons that Government must concern itself with the formal instruction of the young. But it would be in the highest degree undesirable for it to take any part in the education which is provided by scientific and technical societies. We know that many of these bodies are financially very much embarrassed at the present time, but the best way to overcome this is to raise the members' contributions as the Institution of Electrical Engineers are about to do and thereby to increase in every way possible the value of the Society to its members. If this policy leads in some cases to the amalgamations of several of the smaller bodies into one larger one we should contemplate the result with equanimity.

Electro-Magnetic Heat Treatment of Carbon Steel.

By LANCELOT W. WILD, M.I.E.E.

When an eutectoid steel (a steel containing 0·9 per cent. of carbon) is heated it undergoes two main transformations. The first transformation takes place at a temperature of about 730°C., and is commonly known as the AC1 change. In the process heat units are absorbed or become latent, and this is shown by the phenomenon called decalescence, the rate at which the temperature rises becoming suddenly reduced or even negative for a short period. The second transformation, known as the AC2 change, takes place at a temperature of about 760°C. It is accompanied by a complete loss of magnetic susceptibility, the permeability falling to unity. Metallurgists are not completely agreed as to the true meaning of these changes, but it is generally believed that the first transformation is due to the carbon going into solid solution, and that the second transformation is due to a change taking place in the molecular state of the iron. These transformations do not take place suddenly, but are both spread over a range of temperature, and take time to complete, so that the actual temperature attained during the processes depends upon the rate at which heat is being forced into the steel.

Text Book Metallurgy.

The writers of text-books are rather too fond of drawing pretty diagrams in which these two factors are disregarded. If a piece of eutectoid steel is heated to such a degree that the first transformation is just completed and is then quenched, it will be found to be very tough, but only partially hardened. If the steel is heated a little further, till it has just completed the second transformation and is then quenched, it will be found to be very hard, and will possess the highest ultimate strength that it is possible to obtain by any heat treatment. If the temperature is still further raised, and especially if the steel is allowed to soak at an excessive temperature for any great length of time, it will be found after being quenched to be still just as hard but mechanically weak and very brittle.

The Uses of Electromagnetic Heating.

The opening for electromagnetic heating thus becomes apparent. So far only eutectoid steel has been considered. If the steel contains less than 0·9 per cent. of carbon, the excesss of iron exists in the annealed state as free ferrite. Absorption of the ferrite commences as soon as the first transformation commences, and is completed before the second transformation is finished, provided that the carbon content is not lower than 0·4 per cent. When the carbon content is less than 0·4 per cent. further heating is required to complete the absorption of the ferrite. Commercial iron requires heating to as high a temperature as 900°C. as a rule to complete the change. Thus, for steel containing less than about 0·4 per cent. of carbon there does not appear to be much opening for electromagnetic heating

In a steel containing more than 0·9 per cent. of carbon (hyper-eutectoid) the excess of carbon exists in the form of cementite or iron carbide. It is this cementite which gives tools of high carbon steel their excellent cutting properties. Hyper-eutectoid steels should be heated to just beyond the second-transformation. If they are heated much beyond this point, the cementite is absorbed and they lose their cutting property, besides becoming very brittle.

The Behaviour of Eutectoid Steel.

Fig. 1 shows what occurs when a piece of eutectoid steel is heated. The lower curve shows the inverse heating rate—that is, the number of seconds taken by the steel to rise 1 deg. in temperature. It will be seen that the rate of heating begins to fall off at a temperature of 727°C., becomes very slow at about 740°C., and returns to normal at 755°C. This is the AC1 transformation. The upper curve shows the magnetic susceptibility of the steel. The scale is quite arbitrary, being merely the number of scale divisions on the ordinary indicator belonging to the furnace. At 745°C. the steel begins to lose its magnetic susceptibility, but not till 790°C. is reached is the change complete. At this point the steel should be removed and quenched. The same specimen of steel was found to complete its change at a temperature of 765°C. when heated very much more slowly. This interdependence between rate of heating and temperature attained gives the electromagnetic system of working a tremendous advantage over all other methods in use. When the steel has just lost its last trace of magnetism it is just ripe for quenching. If it is removed too soon or too late from the furnace only harm can result.

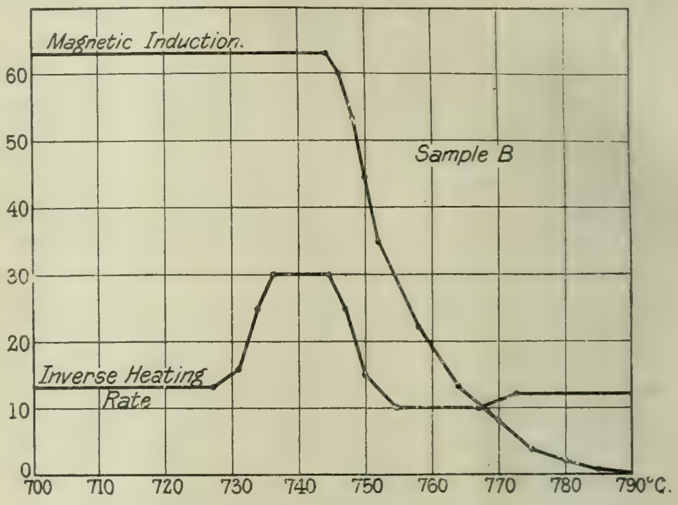

Fig. 1.

Some people assert that after the steel has become non-magnetic it requires some further heating or it will not properly harden. This is a complete fallacy. These people have not been provided with means of testing the magnetic state of the steel with sufficient precision.

It will be seen from the curve that the last 10 per cent. of magnetism requires for its removal a range of 20 deg. in temperature and four minutes in time. Most magnetic detectors are too insensitive to detect the last few per cent. of magnetic susceptibility. Fig. 2 shows diagrammatically the Wild-Barfield system of electromagnetic heating for alternating-current working, where *F* is the heating winding wound on the furnace liner. *D* is the detector coil wound outside the furnace casing (*F* and *D* in conjunction form a quadrature transformer), and *P* is the primary and *S* is the secondary winding of the compensator. This constitutes another quadrature trans-

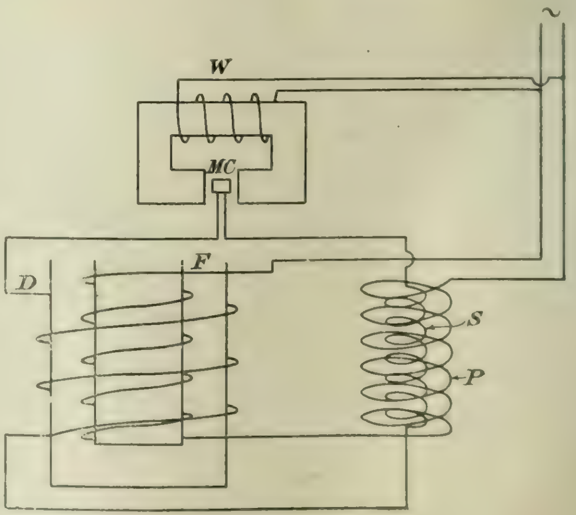

Fig. 2.

former. The compensator is furnished with an iron core which is used to adjust the voltage induced in the secondary coil, so that it balances against the voltage induced in the detector coil. *MC* is the moving coil of the indicator. It is mounted between the poles of an electromagnetic, the energising coil of which is connected as a shunt across the mains.

An Example of Electric Control.

To take a concrete example, let us consider the case of a No. 4 radiation furnace. This has a heating chamber 4 in. in diameter and 13 in. deep First let us neglect the influence of the ohmic resistance of the indicator magnet coil, eddy currents and hysteresis. At 50 periods and with no steel in the furnace, there will be an E.M.F. of 2 volts induced in the detector winding of the furnace. This will be in exact quadrature with the current in the heating winding of the furnace. An E.M.F. of 2 volts will be also induced in the secondary of the compensator. This will be in quadrature with the current in the primary of the compensator. These two E.M.F.'s are, therefore, in phase or in direct opposition according to the way in which they are connected. The connections are made and the core of the compensator adjusted so that they neutralise each other exactly, and no current passes through the moving coil of the indicator.

Now let us place in the furnace a piece of steel, 8 in. long and 0·5 in. in diameter. Obviously the mutual inductance between the heating and detector coils is increased. The E.M.F. induced in the detector coil is now increased to 3 volts. The compensator still only delivers 2 volts, so that 1 volt is available to pass current round the whole secondary circuit. This current, if self-induction can be neglected, will be in quadrature with the main current taken by the furnace, and, therefore, also in quadrature with the supply voltage. The flux passing between the poles of the magnet in the indicating instrument will also be in quadrature with the supply voltage, so that the flux from the magnet and the current in the moving coil will be in phase, and if there is little controlling force the moving coil will turn from its neutral position through an angle of nearly 90 degs.

When the steel has been sufficiently heated to undergo its second transformation it will become non-magnetic, the voltage induced in the detector winding will fall back to 2 volts, and the original balance will be restored. The operator has simply to watch the indicator and never need know anything at all about temperature or rate of heating. With the indicator sent out with this size of furnace, a movement of the pointer of 0·5 in. is produced by an out-of-balance E.M.F. of 0·01 volt, so that it is apparent that the indicator is amply sensitive enough for detecting the last disappearance of magnetic susceptibility, provided that the furnace is used on not too small a load of steel.

The Workshop Furnace.

In a furnace designed to meet the hard wear of workshop conditions the phasing cannot be carried out so perfectly as under ideal conditions, but nevertheless success has been attained. The workshop furnace is enclosed in a case of sheet aluminium, and is provided with a top and base of cast iron. We thus have to take into account both hysteresis and eddy currents. The compensator core also introduces both eddy current and hysteresis phase displacements. In addition to this the magnet coil of the indicator has ohmic resistance, so that the magnetic flux does not lag behind the supply voltage by as much as 90 degs. Fig. 3 shows the effect of these phase disturbances in the form of a vector diagram. OA represents the phase of the supply voltage and the current through the furnace winding. OB is the flux between the poles of the indicator magnet. OC is the E.M.F. induced in the compensator secondary and OD is the E.M.F. induced in the detector coil when there is no steel in the furnace. These two E.M.F.s are not quite equal, and they give rise to a resultant E.M.F., CD, which, is however, in exact quadrature with the magnet flux, so that although there is current flowing through the moving coil, it causes no deflection of the coil, as it is in quadrature with the magnetic field in which it is placed.

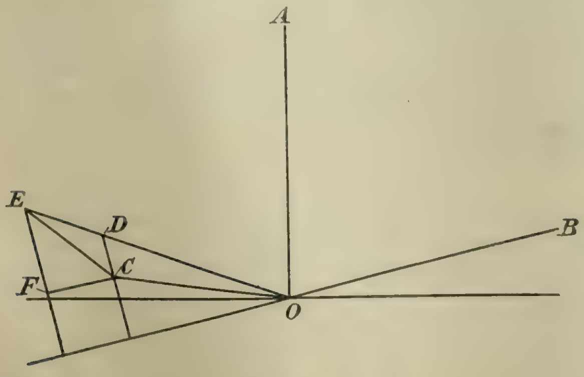

Fig. 3.

When a piece of steel is placed in the furnace the E.M.F. induced in the detector coil is increased from OD to OE, the resultant E.M.F. becomes CE, and this can be resolved into two components EF in quadrature with the flux and FC in phase with the magnetic field, so that a deflection of the moving coil is produced. The introduction of steel into the furnace not only increases the current in the moving coil, but it also materially alters its phase angle. Under certain circumstances it might even reduce the actual current and operate by shifting the phase angle almost entirely.

So long as eddy current and hysteresis disturbances do not exceed the amounts shown in the diagram their only harmful effect is to reduce slightly the effective sensitiveness of the indicator.

The normal position for the moving coil of the indicator is with its axis at right angles to the direction of the field in which it moves. As soon as it is displaced from this position an E.M.F. is induced in it by the field. This gives rise to a current flowing right round the whole secondary circuit. This current reacts with the magnetic field to form a very strong controlling force, so that it is quite possible to work an indicator without any other control. If a resistance equal to about the whole of the secondary circuit is added to the moving coil, the control is weakened and the sensitiveness of the instrument is actually increased considerably. A damping force is produced when the moving coil is started swinging just as in a moving coil galvanometer with closed circuit, so the indicator can be constructed to have a quick period of swing and to be practically aperiodic.

For continuous current circuits the alternating indicator is replaced by a low resistance galvanometer. The compensator is still retained.

If now a piece of steel is introduced into the furnace a ballistic throw will be momentarily obtained. As soon as the steel begins to lose its magnetism, and lasting until all the magnetism has gone, a continuous current will be obtained in the secondary circuit, and the galvanometer spot will travel slowly up the scale and back again, the position at any moment depending upon the rate at which the magnetism in the steel is decaying. As soon as all movement of the galvanometer spot ceases, the steel should be removed from the furnace and quenched. When the compensator is correctly adjusted the ordinary fluctuations of the supply voltage do not produce any kicks on the galvanometer spot. This is because every fluctuation, whilst producing an impulse in the detector coil, also produces an equal impulse in the opposite direction in the compensator.

This method of working is quite satisfactory so long as the heating rate is fairly rapid. Sometimes, however, there are reasons when it is particularly required that the steel should be heated very slowly. When this is the case the galvanometer movement is often so small as not to be easily perceived. In such cases the procedure is either to draw the steel to the mouth of the furnace at intervals, noting whether this produces any movement of the spot, or else to switch off the furnace current for a moment at intervals, for if the compensator has been adjusted to balance the furnace exactly with no steel in the furnace, it will not so balance exactly after steel has been introduced until the steel has attained the non-magnetic condition.

Mr. John Brodie on the Future of Electric Tramways.[*]

In his Presidential Address to the Institution of Civil Engineers last week, Mr. J. A. Brodie dealt mainly with various problems connected with town planning and the construction of roads, especially with regard to the proper provision of the latter for the future passenger and other traffic. The general reconstruction and reorganisation of the road system of the country is one of the most urgent problems of our time. For while railways and canals must continue to afford the best means of transport for heavy loads over considerable distances, and aeroplanes will be freely used for mails and light merchandise, the development of road vehicles will lead to their being employed to a greater extent than has been the case up to now for transport between factory and ship.

The present position with regard to both these matters is complicated by the fact that there exists neither in the central or local Governments a body whose duty it is to co-operate with the various separate independent local authorities surrounding important town centres. The result is that orderly development and continuity of policy in larger matters is mainly non-existent. There are besides no effectual means of inducing these various bodies to sink small local differences and to act together in the greater interests of the trading centres, of which they in reality form a part.

Facilities for Local Passenger Transit.

Statistics recently quoted before this Institution show that street surface methods of passenger conveyance continue to deal with an increasing proportion of all passengers using public conveyances in London, and the same thing applies to most other large centres of population in this country. Tramways now monopolise a large proportion, amounting on the average to about one-third of the older streets in which they are laid, and the provision of satisfactory arrangements for passenger traffic cannot therefore be overlooked when new streets through old portions of a town or new roads are under consideration. In many cases both the cars and the track laid for electric tramways are now reaching the limit of their useful life, and large expenditures are likely to be necessary if the system is to remain in use. It is, however, hardly likely that existing speeds and road conditions will meet the traffic requirements of the next 20 or 25 years, and it is necessary, therefore, that the new conditions should be understood before further expenditure is incurred.

Stagnation in Central Areas.

Competitive electric train systems have been introduced, the best stopping trains with stations about a mile apart, giving an average speed of from 20 to 25 miles per hour, or approximately equal to three times the average electric tramway speed along narrow streets. Passengers are thus being carried to distances of from 6 to 20 miles away from the centre, whilst areas ready for development within 3 or 4 miles from the business centres, but which cannot be reached by present tramway services in the same time, are left without buildings. One of the effects of this appears to be that the increase in population of a parent city with plenty of open ground available has been much retarded, and the growth of population in the outside areas correspondingly quickened, whilst the general rate of increase of the population surrounding the centre as a whole has remained fairly constant. The total loss of population to the city area in a particular case was approximately 150 000. The whole of this loss may not be properly attributable to means of communication, but it will be seen that the question of improved means of local passenger service in the larger towns is one of essential importance.

The Position of the Motor Omnibus.

The introduction of the motor omnibus has in some cases resulted in a quicker service, but unfortunately it has been found that in actual work the cost per car mile of operating motor omnibuses, when all charges are included, exceeds the similar cost on the electric tramway, whilst the cost per seat-mile of omnibuses, as shown in published figures, exceeded the cost per seat mile in tramcars by 114 per cent. No doubt improvements in the carrying capacity of motor buses may reduce the relative cost per seat-mile, but the inherent difficulty of safely steering large motor buses at high average speeds in narrow and crowded streets will prevent the ordinary tramcar figures being reached, and it is probable that the tramway vehicle itself is capable of even greater relative improvement than the motor bus. On the whole it appears likely that the balance of advantage will remain with the tramway wherever large numbers of passengers have to be carried along a route where conditions are such as to permit of improved acceleration, high average speeds, and the best results being obtainable from both types of vehicles.

The Need for Suitable Roads.

To put local passenger services on a proper footing municipal engineers will, however, have to provide roads suitable for high average speeds, whilst tramcar builders will have to re-design their vehicles and adopt some of the good points in motor-bus construction, which tramcars at present lack. Great improvements both in speed and comfort can be introduced on surface tramways in wide roads under special conditions. An instance may be cited where the rails are laid on wooden sleepers on a clinker foundation the upper surface within the limits of the track being finished in grass, and a low fence or hedge provided on each side to keep off stray animals. Speeds up to 20 miles per hour have been authorised by the Board of Trade, and are being run quite safely, and tests show much higher maximum speeds, whilst still using the old-fashioned top-seat tramcars with a short wheel-base

With cars specially designed for quick acceleration a maximum speed exceeding 30 miles per hour could be quite safely reached between stopping stations spaced approximately a quarter of a mile apart, and when thought necessary the introduction of a third line of track would enable non-stop cars to be introduced at rush hours by which high average speeds could be attained. Should it become necessary, the construction of express lines below the street surface is a possibility.

Improvements in Tramcar Design.

At least double the mileage can be obtained on such a line, as compared with the tramway laid on the narrower street surface, and though the current consumption will be greater, the earning power and cost per passenger-mile, should be in favour of the quicker service. The running of the cars on such a line is also very much quieter than on the rigid track. Great improvement in quietness of running would result from the adoption of a resilient tyre, and if, in addition, the best mechanical arrangements are adopted for the transmission of power in the car there appears no reason why public tramway vehicles should not be as quiet in running as private motor cars. The saving in wear of the rail surface, and the additional life of track so obtainable, is also likely to be of greater importance in the future as the cost of ordinary track construction is at present approximately three times that of similar work in pre-war times.

The additional comfort of such a vehicle to the passenger, combined with the absence of jarring noises to the frontagers resident on each side of the track, would more than warrant its adoption. On the whole, the time appears to be ripe for the introduction of radical improvements in connection with the longer distance systems of tramway transport.

The question how far such a method of construction can be carried out through the already built up portions of the larger towns is one which requires careful consideration. If fast services are to be given, it will be necessary in any case to have special tracks, and experience shows that in most cases an improved and widened street surface, if judiciously chosen, will be both cheaper and more advantageous to town residents and to passengers than anything in the nature of underground work.

Where the total population to be carried will not warrant the necessary heavy expenditure on underground tunnels, and where overhead railways do not find favour, it is likely that a limited number of fast surface lines, constructed on wide roads through the more densely populated districts branching out fan-like into the outer areas now being developed, could be made to compete successfully, both in time, cost of working and general convenience, with any other system at present in sight for distances of from 3 to 8 miles from the centre of a city.

Tramway Earnings and Street Widenings.

A point of much importance, which is generally overlooked by municipalities operating tramway passenger systems is the advantage obtainable from applying a proportion of the tramway earnings directly to reducing the cost of street widenings, which, in turn, will enable quicker, more efficient and more economical tramway services to be given. If, for example, it could be arranged that a sum of £1,000 per mile of single track could be contributed as, say, one-third of an annual expenditure on street improvements, the other two-thirds being equally divided between the street authority out of the local rates and the Central Road Authority, out of national funds, the improvement of existing main thoroughfares leading into or out of our towns could be systematically tackled, and something could be done each year towards expenditures which are becoming increasingly necessary, but which are being generally postponed from time to time in a rather short-sighted way.

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[*] Abstract of the Presidential Address to the Institution of Civil Engineers, November 3, 1920.

Mr. Julius Frith on Economies in the Engine Room.*

There are six available sources of energy which we can tap to supply power to our industries: The sun (*a*) using its direct heat to work heat engines, or (*b*) as water power, *i.e.*, using the sun as a vast circulating pump to lift water from the sea and put it on the tops of mountains or turbines; the moon, using its attraction on the waters of the sea "harnessing the tides"; the winds; electro-chemical effects; molecular activity; and combustion, that is, combining things with the oxygen of our atmosphere to produce heat. The practicability of the first is feeble and not suitable to be used in our centres of industry. By the second application of the sun's activity, we can extract and put to useful work some 90 per cent. of the potential energy of the water. The energy of the moon which is really tapped in harnessing the tides is due to the difference between the time of revolution of the earth and that of the moon round the earth, and therefore making use of the tides would tend to keep the moon always opposite one fixed point of the earth's surface. Winds are at best uncertain, though they have been extensively used for grinding corn, pumping water, and driving small electric generators.

The electro-chemical effect is the most promising of those investigated so far. The destroyed conductor has in the past been made of some very costly material, and there is no ready market for the chemical combination produced; but, these are minor points which can no doubt be remedied. Molecular activity, as a source of energy is, we have to confess at the moment a little new and puzzling, but it is very promising. In energy given out per pound of material, it exceeds anything else by several millions per cent. It is, certainly, a little difficult to stop and start, and seems a trifle like using up the bricks of which the universe is built, but we shall no doubt be able to report further at a future meeting.

Last on the list comes combustion. For the moment we make heat by combustion, and are at a loss to convert it to mechanical energy. We need some connecting link between the fire and the generator shaft. This must, theoretically, take up energy from the fire, and in so doing must alter its physical state; in which altered state it is introduced into the engine and reverts to its former state, parting with the energy it received from the fire.

SOME NEW LINES OF ATTACK.

In practice, only about one-fifth of the energy is usefully expended in the engine, and the large amounts of energy rejected are usually not only wasted but become a source of annoyance to our neighbours. There are, however, some promising avenues of attack on the problem. One is to make the condenser itself a source of heat for a second thermal-cycle engine. This idea has not received the attention it deserves from practical engineers, though it has been carried some little way on the theoretical and experimental side and has shown some promise. Another line to follow would be not to condense the exhaust at all, but to pump it straight back into the boiler or heater, there to receive another supply of energy; but this is, apparently, contrary to the laws of thermo-dynamics as we at present understand them. If we could only find some way of putting the exhaust steam back into the boiler as it is released from the engine, instead of making it return to water to be again re-evaporated by our precious fuel just the other side of the boiler plates, the possible efficiency of a steam engine might be almost indefinitely increased.

The combustion of most of our fuels with the oxygen of the air will produce temperatures in the region of 2,000°F., giving us a possible efficiency of 77 per cent. Our present practice, however, is to employ our 2,000°F. in raising steam and superheating it to, say, 600°F., giving a possible efficiency of 47 per cent.

THE PROFIT AND LOSS ACCOUNT.

The gas turbine offers a possibility of using these high initial temperatures, but it would probably exhaust at a temperature comparable with that of an ordinary boiler fire. Further use of these hot exhaust gases could then be made for raising steam. In a recent Government report it was estimated that on the average 5 lb. of coal are burnt for each horse-power-hour produced in industrial power plants. Taking this figure for what it is worth, a corresponding balance-sheet of fuel receipts and expenditure shows that of the 13,000 therms in the coal, 10·8 per cent. are lost in the boilers, 23 per cent. are sent up the stack in hot gases, 6 per cent. are radiation losses, 0·4 per cent. is lost in mechanical friction in the engine, 54 per cent. is lost in the cooling towers, 1·8 per cent. used in the auxiliaries and only 4 per cent. is usefully expended.

The banking loss is obviously due to bad load factor and decreases as the latter increases; the most fruitful way of bringing this about is to make use of the diversity factor of different classes of load and supply as many of them as possible from the same power plant.

The loss due to hot flue gases up the stack can be reduced by reducing either their quantity or temperature; with liquid or gaseous fuel the quantity of flue gases can easily be reduced to two-thirds of this amount. The temperature could and should be reduced by superheaters and feed-water heaters in the flue. This process is, however, limited in practice by the next item on the loss account, namely, the steam in the flue gases. This steam arises from the original moisture in the coal, from the water of combustion of the hydrogen content, and also from steam jets, which are sometimes used for carrying in the air for combustion. The more steam is present the more the process of extraction of heat from the flue gases is limited on account of the corrosive action of the water formed by condensation on the tubes of the feed-water heater. Surely it is time that manufacturers faced the problem of making a cheap form of economizer with, say, cast-iron tubes, which could be put on the tail end of the feed pump and could extract a good proportion of the energy carried away by the flue gases and steam together.

The radiation losses can in general be much reduced by more attention to the lagging and brickwork than often falls to their lot. But the efforts of the reformer may well quail before the stupendous loss carried away by the condensing water and made hideous in the cooling towers. But even with the economies suggested the percentage of useful energy can be increased to 19·5 per cent. working at a good load factor with a large turbine plant.

THE INTERNAL COMBUSTION ENGINE.

Let us now turn to the internal combustion engine and gas producer, and see how this combination will stand similar overhauling. Average practice in moderately small non-recovery plants yields about 1 H.P.-hour for each pound of coal, and the balance-sheet for such a power plant would look something like this: Banking losses, 2 per cent.; lost in ashes, 6 per cent.; radiation from producer and engine, 5·5 per cent.; engine friction, 3·5 per cent.; engine cylinder cooling water, 23 per cent.; used in auxiliaries, blowers, &c., 2 per cent.; carried away in engine exhaust, 38·5 per cent.; usefully expended, 19·5 per cent.

The largest of these losses is that carried away in the exhaust gases. A good deal of this can, however, be used for raising steam in a special form of fire-tube boiler, but here again we are limited in the amount of heat we can extract from these gases by the undesirability of condensing the steam they contain; this is another case for the cheap feed-water heater mentioned before. However, as it is, nearly two-thirds of the heat in the exhaust can be used for raising steam, which may amount to 2 lb. of steam per pound of coal in the producers.

The next serious loss is that in the water used for cooling the gas-engine cylinders. This is more difficult to negotiate, as low-temperature heat is rather a drug on the market. Probably, unless there is a demand for hot water for some other purpose, the best plan is to combine gas and steam plant. This has been carried out in some combined engines in America, using both the gas-engine cylinders and the exhaust to raise steam, which is used in another cylinder driving on to a common crank-shaft. Another proposal, and one that goes much more to the root of the matter, is the "Still" engine. I believe that this engine will "get a move on" presently.

As regards by-products the matter at present largely turns on whether the by-product recovery producer can or cannot be made self-supporting in the matter of the steam it uses. Producer reformers aver that the reformed producers will make their own steam and more. If this proves to be the case it becomes frequently a question between the relative values of coal and by-products whether it does not pay to gasify the coal used for steam power plants. It only waits, however, for the perfecting of the gas turbine to make the gasifying of coal and the recovery of by-products a foregone conclusion. And then, of course, at the back of all this is the immense possibility of gasifying what would otherwise be waste fuel, and there is another possible way of utilizing the heat of combustion and converting it into electrical energy, namely by means of the thermo-pile.

POWER AND HOT WATER AS BY-PRODUCTS.

To every thoughtful mind there must have been forced the conviction that, when all our national resources are used as they ought to be used, ample power will result as a by-product, and fuel charges will be struck out of the bill for power. It would then remain for engineers to reduce the capital charges, which can be done slowly by reducing the cost of plant but much more quickly by increasing the load factor and diminishing the transmission losses of our big power stations. Manchester has given a lead in this direction by the cultivation of large power consumers situated near the station and willing to accommodate their demands to the exigencies of the other loads.

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* Abstract of the Chairman's Address to the North-Western Centre of the Institution of Electrical Engineers, November 9, 1920.

There is a possibility that the use of steam might be justified if the latent heat in it could be extracted and used for some useful purpose such as process work in the factory or a commercial supply of hot water for domestic washing and heating. The latter most attractive possibility is well known and some amount of work has been put into it,* but all the literature on the subject has been too partial and has stopped short of actually proving or disproving the commercial possibility of the scheme. It may be perfectly true—

1. That what the industrial household is most in need of is a supply of hot water for washing the person, the clothes, and the culinary apparatus; and

2. That the power station without much interfering with its function as a power station could supply hot water. But it does not in the least follow—

3. That the ratio of the demand for power to the demand for hot water is of the same order of magnitude as the ratio of their production in a joint station; or

4. That even if 1, 2 and 3, are all true the supply could be given at a price which the industrial householder could and would pay.

It is proposed, therefore, taking for granted items 1 and 2 to prove the truth of 3 and 4. For this purpose I have thought it best to take an actual example, giving my assumptions and figures so that any alteration in the conditions can easily be allowed for. Take an industrial community of, say, 10,000 inhabitants grouped into 1,670 households of six members each, three of whom are working. The houses, arranged on garden-city lines, eight or nine to the acre, and allowing for wide roads and ample open spaces, would occupy about three-quarters of a square mile. The demands for electrical energy per household will be about 6,400 units per annum for those employed in the factories (1 H.P. per individual), 500 units for lighting and cooking in their homes, and 100 units for carrying the household about in trams and for public lighting; total, 7,000 units per annum per household. As there are 1,670 households the town would require a power station turning out about 12 million units per annum, which at 25 per cent. load factor would have a maximum load of a little over 5,000 kw.

Suppose the station to work with a vacuum of about 20 in., it would take about 20 lb. of steam per unit. These 20 lb. of steam could, on condensing, yield 20 gallons of hot water at about 160°F., so that we have an average of 400 gallons of hot water per household per day. Allowing 50 gallons per day for baths and washing, 350 gallons are left for warming the house. If we allow the water to cool from 160°F. to 100°F., about 200,000 therms are liberated per 24 hours, which is sufficient to keep a five-room house comfortably warm. (For those who are more familiar with electrical units this corresponds in heating effect to about $2\frac{1}{2}$ kw. for 24 hours.)

In a town of this size there are about 15 miles of roads. To carry the hot water from the central station four 5-in. mains will suffice; from these would radiate 2-in. mains; and from these a $\frac{3}{4}$-in. service would supply each house. Flow and return pipes would be provided, the flow pipes being lightly lagged. The loss from these pipes would amount to less than 15 per cent. of the heat delivered to the houses if the lagging of the flow pipes allowed half of one therm to escape per square foot per hour per degree Fahrenheit, which would not be considered a very good steam-pipe covering. The total cost of the pipes, including lagging, excavating, laying and filling in would be about £45,000. The extra plant required at the central station might add another £5,000. 6 per cent. interest and $2\frac{1}{2}$ per cent. depreciation (21 years' life)=£4,250 per annum=1s. per week per house, which surely would gladly be paid for this service.

Mr. F. Forrest on Modern Switchgear and Distribution.†

The new Electricity Supply Act, by delimiting the proposed electricity districts with a view to obtaining the best all-round efficiency, by providing for the utilisation of waste heat and water power where found commercially expedient, so as to conserve coal, and by providing for research work so vitally necessary in the case of an industry based upon an ever-advancing science, is a landmark in our industrial history, and the beginning of a new and better era for electrical engineering. Although owing to the present difficult financial situation, the full development of the national scheme as outlined in the Act may be considerably retarded, it will not be inappropriate to consider some of the engineering questions to which the Act will give rise.

The Size of Generating Units.

The type of prime mover chosen for use in the generating stations will be that which under normal working conditions gives a maximum of economy, reliability and convenience for a minimum investment of capital. As far as our present knowledge goes the high-pressure steam turbine fulfils these conditions best. The size of each individual unit is not likely to exceed 40,000 kw. for single generators, owing partly to difficulties of transport, but also because the increased economy with larger sets will be very small, and this is more than offset by the additional risks incurred owing to a smaller number of units being installed. A safe rule to adopt would be that the size of the largest generator installed should not exceed in capacity 20 per cent. of the maximum load on the system it supplies, and spare plant equal in capacity to the largest set installed must be provided and kept available for immediate service. The first and chief consideration must be continuity of supply, and unless some such limit is imposed on the size of the unit, too great a striving after the lowest possible costs may lead to grave embarassment in case of breakdown.

Steam Raising Questions.

The trend of modern engineering in its search after economy is towards still higher steam pressures and increased superheat. Some of our largest new stations are to run with steam pressures as high as 350 lb. per square inch, with a total temperature of about 700°F., whilst at one large station now approaching completion it is proposed to re-heat the steam between high-pressure and low-pressure cylinders of the turbines. The present is a transition period in the design of the modern power house, and the experience gained with these high pressures and with re-heating will go far towards deciding the type and arrangement of the main turbo-generators for future stations.

Although the gas firing of the boilers is at first sight an exceedingly attractive proposition, our present method of burning low-grade fuels direct under the boilers is likely to be continued. Every process of coal distillation for boiler firing involves considerable extra heat losses, which must be compensated for by the production of by-products of greater value than the heat so lost. Unfortunately, this is not the case even with the present high price obtainable for these bye-products, so that gas firing, with its promise of higher boiler-house efficiency, is not yet a financially sound proposal.

Science in the Boiler House.

The efficient burning of low-grade fuels has been made possible by improvements in the design and arrangement of the mechanical stokers and furnace brickwork, but also by the gradual introduction into our boiler houses of men of superior intelligence, supervised by expert steam engineers. These men are now greatly assisted in the carrying out of their work by accurate instruments for indicating the amount of steam delivered by each boiler, gas temperature indicators, draught gauges, and CO_2 indicators. We are hopeful that shortly it will be possible to replace the CO_2 indicator by an instrument for indicating accurately the excess of oxygen in the flue gas, which is what we really want to know. The temperature of the gases discharged from a modern water-tube boiler, with its economiser, is so low that mechanical draught is a necessity; but this gives us a better means of controlling the duty of each boiler during periods when they may be supplied with fuels of widely varying qualities.

Further elasticity in the working of the boiler house might be obtained by subdividing the overhead coal bunkers into two unequal parts, the larger part holding fuel of average quality for use during periods of light or moderate loads, and the smaller part holding fuel of better quality for use during periods of heavy load or in case of emergency.

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* Mr. Pearce has had examples of this at work in Manchester for years. *See also* W. M. Selvey on "A System of Combined Electric Power and Commercial Heating Generating Stations" (Sheffield, 1918).

† Abstract of the Chairman's Address to the South Midland Centre of the Institution of Electrical Engineers, November 3, 1920.

Even with the most economical plant, the overall thermo-dynamic efficiency of the big generating stations we are considering is not likely to exceed 20 per cent. when running with a load factor of 40 per cent., whilst steam is used as our working substance.

The Switchgear of the Future.

The outstanding features of the design and arrangement of the controlling switchgear which will be installed in the large stations of the future will be safety and *absolute simplicity*. Among other means likely to be adopted for increasing the safe working of the main switchgear will be the use of current-limiting reactances of such capacity and so arranged that every main switch in the station will be capable of satisfactorily breaking the maximum short-circuit current of the circuit which it controls. The prejudice against the use of reactance for the main switchgear which has undoubtedly existed hitherto is giving place to a better appreciation of the benefits accruing from their use, and it is now considered to be as sound engineering to insert current-limiting reactances for the prevention of destructive short-circuit currents as it is to mount a 6 in. gun on a non-rigid carriage.

Both safety and simplicity are increased by keeping the number of circuits connected to the main bus bars down to the absolute minimum. For instance, if there are six generators installed in the station, then the number of circuits connected to the main bus bars should not generally exceed 18—viz., six generator circuits and 12 group feeder circuits—each of the latter supplying through current-limiting reactances a sub-bus bar, to which a group of feeders would be connected.

High Tension Cables.

With the increased size of the new electricity districts, feeder and transmission line voltages are likely to be much higher than the standard pressure of 33,000 volts adopted by Manchester and Birmingham for their new stations. For pressures over this figure the three-phase trunk feeders will probably each consist of three single-core lead-sheathed cables, the copper conductors being stranded over a hemp core to increase their diameter, with a view to reducing the potential gradient. The high dielectric loss when pressures exceeding 30,000 volts are used, and the induced voltage in the lead sheathing if single-phase cables are adopted, make the whole subject of cable design for these very high voltages a highly complex problem; but we may be sure that our British cable manufacturers, who have been experimenting for years with extra high voltage cables, will be ready to supply such cables when required, and guarantee their satisfactory working. It is assumed that all main transmission feeders will be placed underground (full advantage being taken of the compulsory wayleaves provided by the Act), and only a few transmission lines of secondary importance placed overhead.

The Problems of Domestic Supply.

Although probably not more than 10 per cent. of the output of the big stations we have been considering will be used for purely domestic supplies, a means for giving this class of supply from substations connected to the main E.H.T. distributing system must be particularly considered. It will generally be conceded that for small low tension domestic supplies direct current is on the whole more satisfactory than alternating current, apart altogether from the larger question of power factor and the fact that for equal declared pressures alternating current is at least 41 per cent. more dangerous to touch or handle than direct current. The latter point is of special importance now that so much portable apparatus is being introduced into the modern household. Low tension alternating current can at present, however, be supplied to small consumers more cheaply and economically than direct current, because with the former step-down static transformers with an efficiency of about 98 per cent. are employed and these require no regular attention, whereas with direct current, rotary converters must be used having an efficiency of about 92 per cent. and these do require constant skilled attendance. A number of entirely automatic rotary converter substations have been working with considerable success for some years in the United States, where labour costs are even higher than ours, but this method is not likely to meet with much favour in this country. The ideal towards which we are working and which a few years ago seemed almost an impossibility, is a completely automatic and static substation for converting E.H.T. three-phase alternating current into low tension direct current, with an overall efficiency approaching that of the modern transformer.

The Mercury Vapour Rectifier.

The remarkable development during the last few years of the mercury vapour rectifier for substation work in sizes up to 500 kw. each, has brought us much nearer to our ideal, and I believe it is apparatus of this character which will be adopted for small traction and lighting sub-stations in the future. It is noiseless, occupies a small space, and requires no regular attention. It is insensible to variations in frequency, its regulation or voltage rise between no load and full load can be adjusted between 5 per cent. and 17 per cent., and its overall efficiency including the step-down transformer is about 93 per cent. at 500 volts, this efficiency being practically constant at all loads. In first cost it is cheaper than rotary converters, and can be installed in a less expensive building. One disadvantage with it is that the arc and therefore the direct current supply is not self-restoring after an interruption of the alternating current supply, but has to be restarted by means of a small ignition arc temporarily set up between an electrically controlled steel rod plunger and the mercury bath cathode. It is, however, not difficult to foresee that when a fully automatic substation is required some simple instrument of the relay type will be devised to restart a rectifier and connect it to the bus bars after the alternating current supply has been restored. These rectifiers seem to hold in themselves great promise for the future of electric supply in suburban or more isolated districts.

Mr. H. Dickinson on Electricity Supply.*

After referring to the progress made by the Liverpool sub-centre since its formation in 1919, and paying a special tribute to the efforts of Dr. Marchant, his predecessor, Mr. **Dickinson** said that he proposed to deal with the question of electricity supply, which was exciting much interest in this and other countries. He recalled briefly the Coal Conservation Report of 1917 and the Electric Power Supply Report of the following year. The main suggestions made in these reports were incorporated in the Bill brought before Parliament in 1919. There had been much criticism shown, but too little time had been available for the discussion of contentious points. The decision to drop the proposal to form District Boards and compulsory purchase was unfortunate, and it would delay procedure by many months, as each scheme had to be contrived to meet the views of all the different partners. The formation of District Boards, on the other hand, could have been proceeded with immediately. Nevertheless, the Electricity Commissioners had some power of coercion, as they might refuse sanction for extensions to recalcitrant authorities. But the process would be slow and give rise to much discord. In Mr. Dickinson's opinion, further powers will have to be granted before the aims of the Bill can be satisfactorily carried into effect.

Present and Future Conditions of Supply.

Mr. Dickinson next analysed the present conditions of supply, which involve hundreds of different systems, with varying pressures and frequencies. Co-ordination, standardisation and unity of control are essential, and the control of generation and main transmission over wide areas is now generally endorsed by the electrical industry. Already improvements in alternating-current machinery have led in many cases to the entire replacement of the original plant. The complete scheme thus only carries the present tendency a stage forward. In future, generating stations will be laid down with more regard to cheap production, and larger and more economical units will be employed. Higher electrical pressures will, however, allow greater flexibility in the choice of the site. The present high cost of labour makes it necessary to install labour-saving devices wherever possible.

Another essential feature of progress is the use of cables capable of withstanding much higher pressures than in the past. The presence of traces of air in insulating materials has a prejudicial effect, but it is claimed that new methods have overcome this difficulty, and the opinion is held that cables suitable for 66,000 volts could be manufactured. Cables for 33,000 and 55,000 volts are actually being made.

In the future waste heat available in a district should be used for generating electricity, and some varieties of fuel, at present unmarketable, might be employed if a super-tension network were in existence. Pulverised coal could be more widely used. The results of such steps would mean a material saving of coal.

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*Abstract of the Chairman's address to the Liverpool Sub-centre of the North-Western Centre of the Institution of Electrical Engineers, November 1, 1920.

In reviewing the problem of electricity supply it is necessary to look five or ten years ahead. Undertakings are now receiving applications for supply at an unprecedented rate, and much additional plant will be required; yet some existing stations are incapable of further development, though linking-up would diminish the amount of new plant necessary. Developments in the use of electricity will proceed more rapidly under the new conditions, and such problems as railway electrification will be facilitated. Finally, a unified system will afford a great safeguard against breakdowns. It is illogical to contend that it is right to spend money on the extension of existing stations which would subsequently have to be bought out, and yet to object to the expenditure necessitated by the proposals of the Electric Power Supply Report. Reconstruction of existing stations would only be a temporary expedient, and in the long run the total capital expenditure would be greater.

Improvements in Efficiency.

Dealing with possible improvements in efficiency, Mr. Dickinson laid stress on three factors, the use of larger generating units working under high vacuum, the use of higher steam pressures, and the heating of the condensate by steam abstraction from the turbine. A fourth possible factor would be the re-heating of the steam at the different stages of its passage through the turbine, but in view of the complexities involved the benefit derivable was dubious. Generally speaking, improvements must be obtained mainly by raising the temperature of the steam and lowering the final temperature. To-day, temperatures up to 700°F. are considered satisfactory and pressures of 300 lb. in turbines and boilers are being used. Little advantage is to be gained by carrying the vacuum beyond 29 in., a figure which has been attained in some plants. It may not be long, however, before we see stations running with steam at 500 lb. pressure and a temperature of 750°F. By using steam from the auxiliaries and tapping the steam at various points in the turbine the temperature of the feed water may be raised considerably, but this process, if carried too far, would diminish the value of the economiser. Using flue gases to heat the air before it enters the boiler furnace involves expense and complexities, but this is partially relieved by the removal of the need for an economiser. At high pressures this is an advantage, as cast-iron becomes uncertain, and cast-steel is very expensive, while in wrought-iron corrosion and wastage would be excessive. It has been suggested that pressure on the economiser should be kept low by using two pumps in series or a multiple rotary pump, but this would add materially to the cost and complication of feed pipes. Reference was also made to several problems in the design of large turbines, one being the question of giving sufficient area to the blades at the low-pressure end without exceeding the margin of safety. Special blades now have been designed to meet this difficulty.

The tendency in recent years has been towards higher running speeds. 5,000 kw. and 6,000 kw. machines at 3,000 revs. per min. have been put into operation, and there will soon be running in this country a 12,500 kw. set with 25 per cent overload capacity capable of running for two hours at this speed. Machines of still higher output running at this speed may be made in the near future. High speeds involve smaller diameter and longer rotors, necessitating special precautions as regards ventilation. Water-cooling of the rotor through tubes has been attempted but has not quite answered expectations. Methods of cooling and filtering air are many, but do not call for special comment. Ten years ago Dr. Ferranti said that a conversion efficiency of 25 per cent. was necessary if electricity was to be available for all purposes. He has recently stated that he expects future central stations to produce on the switchboard 28 per cent. of the energy in the fuel. Meantime, one large generating station, designed for an overall efficiency of 24 per cent., will soon be in operation.

Heating and cooking apparatus has been much improved in recent years, and there is a promising field for their use. The high initial cost is a drawback, yet such appliances are a sound investment when one considers time and labour saved.

Distribution Problems.

Under the proposed Joint Electricity Authorities or District Boards the distribution and transmission of electrical energy will assume great importance. The use of higher pressures will involve more powerful switchgear and automatic control to isolate quickly any faulty section. Existing methods, the use of extra pilot wires and split conductors should be carefully studied. In some districts the drop in very long feeders, when cookers and radiators are in use, presents difficulties. One solution would be the employment of alternating current and high-tension feeders. Considerable advances have been made in mercury rectifiers which are in successful operation in many places on the Continent. Attempts are being made to render the apparatus automatic throughout its entire range. The cost of low-tension mains in some areas is heavy, and it would be a big problem to contemplate their replacement by some other form of cable.

In the final section of the address the author made some general remarks on costs of production which have advanced enormously during the war. We may, he thinks, expect ultimately a reduction on the coal cost per unit due to improved efficiency, &c. Wages, repairs and rent, taxes and rates all show great advances, but capital charges have fortunately not exhibited the large increase added to other items, though this item may also increase in the near future. However, as matters settle down, we may reasonably expect a diminution in the cost of energy. One of the most hopeful signs is the anxiety of the various nations to resume trade relations. What is needed now is a period of freedom from industrial disturbance, so that commodities and prices may settle down and stable conditions may be attained.

Correspondence.

THE WOMAN IN THE PROGRESS DEPARTMENT.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The letters of Miss Entwisle and Miss Nott, published in your issue of Oct. 22, condemn the writers in themselves.

A more tactless letter than Miss Entwisle's would be difficult to conceive. She appends the letters A.M.I.E.E. to her signature, and she is also a member of the Society of Technical Engineers. Surely these two facts in themselves refute the accusation of men's prejudice towards women in the engineering profession. It is obvious that by admitting Miss Entwisle to these institutions men are ready to appreciate women's ability. Would any "mere male" have been admitted to associate membership after only five years' experience to his credit.

There is little doubt that Mr. Hiscox bases his arguments on experience, perhaps bitterly gained, yet Miss Entwisle considers herself to be in a position to contradict him after five years in the profession, and experience gained with one firm only. The lady's remarks anent jobs being merely clerical and beneath the dignity of the "lordly male" are, at the present time, in distinctly bad taste, to say the least of them.

May we remind Miss Entwisle that many men in jobs far more humble than even "clerical jobs" gave those jobs up in order that ladies like your correspondents could have the opportunity to educate themselves fitly for such positions as they held during the war and to hold the jobs when the men came back.

With regard to Miss Nott's letter. Will Miss Nott furnish accurate details of work she actually did, not saw others do, whilst "serving her time" in a large electrical factory? On her own showing the shops have only been open to members of her sex some five years, yet Miss Nott has not only "served her time," but has for some time held a position of responsibility.

Miss Nott shows an utter lack of knowledge of the foreman when she says she never met one who objected to her presence in the shop. Miss Nott might be reminded that she "served her time" in abnormal conditions—it was the foreman showed his tact and sense of fair play when he gave her information. Had Miss Nott heard an unabridged opinion of the average foreman on "Women in the Works" her ideas would have received a drastic revision.

With regard to the remark that "a good deal of women's work is grade one." We have only to look back to the time when women first started making shells to prove the utter fallacy of that statement. The degree of accuracy mentioned by Lady Parsons in her paper on "Woman's Work in Engineering" was only attained by the introduction and development of accurate automatic machines—set up, incidentally, by men—jigs and gauges, the product of the brains of mere males. With every device perfected, so far as possible, to ensure automatic accuracy, it is difficult to understand how any woman—or even child—could fail to produce work to a fine tolerance. As to whether physical strength is so very necessary to an engineer, it is as well for your correspondents to remember that the term "engineering" embraces a good deal besides office and designing work or the comparatively light work on test beds.

In conclusion, it is difficult to understand how Misses Entwisle and Nott can care to bring their views into the limelight of public opinion in face of the number of fully qualified engineers who, after serving their country in the field, are unable to find employment.

The "Electrical Review" of Oct. 22 published a list of 10 names of engineers at present on the books of the Labour Ministry—all over thirty years of age, of wide experience, and all members or associate members of the Institution of Electrical Engineers.—We are, &c.,

"Two Males."

TO THE EDITOR OF THE ELECTRICIAN.

Sir: The recent article by the writer on "The Woman in the Progress Department" has been productive of some spirited criticism, as is evidenced by the letters which have appeared in The Electrician, but despite the arguments which have been advanced, the writer's opinions have not undergone any modification. The article was written with a due sense of responsibility, and the views expressed were the result of many years' experience.

One would think, from the criticisms which have appeared, that it was during the war period that the woman first became acquainted with the engineering factory, whereas for many years prior to that she had been giving honourable service, proving her proficiency in those branches of industry for which she was adapted. And yet the writer has been called "inconsistent" because he recognised this proficiency, which was the result of years of training. It is observed that, whilst one woman writer declared that "any intelligent girl (or boy) could learn *any* mechanical process in a few weeks, if well taught," the other writers took a contrary view, as the following sentence will show. "Much of the distrust which exists is due to prejudice, and will wear off as women prove their capabilities." There it is shown that, so far, women have *not* proved their capabilities, despite the fact that, instead of a few weeks, they have spent a few years in endeavouring to do so.

It would appear to the writer that too much stress is being laid upon "education," "college training," and the like. "Women's greatest drawback is that many firms will not open their doors to them, and, therefore, the woman who knows she will have to earn her own living . . . is debarred from taking an engineering course at college owing to the uncertainty &c." The writer would suggest that firms themselves usually prefer to be the educatory medium, believing in practice rather than in theory. It is of course desirable for an apprentice to take up engineering studies, but in assuming that a college education is sufficient qualification to warrant a position in the engineering factory it seems that the woman is grasping the "wrong end of the stick."

Your correspondents speak of the prejudice of the men, but can it be expected that a man, who has spent several years in a factory and has become more or less proficient in his duties, will accept a woman upon level terms, whose only qualification is "a college education?" *He* had to work for his position, and rise upon his merits. *She* expects to get a similar position without working for it (in the manual sense). We heard nothing of the "wonderful woman" before the war, and yet she was in evidence. Then, however, she worked for her position, and beat the man at his own game. But no prejudice was exhibited. The man recognised that the woman was his superior in a certain branch of industry, and he allowed her the spoils of victory and took up another branch. The woman, having proved her superiority in this branch, did not immediately proclaim her superiority in all branches, but educated herself to hold what she had won, and to fit herself for something still higher. The newspapers did not send representatives to interview her, neither did they publish her portrait. Yet it is significant that, despite the exodus of women from the factory, *she* is still there, and likely to remain there for, of course, she is a necessity, whilst her well advertised sister is not. If the woman is so proficient, would the employer be in such a hurry to get rid of her, even to satisfy the demands of the trade unions? Despite the power of the latter bodies it will be found that the employer can usually hold his own, if he has a strong reason for so doing. It is evident that he did not consider the matter of sufficient importance to contest, and this somewhat spoiled the brilliant picture that had been painted.

One correspondent speaks of the woman in the shell factory, who turned out such accurate work, but can a shell turner be termed an engineer? And in regard to this accuracy, who was really responsible, the turner—or the machine setter? And, again, was a woman supervisor responsible for quality and quantity, and still again, did a woman devise and execute the tools which made accuracy, not only possible, but practically certain? Also, in one very large shell factory, although most of the operations were done by girls (under male supervision), the really important operation (*i.e.*, boring) was in every case performed by men. It was a case of a repetition job being made suitable for female labour. But let us give credit where credit is due. The woman was no "dud," and she quickly grasped what was expected of her, performing her task expeditiously and efficiently. That she was worth her place is not disputed, but unfortunately for herself, she had an exaggerated idea of her own importance, and attempted to make others believe that she had acquired, in a few month's the essentials of engineering. That was her undoing.

Many instances could no doubt be brought forward to show that the woman had triumphed, but many more could be called upon to show her failures. This is only to be expected, and is scarcely worth argument. There are "duds" amongst the men, and always will be, and the same remark must be applied to the women.

Dealing with the administrative side, your correspondents admit that the woman has not yet given this serious consideration, so we may assume that there will be a rod in pickle for us when she does turn her activities in this direction. One writer agrees that five years' training is necessary to qualify for a section leader's post in the Progress Department, which shows, at least, that she appreciates the value of practical experience. Another writer blames the man in charge for the lack of opportunity for the woman to prove her capability, "for the simple reason that the 'mere male' in charge is generally too *sure* of his own powers, or too much *afraid* of hers."

This seems a rather peculiar statement, but the present writer has had the privilege (?) of coaching girls in this profession. He was not "afraid of *her* powers," for the simple reason that it was to his advantage to make her proficient. His experience of progress organisations is somewhat extensive, but he is forced to the conclusion that, in the main, the woman shows no aptitude for real progress work. His method has been to sectionise the department, to place a girl in charge of each section, and to promote her when she has become proficient. The unfortunate thing is that the girl dislikes promotion (except the financial part of it) and so long as her salary is progressive, that is the only progress she really understands. The real meaning of "progress" is beyond her comprehension, and she exhibits no enthusiasm in the profession. If her section is concerned in the making out and issuing of workers piecework tickets, she will learn the duties quickly, and soon become proficient, but she is quite upset at the suggestion that she should leave that for the compiling of graphs and charts. There is too much learning for her, and she would rather remain on the work with which she was familiar, than make the endeavour to rise higher and thus acquire more knowledge.

It will be observed that she differs from her "mechanically-inclined" sister to a certain extent, as the latter endeavours to rise on the strength of the little knowledge she has gained.

In reality, however, the difference is but slight, for disinclination to learn is apparent in them both. The girl in the Progress Department would like a good position, but she is not prepared to work for it, and as it cannot be attained without work, she stays where she is. The same remarks apply to the girl in the shops, and the crux of the matter is that, until the woman is prepared to work for a position—to recognise that, in spite of what she knows, there is much more that she doesn't know—she will never be taken seriously, and the revolution of the engineering industry will not result from her endeavours.—I am, &c.,

W. J. Hiscox.

London, November 5.

[This Correspondence is now closed.—Ed. *E.*]

SCIENTIFIC LITERATURE AND INDUSTRIAL RESEARCH.

TO THE EDITOR OF THE ELECTRICIAN.

Sir : Now that research has assumed such a prominent place in industrial life, the efficient use of scientific literature has become of supreme importance, and Mr. Eason's article in your issue of October 22, therefore, makes a timely appearance. The efficient investigator, before he commences experiments for the solution of a new problem, finds out what has already been done by others on the same subject. In thus appropriating a foundation for his building he saves time and energy for himself and, as apparatus is expensive, money for his employers.

There never was so much valuable knowledge awaiting development and application as there is to-day, nor so many workers adding daily to this common store. Yet, how strangely inefficient are the average methods of gleaning this information. The remarkable strides which industrial research has made in the United States, and the great extent to which success over there has followed upon the application of results obtained and published by scientists on this side of the water, emphasises the importance to a research organisation of a well-conducted Information Bureau compiled from the world's scientific publications. Information is practically useless unless filed and indexed efficiently. Many scientific investigators, enthusiasts in a new line of research, will not stop to find one of the ready-made foundations. Impatient to build, they begin to dig, so that if the acquisition of available knowledge on any particular subject is made easy, much unnecessary labour is avoided.

The average industrial research organisation is interested in a very wide range of subjects, reaching out in widening circles from the speciality with which it is most closely concerned, and on any of these and similar subjects the investigator must be able to find the best that has been published. In the large electrical corporation laboratories, where the scope is even less limited, the importance of the subject is still greater.

Mr. Eason has shown that we are not without aids to the efficient use of scientific literature—to his valuable list might be added the recently founded "Technos," published in French ; but the very fact that all these opportunities exist means confusion and wasted effort. Why should there not be in our own country one recognised well co-ordinated system of scientific and technical abstracts, to which a man could turn in confidence, on the one hand, that he would be missing nothing, and on the other that he would not be ploughing the same ground over and over again ?

As is usual in a case of this kind, the reason for the existing state of affairs is difficult to define. It is more than probable, in the process of its evolution, jealousies between different bodies prevented the co-operation so desirable in the early stage, and now co-ordination means a great undoing. But it should come. In spite of the many obvious difficulties, there should be every prospect of success if a committee of representatives of the various scientific institutions and societies, and of the periodicals now abstracting for profit, were to get together in the right spirit. Things like this are done better out of Government Departments ; but, failing agreement of the conflicting interests, the time would then be ripe for the Department of Industrial and Scientific Research to step in and solve the problem by embracing in one comprehensive scheme the best in each of the present systems. As Mr. Eason points out, it is very desirable that there should be a minimum time lag between the appearance of an article in the Technical Press and the appearance of the abstract. An abstractor keen on his work usually complete's one week's journal before the next appears, so that, allowing the printer a week—a generous allowance in comparison with what the evening papers can do—there is no reason why the abstract should not appear the week following. Even in the case of foreign articles, the delay should not be much longer, as the leading French and German periodicals are now arriving within three or four days of publication. Abstracts are frequently scanned with a view to the original article being obtained when of special interest, and nothing is more annoying than to get a reference so long after the publication that the original is out of print.

In a recent letter to "Engineering" (Vol. CX., p. 80, 1920), the importance of standardising the *format* of abstracts, proceedings, &c., was urged by Mr. Wordingham, and the matter is certainly of importance to industrial research, where one bureau must collect from such varied sources.

With the opening of the new era of industrial research there was never a better time for putting these things on a sound basis. A symposium on the co-ordination and use of scientific literature would be a novelty ; but the subject is important, does not lack interest, and would certainly result in considerable benefit by being discussed.—I am, &c.,

Acton P. Dunsheath.
November 5th.

INSTITUTION OF ELECTRICAL ENGINEERS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir : Apart altogether from the merits of the question at issue—namely, the proposed raising of the subscriptions to the Institution, I wish to protest against the method adopted of ascertaining the wishes of the members.

A very small proportion of us can personally attend the meeting and hear the arguments for and against the proposals on December 2nd, and so we are invited to send proxies to the Council to back their scheme. Now, as this amounts to an affirmative vote, why cannot we be allowed a straight vote "for" or "against," after having a statement of the case submitted to us by post ?

The present system, in fact, gives those in favour a chance of voting, and practically bars those against from expressing their wishes. To whom, for example, am I to send my proxy (presuming I wish to oppose), and at whose expense is this opposition to be organised ? This method of obtaining votes for one side, at the expense of the whole membership, is very unfair. I know that the same thing is done by the directors of public companies, and in these latter days politically also, but that does not make it any fairer.

If the Council really wish to have the opinions of all its members, it could (*a*) take a postal vote, (*b*) take a personal vote in London *and* in the local centres, or (*c*) indicate where proxies can be sent by those wishing to oppose.

If the Articles of Association insist on the present unfair method of voting, may I suggest that the time of the meetings on December 2nd could be well spent in amending them.—I am, &c.,

Robert A. Sheldon, A.M.I.E.E.

Birmingham,
Nov. 9th.

[Mr. Sheldon has entirely mistaken the terms of the notice convening the meeting and the accompanying letter from the President. If he is unable to attend the meeting himself, he may appoint as proxy on the form sent him anyone attending the meeting who is in agreement with his views. It is, in fact, for the very reason that so small a proportion of the members will be able to attend the meeting that the proxy method of voting has been introduced.—Ed. *E.*]

ELECTRICITY IN FACTORIES AND WORKSHOPS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of October 15th a letter appeared by Mr. Wordingham with reference to the relative dangers from electric shock by alternating and continuous currents. I have often wondered myself why the authorities do not make a difference between the two systems when propounding rules for the supply voltage. Many years ago, when the question of introducing alternating current into New York for general supply was under consideration, there was a hue and cry, and a good deal of correspondence took place in the American technical press on the matter. In some experiments that were carried out by Mr. Harold P. Brown at Columbia College on animals having the same resistance as the human being, it was found that while 360 volts alternating current was fatal voltages of over 1,000 continuous were quite safe.

Many of your readers will remember the case at the Sheffield baths, where two men mere killed by 200 volts alternating current. Mr. Wordingham's suggestion is a good one. When the metal filament lamp first arrived, a large number of small transformers, with secondary pressures as low as 25 volts, were installed on consumers' premises to save wiring lamps in series. Why could not the same thing be done now for the sake of safety? The alternating current is not popular, as it has so many drawbacks, and should never be used except for long-distance transmission, and then only to carry the current to sub-stations, where it would be converted to continuous current for local supply. There are special cases, of course, such as ship propulsion of large powers, where the continuous current would be out of the question; but for general supply, such as in our large cities, towns and villages, the continuous current is the best. Even in America, where the alternating current is so much used, they are beginning to find that out.—I am, &c., CHARLES RETTIE.

Liverpool, November 1st.

THE A.E.G. CONTRACT

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I am instructed by my Directors to write to you with reference to the Notes appearing in your issue of October 29 last regarding the order for electrical plant recently placed by my firm with the A.E.G. The writer of the Notes is evidently not aware of the circumstances, and I therefore beg that you will be good enough to insert this letter in your next issue.

It is far from correct to say that there was little difference in the prices. Even had the contract been divided into sections, the lower British quotations were appreciably higher than the aggregate figure quoted by the A.E.G., while when compared with the lowest total figure named by any one British firm the difference was very substantial.

My directors were most reluctant to place this order abroad, and afforded the British firms more than one opportunity of revising their prices and terms of delivery, but unfortunately without any appreciable response. Even so, my directors would not have refused to consider the British offers, but unfortunately the English firms insisted on a fluctuation clause, of the operation of which my Company has had already bitter experience, and which introduced a serious element of uncertainty. In addition to the above, under the terms of the British offers, delivery would not have been completed for at least 20 months, while the A.E.G. were not only prepared to undertake to complete in about one half of that time, but even to accept a penalty clause in respect of any delay. Obviously in connection with such a contract delivery is a matter of almost overriding importance.

My directors sincerely regret that they were compelled to place this order on the Continent, but circumstances as to price and terms of delivery presented a consideration which it was impossible to ignore.—I am, &c.,

For Partington Steel & Iron Co., Ltd.,
GEO. R. DOBSON, Secretary.

Partington Steel & Iron Co., Ltd.,
Irlam, Manchester, Nov. 4.

[This letter was received on Nov. 5.—ED. *E.*]

Mr. H. W. Clothier on Ironclad Switchgear.

At a meeting of the Newcastle Students' Section of the Institution of Electrical Engineers held last Friday, Mr. H. W. CLOTHIER gave a lecture on "Ironclad Switchgear," and described the experiences which led up to the enclosure of conductors.

He said that the history of switchgear design progressed from the earliest types of air break and plug switchgear, through the addition of spring sparking contacts and the arrangement of arc arrestors in series with the arc to the first example of the oil switch; thence *via* the scheme of having the main break in air with a spring sparking contact, of which the bottom contact was pulled down into a pot of oil when opening, thus drawing the arc into the oil, to the present day design of armour-clad switchgear.

The safety of attendants evidently received considerable attention on many of the older patterns of switchboards, but the methods of ensuring this safety were different. The majority of switchboards at that time were of the single-phase three-wire type, particular care being taken to insulate all apparatus from earth, and the arrangement of the gear was such that it was impossible for anyone working on the neutral to touch either the inner or outer phase leads, thus limiting any possible shock to the capacity charge of the body. This practice actually led to trouble owing to the perfection of insulation achieved, as if an arc was once started it was possible for it to continue for a considerable length of time.

Mr. Clothier expressed the opinion that in future engineers would not dream of leaving conductors unenclosed, and that in view of the greater safety to be obtained the use of ironclad switchgear would become general. Any combination of ironclad and open gear Mr. Clothier considered to be very undesirable, because danger is always introduced at the junction of the two types, owing to the presence of live conductors near the ironclad switchgear. If such an arrangement was required then great care must be taken in the design and layout.

The Motor Show, 1920.

Last week saw the opening of the Motor Exhibition—strange to say, the largest there has yet been in that this year it occupied both Olympia and the White City. Stranger still, because it was held at a time of difficulty due to the "slump" which is at present being keenly felt by many firms. Last year's show saw an unusual state of affairs—an unprecedented demand and a totally inadequate supply. This year, despite labour troubles, there are several firms providing a larger output than the public is prepared to take. Increased taxation and national financial tightness have had their natural effect upon the public's purchasing power. It seems the irony of fate that last year many models shown had not withstood the test of lengthy road tests when the public rushed in to buy—yet this year when the opposite is the case the eagerness to buy has ceased.

MODELS AND DESIGNS FOR ALL.

The models exhibited, however, cater for all desires from the last word in luxury to the minimum requirements for road comfort and propulsion. If anything there was a marked development in that cheaper and lighter make of car, which particularly appeals to the "owner-driver" class of purchaser. It is interesting to note battery and magneto ignition are still keen rivals, and that so far practice does not seem to have shown a decided preference for either method. We should have thought that the present poor state of our roads, due to neglect during the war, would have caused greater attention to be devoted to methods of body suspension, but the show does not reveal any particular changes or developments in this direction. It may be that makers consider roads will be rebuilt to pre-war standards, but it should be remembered that for export trade adequate comfort on bad roads is a necessity. Overhead valves and camshafts and also the detachable head are items of engine design which appear to have obtained a permanent place. With the exception of cycle cars, air cooling, which was so much in evidence last year, seems to have given way to the older method of water cooling.

IGNITION AND LIGHTING.

This year's show again provides evidence that the British made magneto is a success, and unless the question of price arises due to the continental exchange rates or deliberate "dumping" there is no reason to fear foreign competition. The same comment may be made on the electric self-starting apparatus, and it is to be noted that it is becoming general, even in the lower-priced cars, to fit this modern addition to the car drivers' comfort and convenience. Some 90 per cent. of the exhibits are provided with this apparatus. Electric lighting sets are also apparently gaining considerably in popularity, and again, this development is to be found in connection with the cheaper cars as well as on the more expensive ones. Last year about 22 per cent. of the exhibits were priced under £500, this year approximately 15 per cent. come under this figure ; 18 per cent. come between £500 and £600, and about an equal number between £600 and £800, 12 per cent. between £800 and £1,000, and 32 per cent. above £1,000, the remainder being either above £1,500 or not definitely priced. This comparative figure relate to cars, and do not include cycle cars. Of these there were several types to be seen, the lowest in price being the Carden at £100, whilst there were many priced between £100 and £200.

Electrical Transmission.

Coachwork and finish generally seem to have improved, probably due to more settled manufacturing conditions, and the absence of haste in preparing exhibition models. At stand 306 at the White City was to be seen the Crown Magnetic car, or as it has been termed in the popular press, "the car with a thousand gears." In this car the customary gear-box is replaced by electrical transmission, and it is the only exhibit of this character in the show.

The Carter electric bath chair, designed for the use of the infirm and convalescent, is another electrical novelty seen at the White City. At the same place Messrs. Fuller's United Electric Works, Ltd., displayed a representative exhibit of their various starting and lighting accumulators, dry batteries, and cables. At the stand of Messrs. C. A. Vandervell & Company, Ltd., we were again impressed by the finish and general design of C.A.V. starters, magnetos and lighting sets. The display of glassware for internal car lighting also called for worthy comment, and this firm are still apparently pursuing the commendable practice of issuing literature which adequately and clearly describes the apparatus and the functions for which it has been designed to perform. Messrs. Rotax Motor Accessories Company, Ltd., also had a good display of electric lighting sets and starters.

The plan of dividing the show between Olympia and the White City certainly relieved the crush, and the transport arrangements provided between the two places were well arranged. Evidently additional show space as well as moving space for the public was needed, because both sections of the exhibition were adequately filled with exhibits, and were well attended by the public. There did not, however, seem to be quite the same wish to buy, or the same excited rustling of cheque books and flowing of fountain pens in filling up order forms as we have sometimes noticed. Evidently demand is tending to return to normal, and it is to be regretted if the present financial stringency should have had a marked reflex effect upon the exhibition. A word of praise is certainly due to the organisers for the commendable way in which the show was got ready to time, and the general comfort of the public provided for. The exhibition closes to-morrow.

Electric Traction in the Argentine.

The question of the electrification of suburban lines being of such pressing interest to engineers and the general public in this country at the present time, any detailed information as to what is being done in this direction is of value. The British-Thomson-Houston Company are therefore to be congratulated on getting out as a handsome booklet a description of the work they recently carried out in the electrification of the suburban system of the Central Argentine Railway. It will be remembered that the equipment of this railway was fully described in The Electrician for Oct. 18, 25, Nov. 1 and 8, 1918, Vol. LXXXI., p. 510, 530, 550, 570.

A useful introduction to the book refers to the development of electric traction in British practice, and is followed by notes on the history, geographical features, climate, business and labour conditions in the Argentine Republic. An interesting point about the traffic on this railway is that there are four peak loads instead of two, as it is the habit to take a lengthy mid day interval in Buenos Aires, with a result that a large number of people return home to lunch. This, of course, gives a higher load factor than is usual in this country ; and it is also found that the trains are fairly full throughout the day. This, however, is probably quite as much due to the excellence of the service as to the custom mentioned, as it has similarly been found on the London & South-Western Railway that a regular electric service is the means of a large development in the traffic, quite irrespective of the business and home-going rushes. The book as it stands is quite worthy of a place in the technical library, and the British Thomson-Houston Company are to be congratulated on their production.

Pacific Cable Board Accounts.

The report of the Pacific Cable Board for the year ended March 31 states that traffic receipts were £642,948, and that, after taking into account refund of tolls and dues, payment for charter of c.s. "Iris," and miscellaneous receipts, the total was £664,986. Head office expenses were £11,818, and cable stations (salaries and expenses £176,686 ; cable ship salaries and expenses were £20,971, and, after providing £5,379 for provident fund, and placing £353,000 to reserve and renewal fund, there was a balance of £97,129. The interest and sinking fund on the £2,000,000 advanced for capital expenditure came to £77,545, the reserve and renewal fund for the Sydney-Auckland and Doubtless Bay-Auckland cables was £9,150, leaving £10,433 15s., which will be applied in reduction of the outstanding balance of the original advance.

The net traffic receipts (£642,948) exceeded those of 1918-1919 by £88,436. 11s. 4d., and created a further record. Since the close of the previous financial year, the Government traffic, which formed, during the war and for some months after its termination, such a substantial proportion of the entire cable traffic, has diminished. This fact has, however, not resulted in any appreciable reduction in traffic, as public messages have been increased by the reinstatement of the deferred cable service, and the facilities of the other routes to Australasia were seriously curtailed by interruptions of important cables which resulted in the diversion of a large proportion of their business to the Pacific Cable. The expenditure (excluding special appropriations) exceeded that of the preceding year by £29,035. 10s. 10d., and was higher by £41,857. 1s. 9d. than the estimate, due mainly to the rise in the cost of supplies and to increased payments to staff. The war bonus was raised from 30 to 50 per cent. during the year under review.

In the preliminary forecast of revenue and expenditure for the year ending March 31, 1921, the traffic revenue is put at £400,000, the working expenses are anticipated to be £212,800, and the renewal fund will require £39,150, leaving £148,050. The investments for account of the reserve fund were valued on March 31, 1920, at £755,925. 19s. 7d. In addition, there is in hand stock cable to the value of £69,936.

Cables and Landlines.

During the year two interruptions occurred on the Board's cables, both in the vicinity of Norfolk Island. The first was in June, 1919, when the cable between Norfolk Island and Auckland was interrupted from the 23rd to the 30th. The second interruption was to the Norfolk Island-Suva Cable, which was out of commission from Feb. 26 to March 8.

The landlines in Canada leased by the Board from the Canadian Pacific Railway suffered few interruptions of more than minor importance, and satisfactory working was maintained. A complete alternative route between Vancouver City and the Bamfield terminus of the cable has been secured by the leasing of an additional landline between Vancouver City and Victoria, where it is joined up to the Board's Victoria-Bamfield cable. In October, 1919, through working was introduced between the terminus of the Imperial Cable at Halifax and the Bamfield terminus of the Pacific Cable. Formerly all Pacific Cable traffic crossing Canada by the Board's landline was retransmitted at Montreal. It is now relayed automatically through that station, so that one retransmission is cut out, resulting in the reduction of transit times and errors. The landline between Melbourne and Sydney gave very satisfactory service throughout the year. It is intended to equip the line for fast-speed Wheatstone working with Creed printing apparatus at the Melbourne end. Contracts have been placed for the apparatus which will involve expenditure of approximately £3,500.

Stations.

The Board's house property at the various stations has been maintained in good repair, and various improvements have been made or are projected. New electric power plant was installed at Bamfield, the steam-engine being replaced by an oil-engine. The new plant is proving satisfactory in every way. The power is used mainly for lighting the station, driving apparatus and pumping water. Electric lighting will shortly be adopted at the Southport station, and a contract has been placed during the year under review for the necessary plant. When the installation at Southport is completed every one of the Board's stations will be electrically lit.

Staff and Traffic.

The health of the staff has been generally satisfactory during the year, and the high level of loyal and efficient service has been fully maintained. The Board have increased the number of superintendents from six to eight. One of the additional appointments is in connection with the Halifax station, for which the Board had not previously appointed a superintendent. The other appointment is for the Melbourne station. The Board have not yet reached a conclusion as to the nature of the improvements in the staff superannuation arrangements, for the purposes of which a sum of £50,000 was appropriated from the revenue of the year 1918-1919, but proposals for instituting a staff pension scheme in lieu of, or supplemental to, the existing provident fund, will be examined at an early date.

During the year over 9,000,000 paying words of international traffic (*i.e.*, traffic other than local traffic between Australia, New Zealand and the Pacific Islands) were handled. This was over 750,000 words in excess of the total during the previous year and 300,000 above the previous record number of paying words carried in 1916-1917. In addition to international traffic, approximately 2,320,000 paying words were carried during the year between Australia and New Zealand, and between those Dominions and the Pacific Islands. This was 480,000 words in excess of the 1918-1919 figures. No opportunity has yet presented itself for reinstating the week-end telegram service.

Solving the Transport Problem.

A New Benn Bros. Journal.

A new journal generally announces that it requires to make no apology for its appearance, and that it responds to a well-defined demand. But "The Transport World and Motor Freight Exchange: The Journal of the Road-carrying Industry," a weekly journal which Messrs. Benn Brothers, Ltd., are announcing to appear on January 1, is hardly able, in all the circumstances, to follow this tradition. To begin with, it does require a very distinct apology for venturing to enter the publishing field with a new weekly paper at this juncture. If not an apology at least a good explanation is certainly needful. Those who know anything of the paper and printing market, will agree that these are not the times that the expert publisher would select for the launching of a new enterprise. Paper was never so dear, and printing was never so difficult, and yet, Messrs. Benn Brothers, Ltd., propose to start another paper. The explanation is that the paper *must* be started, and further, that it must be started at once. There is not only a field open and a well-defined want to be supplied, but the field will not wait, and the want is urgent. Road transport is the one obsessing, overpowering, paramount problem of the moment. Practically no business firm is entirely free from the anxieties associated with it. The development of our trade and industry is contingent upon the development of our transport, and there never was a moment in the whole of our industrial history when greater transport facilities were so much needed.

The Essence of the Transport Problem.

Transport is commonly supposed to be a matter of railway trains, or motor lorries, or aeroplanes, or horses and carts, or some other form of receptacle upon wheels or wings. It is only since road transport came to be an important factor in the situation, and since the number of motor owners has considerably increased, that a new conception of the problem has arisen. Railway companies and public carriers generally, have for long recognised that the essence of the motor transport problem is the return load. Large firms of motor owners and that great mass of small enterprises which has now sprung up in the form of transport agencies, are only just beginning fully to realise the real nature of their difficulty. Until the problem of the return journey is grappled with and solved, every vehicle has to do two miles running in order to give one mile service. This return load question is the first and principal reason for the appearance of the "Transport World." Its chief mission in life will be to bring together the owner of the freight, and the motor proprietor. In this sense it will be a real and effective freight exchange.

Roads *v.* Railways.

Road transport has assured an added importance in the last few weeks on account of the rapid rise in railway charges. Whereas, a few months ago, the transport of goods by road motor, was in many cases an expensive luxury, to-day, direct transport by road is a definite economy as compared with railway service. The steam wagon, the motor lorry and the electric vehicle are in a position to claim that they can render not only a better, but a cheaper service than railways, but road transport does not by any means depend alone upon financial advantage in the appeal which it makes to the traders of the country. It can offer a service which is altogether unobtainable through any other field. The first elementary advantage which it claims, is, of course, that it can perform its service with one loading, and one unloading. It abolishes altogether the troublesome and risky business of cartage to and from the railway depot. Contents by road transport from door to door are handled twice, whereas, if sent by rail, four handlings at least are necessary. All the risks associated with moving and lifting are therefore reduced at a stroke. Road transport can do much more. It eliminates most, if not all, the necessity for expensive packing—a lorry can be loaded and packed in exactly the same way as a packing-case itself, and when the packing is done, it is not necessary to consider how many times the case will be turned over, and all the consequences that might arise from placing it upside down. There is no need to pencil all over the consignment "This side up, with care." Even, therefore, where road transport may show a slightly higher charge than would be incurred upon the rail, it is often more than balanced by economies in crates and packing materials, and by the elimination of the serious risk of numerous handlings.

But these are details. The "Transport World" really means what its title says. It proposes to take its place as the organ of the transport world, it will give voice to a great organism which exists to-day, and is dumb. It will canvass the interests of commercial road users, and act as a focus for their opinions and their needs. It will by no means confine its attention to the professional owners of motor transport, it will seek to serve the hundred thousand manufacturers and other commercial concerns, who, owning their own vans, are the greatest sufferers from this difficulty of the return load. A simple way in which the reader can sketch for himself the gigantic size of this problem and the enormous waste involved in the present lack of a solution to it is to stand for an hour at the junction of two well-used country roads and notice the number of empty lorries which pass.

Not a "Motor Paper."

The "Transport World" is not in any sense a motor paper; it does not aspire to compete with the motor press, as at present established. Motor manufacturing, motor buying and selling, and the pleasure motoring world is served by a public and technical press of the first order. Messrs. Benn Brothers, Ltd., do not desire to be regarded as in any way competitors of their friends in these fields. There is no industry that has a better press, and there would be no excuse for further efforts in that direction. "Transport World" will occupy a position of its own, and will supplement the service now given to the motor world proper.

"Transport World" is not concerned with the buying and selling and manufacturing of lorries and motors, so much as with their day by day use. An analogy for our position is to be found in the "Shipbuilding and Shipping World." There is a press which deals with the technicalities of shipbuilding and naval architecture, and there are other papers quite distinct which confine their attention to freight and baling and the operation of ships. "Transport World" will aim to be to the users of the road, what "Fair Play" or "Syren and Shipping" are to the users of the sea.

A great deal has already been done with a view to helping towards a solution of the return load problem. The Automobile Association itself, and many other agencies, large and small, have arranged systems of freight exchange, and facilities for securing information as to transport available and freight owners' requirements. The "Transport World" will enable all this work to become really effective; it will act as the great co-ordinating agent. The need which all of these endeavours have only been able to satisfy in part, is for a central source of information which will make it possible for anyone to ascertain instantly what is the transport position on any route, or in any district, at any time. The "Transport World" will, therefore, be welcomed by all those associations and agencies which have started to work in this field, and should be able very materially to enhance their scope and usefulness.

It is, perhaps, unnecessary to add that the new journal starts under the very best of auspices, in that it becomes one of the powerful group of journals which operate under the banner of Messrs. Benn Brothers, Ltd. It will be planned and conducted on the principles which have always been associated with this firm, and which seem to us to provide the ideal conditions for trade newspaper success. So far as editorial policy and style of production are concerned, the "Transport World" will have no more to do with any of its associated papers than they have with one another. It will, however, enjoy from its first issue, the advantages of a publishing organisation designed and conducted upon a scale which would be impossible to any single technical paper. While on its technical side, it will be in the hands of acknowledged experts in motor traction problems.

The readers of this journal who are interested in transportation problems, who either own motors or have the disposal of freight, are invited to communicate with the Publisher, the "Transport World," 8, Bouverie-street, London, E.C. 4. It is proposed to offer special terms and advantages to the existing customers of Messrs. Benn Brothers, Ltd., whether advertisers or subscribers, and particulars of these will be gladly sent upon receipt of an intimation that they would be welcomed.

As one of the elder brothers of the same family of journals, we may perhaps be permitted to express our gratification at the arrival of so welcome and so promising a youngster amongst us.

The report of the New South Wales Railway Commissioners for the year ended June 30 shows a tramway revenue of £2,881,797 and a net deficit of £8,449. Tramway passengers carried were 324,884,651, increase 56,086,837. The Commissioners emphasise the necessity for city and suburban electric railways. Even if work were commenced immediately, the electric railways could not be in operation or give relief for some years, while increases of traffic in that interval would be quite beyond present means of transport.

The Telephone Service.

The Select Committee on Telephone Charges has continued to take evidence on the telephone service. Col. H. **Laws Webb** severely criticised the service, and stated that, whereas the increased rates proposed by the American telephone companies to meet the increased cost of labour and material since the war ranged from 25 to 30 per cent., the increases proposed by the Post Office range from 60 to over 200 per cent. Comparing the estimated costs of the Post Office in 1920 and the actual costs of the National Telephone Company in 1911 (the last year of its life), he said the working expenses of the company were £2,100,000 for 560,000 stations, and, in round figures, 800,000,000 calls. That worked out at £3 18s. per station, or at 5s. per 100 calls, all costs included. On the basis of the estimated costs in the Departmental Committee report, the costs of the Post Office system in 1920-21 would be £10,460,000, or £11 13s. per station and 26s. per 100 calls. American experience in the telephone business indicated that the most efficient service and the widest development of the telephone system were obtained by a system of rates which charged the business user in proportion to his use of the plant and service, and encouraged the residential user and the country town inhabitant by a tariff which made the service attractive to people of moderate means. A similar system would popularise the telephone service in Great Britain. He proposed an alternative tariff to that of the Post Office. In country towns and villages where the ultimate development was not likely to exceed 500 telephones, there should be flat rates of £8 a year for business telephones and £6 10s. for residences, and in towns up to 2,000 telephones there should be flat rates of £9 a year for business and £7 10s. for residence telephones. In towns of 20,000 to 100,000 population he suggested a measured rate for both business and residence telephones ranging from £8 for 600 messages to £23 10s. for 4,700 messages, with additional messages up to 6,000 at 5s. per hundred. For private branch exchanges the minimum rate for two lines, two extensions, and 3,000 messages should be £27 a year. In cities exceeding 100,000 population the corresponding rates should be £9 to £25 10s., and £29 10s. for the private branch exchange. In London the measured rate should range from £10 for 800 messages to £26 10s. for 4,000 messages. The minimum rate for two lines, two extensions, and 3,000 messages on the private branch exchange should be £33 a year. The tariff proposed for trunk calls of three minutes duration ranged from 6d. up to 25 miles to 9s. 6d. for 500 miles. He believed his proposals would bring in the £4,000,000 a year which the Post Office required.

Mr. **Alex. Conan**, representing the Dublin Mercantile Association and the Dublin Chamber of Commerce, said he approved generally of the message rate and of most of the changes proposed, subject to certain conditions. The increased charges were apparently inevitable, but were largely attributable to the excessive cost of administration. There were extravagance and incompetence in Government administration, and there was no incentive to keep down expenses. Government employees took things very easily. Gangs of fellows were to be seen smoking their pipes and doing very little. He thought that the result proved that there was Government extravagance and he suggested that extravagance was entailed by the method of working adopted.

Mr. F. **Chiesman** said that the committee of the Drapers Chamber of Trade were unanimous in the view that there should be an installation charge for all new users of the telephone. After that there should be an annual charge for maintenance to all users, this charge giving no claim on any calls whatever; but the message rate should be substituted, so that no one would have a preferential rate. They should abolish the old flat-rate system.

Institution of Electrical Engineers—Increase of Subscription.

In our last issue we briefly announced that a Special General Meeting of the Institution of Electrical Engineers was to be held to discuss the question of increasing the subscription. It is now stated that the meeting will take place at the Institution of Civil Engineers on Thursday, December 2nd, at 6 p.m., when the following resolution will be considered :

(*a*) That the following be substituted for Article 27 of the Articles of Association of the Institution :—

> 27. Persons who have not compounded shall from the 1st January, 1921, pay the following annual subscriptions :—

	In the United Kingdom. £ s. d.	Abroad. £ s. d.
Members	5 5 0	4 5 0
Associate Members	3 15 0	3 5 0
Associates	4 5 0	3 15 0
Graduates	2 10 0	2 10 0
Students, until the end of the calendar year in which the age of 21 is attained	1 1 0	1 1 0
Students, after the calendar year in which the age of 21 is attained	1 11 6	1 11 6

(*b*) That the fourth paragraph of Article 33 beginning with the words "Members who . . ." and ending with the word "guineas" be amended by the substitution of the word "four" for the words "two and a half"

If this resolution is passed a confirming meeting will be held at the same time and place on Friday, December 17th.

The notice of the meeting is accompanied by the following letter from the President :—

Dear Sir : In sending you the formal notice of a Special General Meeting of the Institution to be held on Thursday, 2nd December, 1920, for the purpose, if thought fit, of amending the Articles of Association to enable the subscriptions of members to be increased, the Council desire to bring before you the following considerations :—

In the Council's Report for the year 1919-20 and the hon. treasurer's statement at the last annual general meeting, mention was made that by reason of the general rise in prices the revenue of the Institution would in all probability fall short of the actual requirements in the early future, notwithstanding the exercise of the strictest economy. The scale of subscriptions for the various classes of membership has remained unaltered since 1912. In purchasing value the income then realised was worth at least twice the same amount to-day.

The Council have given anxious consideration to the question of the maintenance of the financial equilibrium of the Institution with the smallest possible increase of subscription, and the revised scale now proposed owing to the larger membership resulting from the greater activities of the Institution shows increases bearing only a small proportion to the increased costs already referred to. The increase in subscription has been delayed as long as possible, but the Council are of opinion that the time has now arrived when the change should be made, and recommend that this be done at the commencement of the next financial year, viz., January 1st, 1921.

The Institution of Electrical Engineers is exceptionally active by reason of the fact that its responsibilities and opportunities have been so much enlarged during the past few years, and the Council feel that membership of the Institution may now, more than ever, be claimed as a valued privilege and that the Institution is at the present time in a more favourable position to advance the interests of electrical science and industry than ever has been the case previously.

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I am, dear Sir,
Yours faithfully,
November 4, 1920. Llewelyn B. Atkinson,
President.

Legal Intelligence.

The Ashton Tramways Arbitration.

Last week Mr. Justice Rowlatt heard a special case arising out of the arbitration relating to the purchase by the Ashton-under-Lyne & Hyde Corporations and Andershaw and Denton Urban Councils of the tramway undertaking of the Oldham, Ashton & Hyde Electric Tramway, Ltd.

Mr. Knox, K.C., for the municipal authorities, said the points raised were what items, in calculating the cost of the tramway, were subject to depreciation. The arbitrator found in regard to certain items that no depreciation ought to be made in calculating the purchase price. The Corporations contended that these items should be reduced by allowances for depreciation. The arbitrator had found that on the engineering item allowance should be made for depreciation. In regard to other items—for preliminary expenses, cost of raising capital, interest on capital during construction, and cost of temporarily removing part of the tramway owing to alterations to Guide Bridge—the arbitrator made no allowance for depreciation. The arbitrator had awarded £142,174 as the value of the tramway undertaking on May 1, 1918.

Mr. Clode, K.C., for the tramway company, argued that the question of whether or not depreciation should be taken into account in respect of the items challenged was a question of fact entirely at the discretion of the arbitrator, and the Court ought not to interfere with his findings.

Mr. Justice Rowlatt, in giving judgment, said the proper method of arriving at the purchase price of the tramway was to take the cost of the undertaking as a profitable concern, subject to depreciation. The arbitrator was justified in making allowance for preliminary expenses. Cost of raising capital was an item which could not be allowed, but interest on capital during construction was part of the cost of the tramway, and the arbitrator had rightly made allowance for that item. He could not see that the expense of altering Guide Bridge was part of the expense of constructing the tramway; therefore, the arbitrator was not right in making allowance for that item. His lordship supported the arbitrator's view that the round figure he took for preliminary expenses was a non-depreciable article and nothing should be deducted for depreciation. Interest on capital was depreciable with the capital on which it was interest, part of which was depreciable and part non-depreciable. The award must, therefore, go back to the arbitrator for analysis and adjustment of that item.

Middlesbrough, &c., Tramways Arbitration.

Mr. Justice Rowlatt had before him, last week, a special case stated on an arbitration between the Imperial Tramways Company and the Corporations of Middlesbrough, Thornaby and Stockton-on-Tees, relating to the purchase by the three boroughs of the tramways undertaking in their area. As the corporations had decided not to contest the award of the arbitrator as to the amount payable for the acquisition of the tramways, his lordship made an order confirming the award and costs were awarded to the Company.

Commercial Topics.

London Electricity Supply Loans.

During the year 1919-20 the London County Council sanctioned the raising of loans amounting to £478,959 by the metropolitan borough councils for electricity supply extensions, compared with £279,059 in 1918-19, and £221,582 in 1917-18. Up to date the County Council has sanctioned 580 loans, representing a capital of £7,563,695, for electricity supply in London. These figures only relate to municipal electric supply undertakings, but if we include the companies with their total capital expenditure of about £15,000,000 we can see what a large sum has been invested in the supply branch of the electrical industry in the county of London.

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German Engineering Combinations.

The movement for the amalgamation of German engineering, metal and chemical firms continues, and should be closely watched by British manufacturers. One of the latest and most important schemes of fusion of interests is that arranged between the Rhine-Elbe Union, Herr Stinnes's recent big metal combine (which employs 100,000 men) and the Siemens-Schuckert Elektricitäts Werke, one of the big electrical manufacturing firms. The aim is to secure to the Siemens Company a plentiful supply of raw and half-finished iron and steel. Four other large companies, which produce finished metal goods, are also about to be incorporated in the Stinnes concern. It is stated that the A.E.G., the Allgemeine Bergwerk Gesellschaft and other smaller companies are interested in the new combination.

A similar process is reported to be going on in all branches of important German industries. The Aniline Group held a meeting recently to discuss the association of interests in dyestuffs firms. This had already been agreed for a period terminating in 1955, and it is proposed to prolong the term to 1999. The firms also went into a scheme for community of interests in the nitrogen trade, the proposal including the formation of a company with 500 million marks capital to take over and run the nitrogen factory of the Badische Aniline und Soda Fabrik in Oppau and Merseburg. Another recent amalgamation in engineering is that of Strauss & Company, which has joined up with the Sugg foundry at Munich. Fusions are also reported in the chemical trade, in mining and oil companies. The effect of these amalgamations will probably be felt in the struggle for foreign markets. Since the removal of the war restrictions on the formation of new companies on Oct. 15, there has been considerable activity in company promoting, but the main interest in the present movement centres around the merging of the big manufacturing companies.

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Heating and Cooking Apparatus in Czecho-Slovakia.

An interesting report has been received by the British Electrical and Allied Manufacturers' Association, from a special correspondent in Prague, dealing with the recent Exhibition of electrical apparatus and quoting detailed prices for a large number of accessories. We make some extracts from this report as the information may prove useful to our readers. When the report was prepared the Czecho-Slovakian krone was worth approximately nine-tenths of a penny.

The Electricial apparatus section was well represented, voltmeters, ammeters, small dynamos, switchboards, electric heating appliances, flat-irons and electric cookers, being exhibited by several firms, though there was nothing original. Flat-irons and cooking apparatus of every description were displayed, and lively competition resulted in prices being cut very fine. The quotations from the bulk of the exhibitors may be summarised as follows. For flat-irons the weight is given in kilogrammes, the consumption in watts, and the export price in kronen) :—

2·0 and 2·5 kg., 350 watts, 94 and 100 kronen ; 2·7 and 3·0 kg., 380 and 400 watts, 112, 128 and 118 kronen ; 3·5 to 3·7 kg., 400 watts, 129 to 154 kronen ; 4·5 kg., 450 watts, 140 kronen ; 6·0 kg., 550 watts, 178 kronen ; and 7·0 kg., 660 watts, 192 kronen.

All irons were nickel plated, and one exhibitor guaranteed that the material from which his irons were made could be subjected to a temperature of 1,100 deg.C. without deterioration. One of the electric irons exhibited weighed 3 kg. and only consumed 110 watts with a 220-volt current. It is stated that this was tested personally with an ammeter. Small nickel-plated electric flat-irons, weighing 1½ kg., with a watt consumption of 250, for use when travelling, were quoted at 63 to 99 kronen.

The enamelled electric saucepans varied in capacity from 1 litre to 7 litres, in watt consumption from 450 to 1,500, and the export price from 84 to 296 kronen. The nickelled electric saucepans were of 1 and 1½ litres capacity, the consumption being 350 to 700 watts, and the prices 73 to 92 kronen. Electric ovens for drawing-rooms were shown, the weight varying from 11 to 15 kg., the consumption 2,000 to 4,000 watts, and the price from 400 to 500 kronen. Flexible electric bed-warmers (flannel covered) of 450 × 300 mm. size were 190 kronen, and foot-warmers, weighing 3 kg., 86 kronen. Electric soldering irons were quoted at 135 to 140 kronen each. Pocket electric lamps were exhibited in profusion, and prices ranged from 12 to 30 kronen each, and batteries of 4½ volts from 3·20 kronen upwards. Dry cells measuring 85 × 44 mm. were quoted at 8 kronen each, and the larger size of 180 × 100 × 100 at 31 kronen. Electric filament lamps were only seen at one stand, and the prices quoted were : 130 to 135 volts, 14 kronen ; 136 to 175 volts, 15 kronen ; and 166 to 188 volts, 18 kronen. The prices were all factory quotations, and early deliveries could be guaranteed.

Electricity Supply.

Cheriton Urban Council decided to substitute electricity for gas in 27 public lamps.

Watford Urban Council have received sanction to a loan of £18,420 for mains, services, transformers, &c.

Chester City Council have granted the electrical engineer (Mr. S. E. Britten) an additional war bonus of £150 a year, bringing his salary up to £900.

Sanction has been received by Turton Council for the borrowing of £17,000, repayable within 25 years, for extensions of the electric supply undertaking.

Mr. S. Edgar Fedden, of Sheffield, has been appointed to arbitrate in the dispute between Bingley Urban Council and Keighley Corporation as to the supply of electricity in bulk to Bingley.

Barnstaple Corporation has been authorised to install two 500 kw. direct-current generators, two boilers and other plant. The Corporation has also been authorised to purchase a 500 kw. secondhand set.

The Bispham electricity works have been closed down and the consumers have been transferred to the Blackpool system. Extensions of the Blackpool mains are being carried out.

Mitcham Urban Council asked the Ministry of Health for permission to install electric lighting in the Western-road houses. The estimated cost, with overhead lines, is £2,637 12s. (or with underground mains £880 extra), and for gas £2,052 16s.

Stockton-on-Tees Council has been authorised to borrow £38,647 for extensions of the electricity works. The Corporation asked for £54,750 and the Electricity Commissioners intimated that they will be prepared to consider further requirements when the actual expenditure has been ascertained.

After a long discussion Torquay Corporation decided on Tuesday to sanction the erection of a large electric generating station at Newton Abbot at an estimated cost of £250,000 to £300,000. The new station will be able to supply Torquay, Newton Abbot, Paignton, Teignmouth and other smaller towns in the district.

On the recommendation of the Darlington Electricity Committee the engineer and manager (Mr. J. R. P. Lunn) will get a bonus of 5 per cent. on any reduction in working costs effected below those which obtain in other municipal supply undertakings. The charge for electricity has been raised from 4d. to 4½d. per unit.

Councillor H. K. Beale has been re-elected to the Birmingham City Council without opposition, and he will continue as chairman of the Electric Supply Committee. In a statement issued by the Committee, electricity consumers are asked to exercise the utmost economy in the use of electric current, especially between 3.30 p.m. and 5.30 p.m., during the whole of the winter.

The East Ham Electricity Supply accounts for the year ended March 31 show revenue £51,834 (compared with £34,407 in previous year), and costs £43,194 (£31,679). Interest, sinking fund and repayment of principal required £10,980 (£10,476), and the net result was a deficit of £2,340 (£7,748). Units generated were 5,122,910 (4,244,260), and sold 5,122,910 (4,244,260).

For the year ended July 31 the revenue of the Aberdeen Electricity Department for the year ended July 31 was £150,909 (compared with £109,219 in 1919) ; ordinary expenditure was £97,153 (£65,305) and casual expenditure £2,309 (£887). Interest required £16,670 (£14,128), and sinking fund £22,386 (£21,025), leaving £12,469 (£7,872), which has been placed to reserve. Units generated were 23,174,220 (19,815,610) and sold 18,800,949 (16,368,054).

Carlisle electricity department's accounts for the year ended March 31 show receipts £48,980 (compared with £39,378 in previous year), working costs £33,252 (£27,211) and gross profit £15,728 (£12,167). Interest and income tax required £5,760 (£5,011), and repayment of loans £7,667 (£6,233), leaving net profit £2,301 (£923). Units generated were 7,853,962 (7,261,483) and sold 6,216,678 (5,560,321). Maximum load was 3,343 kw. (2,604 kw.), and load factor 21·2 (24·4) per cent. Works costs were 0·837d. (0·67d.) per unit sold, and total costs 1·338d. (1·23d.) exclusive, and 1·801d. (1·66d.) inclusive, of capital charges.

The accounts of the Oldham electricity undertaking for the year ended March 25 show revenue £119,124 (against £88,405 in previous year), working and general expenses £69,976 (£56,408), and gross profit £49,148 (£32,497). Sinking fund required £10,644 (£12,021), interest £12,267 (£11,902) and expenditure on meters £895 (£248) and extraordinary expenditure (writing off old engines, income tax under schedule D, &c.) £14,568, and the net profit was £10,774 (£8,326). Total revenue costs were 1·066d. (0·916d.) per unit sold. Maximum load was 9,292 (6,630) kw., and load factor 20·45 (25·44) per cent. Units generated were 21,011,346 (18,550,564) and sold 16,693,515 (14,777,817).

The Portrush Urban Council has been authorised by the Electricity Commissioners to proceed with its electric supply scheme and to let contracts. In regard to the inquiry for terms for supplying electrical energy to the Giant's Causeway and Portrush Tramway Company the electrical engineer (Mr. Pleasance) is to ascertain the company's probable requirements. In the meantime it is reported that the company's interim occupation of Walkmills will be continued for another six months on the existing terms, and it is expected that before the 31st May next the company will either have settled a lease of Walkmills or made arrangements with the Council for the supply of power.

Ald. W. T. Dagnall, chairman of the Electricity Committee, and Mr. S. L. Pearce, chief engineer of the Manchester Corporation electricity department, arrived home on Friday after a trip to the United States, where they have been studying the American methods of electrical generation and transmission. Anxiety concerning the coal strike caused part of the original programme to be abandoned. In an interview, Mr. Pearce stated that, "so far as generation is concerned, apart from the fact that America is operating on a much larger scale than ever, and utilising much larger plant, there is not a very great difference in the practice of the two countries. If you compare the modern plants to be ound in America with the modern plants, either operating in this country of being planned, we are in no way behind. When the present financial strain is eased, America will be on the eve of tremendous electrical development." Mr. Pearce comments on the fact that in some cases gas and electricity undertakings in America are owned and controlled by the same company. This does not lessen competition between the two utilities, but has a tendency for the gas concerns to apply their output in the direction of cookers, heating, &c., and to leave the electricity concerns to cater for lighting and industrial power.

Electric Traction.

Glasgow Corporation Electricity Committee has decided, as a result of inquiries, to purchase a passenger electric vehicle for the Electricity Department.

A sub-committee of the Leeds Tramways Committee has approved a proposal of the manager (Mr. J. B. Hamilton) to construct a tramway to Middleton. The line will be of standard gauge, and will be for the conveyance of material and workmen to the new housing site.

Stretford Urban Council has applied for sanction to borrow £17,000 for the construction and equipment of a tramway in Upper Chorlton-road, £43,500 for a line along Seymour-grove, and £3,500 for one along Talbot-road and Seymour-grove.

The Newport (Mon.) Tramways Committee recommend the Corporation not to accede to the request of the traffic employees for an advance in wages of 12s. per week. The concession of the new demand would cost £8,000 a year, and even on the present conditions it will be recommended to raise the tram fares to a minimum of 2d.

The Advisory Committee resumed on Tuesday the inquiry into the application by the L.C.C. for power to increase Tramway Fares. For the Council it was stated that they were not seeking for a further increase of the fares in force, but for authority to continue these fares after the period of six months covered by the Interim order had expired. There was bound to be a serious deficit on the current year's working, even if the increased fares asked for were continued. While the revenue for 1920 was likely to be double that of 1914 the expenditure would be practically three times as great. Mr. A. L. C. Fell, general manager of the tramways said it was only in the fares below threepence that they proposed to go beyond their statutory powers. Many threepenny passengers still got statutory distances. A million more fourpenny return tickets were issued to workers than before.

The provincial tramway undertakings are gradually restoring their normal services. At Manchester, Salford and other northern industrial centres the full complement of tramcars is already being run, and in the remaining areas the normal standard will be reached this week. In the Potteries a dispute has arisen out of the restricted service given during the coal strike. When the agreement guaranteeing a 48-hours week or equivalent pay was suspended on Saturday the Stoke-on-Trent branch of the United Vehicle Workers' Association demanded its re-instatement. The Potteries Electric Traction Company stated that if they complied they must suspend some of the men more recently engaged until traffic again became normal. The union refused to agree to this, and, without consulting the workers' association, called a strike for Tuesday.

Bradford Corporation has had railless trolley cars in operation for the past eight or nine years, and an innovation in the shape of a covered railless vehicle is about to be introduced. The provision of the enclosed top deck is made practicable by a 7-ft. wheel base. The sides of the vehicle taper towards the roof, and it has accommodation for 51 passengers, including 26 on the upper deck. The old railless cars only carry 29 and the tramcars about 60 passengers. The new car, which was designed and made at the Corporation works at Thornbury, made a successful trial trip on the 3rd inst. from Bolton, via Killinghall-road, Sticker-lane, and Manchester-road to Town Hall Square. The wheels are rubber-tyred, and the vehicle has well-sprung seats, fixed char-a-banc fashion. An adjustment was necessary at Bankfoot, to which point the car had run with the usual two trolleys. The negative trolley was disconnected and fastened down. Contact with the permanent way was effected by fixing an iron shoe to the front of the car. This shoe fits the curved part of the rail of the permanent way, and is connected by a short rod to the steering axle of the car. It is thought the working expenses of the new car may be slightly more than those of the ordinary tramcar, against which fact must be placed the enormous saving in the cost of laying a permanent track. That saving amounts to something like £50,000 per mile. Allowing for an ample increase of working expenses compared with the present railless system, the new vehicle would be considerably more economical. There is reason to suppose that the railless car of the comparatively big type may prove the city road vehicle of the future, particularly in towns where the steep gradients are not met with.

Imperial and Foreign Notes.

Forbes (N.S.W.) Council are applying for permission to borrow £20,000 for establishing electricity works.

Manly (N.S.W.) Council, which has decided to acquire the local electric supply company's undertaking, proposes to take a bulk supply from Sydney Corporation.

Sydney (N.S.W.) Electric Lighting Committee is having a report prepared by Prof. Cotton on the possibility of using the water-power of the Colo River for generating electrical energy and thus avoid purchasing a coal-mine.

Good progress has been made by the Hydro-Electric Power Commission of Ontario with the construction of the Queenstown-Chippawa Power Canal. In the "Canadian Engineer" of September 16 it is stated that nearly seven million cubic yards of the excavation work (nearly half of the total) has been completed; the forebay is ready to be lined and new construction equipment has been purchased. It is proposed to erect four 55,000 h.p. generating units at first, but ultimately the station will have nine units and a capacity of 495,000 h.p.

It is estimated that the output of electric lamps manufactured in Japan during the current year will be 14 millions, and the sale of Japanese lamps is said to be increasing in India, China, and the East generally.

The workers at the Berlin municipal electricity works are on strike for increased wages. The award of the arbitration court was rejected and the men claim 14,000 marks (nominally £700) a year for unskilled and 18,000 marks (£900) for the skilled workers. The tramway workers have also gone on strike in support of the electricity employes.

It is proposed to erect a powerful radio-telegraph station in Flanders, which will be in permanent communication throughout the 24 hours with American stations. A 12-hour service will also be maintained with the Argentine Republic and an eight-hour service with the Congo.

The Swedish Board of Trade and Agriculture has prepared a scheme for the supply of electricity to the Island of Oland. The assistance of the Government is sought, but if the Governmentis not willing to bear the expense, it is proposed that a grant of 200,000 kronor be sanctioned to cover the cost of a sea cable, and a State loan of 1,000,000 kronor for transforming plant, distributor cables, &c.

In consequence of the high price of coal and cost of transport the Dome Mining Corporation has decided to engage a hydraulic engineer to prepare a scheme for the utilisation of water power, which is available near the Company's properties in Spain. The engineer will estimate the cost of a complete installation. The erection of two dredges and a power station will cost about £120,000, exclusive of import duties, water race and pipe line.

H.M. Minister in Guatemala states in a recent letter to the Department of Overseas Trade that his general impression is that conditions in Guatemala are about to be very favourable for British trade, provided that British merchants and manufacturers are alive to their opportunities. The new Government are reported to be strong, energetic and businesslike. There is a great demand for English machinery and plant, especially that suitable for coffee estates, and for the cabinet-making and metallurgical industries. There is also a demand for all kinds of tools. The Minister states that if firms will supply him with catalogues he will see that they reach the right quarters. Catalogues should be sent to: Sr. Ministro de S.M. Britanica, Ciudad de Guatemala, Republica de Guatemala.

The French Government has made an arrangement with the Cie. Generale de Telegraphie sans Fil, which will enable the company to establish wireless telegraph services for commercial traffic between France and all other countries of the world. The State will receive a share in the net profits after the shareholders have received a fair interest upon the capital. The company has commenced the construction of two large radio-telegraphic stations in the neighbourhood of Paris. One of these will be allocated to trans-oceanic communications and the other to communication with European countries. Pending the completion of these stations the service will be temporarily effected by means of the stations at Lyons and Bordeaux, with the assistance of the French Administratior of Posts and Telegraph. When the company's stations commence operation the Government stations at Lyons and Bordeaux will cease to deal with commercial service. Marconi's Wireless Telegraph Company is interested in the Cie. Generale de Telegraphie sans Fil.

In a recent report by Mr. H. O. Chalkley, Commercial Secretary to H.M. Legation at Buenos Ayres, it is stated that the project for utilising the Iguazu Waterfalls for the generation of electric power has been revived on the initiative of the Argentine Minister of Foreign Affairs. In July, 1919, the Government authorised the Director-General of Navigation and Ports to carry out a survey of the river Iguazu and a sum of 10,000 pesos was granted to defray the cost. The Brazilian Government has also been asked to co-operate in carrying out the surveys in the zone under its jurisdiction. The Minister of Public Works will prepare a scheme for the utilisation and transport of the power to Buenos Ayres and other large centres. The falls are situated on the border line between Argentina and Brazil, some 800 miles from Buenos Ayres. They have 275 cascades, one of which has a sheer drop of 213 ft. The opinion of United States engineers is that the scheme is technically feasible. The financial and engineering factors involved in its realisation, however, are so formidable that there is no early prospect of the project being undertaken.

Institution Notes.

The Council of the British Association has appointed Dr. E. H. Griffith, F.R.S., general treasurer, in succession to the late Prof. John Perry.

The Wireless Sectional Meeting of the Institution of Electrical Engineers announced for Nov. 17th has been postponed to Nov. 24th, at the Institution of Civil Engineers, at 6 p.m.

The Annual festival of the Electrical Trades' Benevolent Institution will be held on Wednesday, December 15, at the Connaught Rooms under the presidency of Mr. E. Manville, M.P.

We are informed by the Council of the Institution of Electrical Engineers that they will take possession of their own premises on Victoria Embankment early in the New Year, as the premises will be vacated by the Government in December.

The I.E.E. Benevolent Fund has benefited by a donation, through Capt. S. T. Pemberton, of £30. 0s. 9d., being the balance of the Corps Funds of the late Warwickshire Royal Engineer (V.) Corps Signal Company.

The inaugural address of the 167th Session of the Royal Society of Arts will be delivered on Wednesday, the 17th inst., at 8 p.m. by Mr. A. A. Campbell Swinton, Chairman of the Council of the Society. His subject will be "Wireless Telegraphy and Telephony."

Scientific Paper No. 390 of the Bureau of Standards contains a study of the causes of the "Two Common Failures of the Clark Standard Cell." The causes and effects of the cracking of Clark cells at the amalgam terminal and the formation of gas in the amalgam limb are discussed, as are also the methods employed in an attempt to eliminate these defects. It is shown that the cracking of the cell can best be prevented by the very simple expedient of using a cell blank in which platinum wire previously subjected to the action of zinc amalgam is employed as the negative terminal, also that the effects of gas formation can be minimised through the employment of the smallest excess crystals required to insure saturation at the highest temperature at which the cell is to be used.

The Institute of Physics has also been registered, and the word "Limited" is omitted from the title by licence of the Board of Trade. The objects are to elevate the profession of the physicist, and to advance and diffuse a knowledge of pure and applied physics. The management is vested in a board of four persons, to be appointed by the Faraday and Optical Societies, and seven by the Physical Society. Other societies who may enter into participation during the existence of the first board shall each have the right to nominate an additional member. The first members are Sir Richard T. Glazebrook, K.C.B., F.R.S., Prof. C. H. Lees, F.R.S., Sir R. A. Hadfield, Bt., F.R.S., C. C. Paterson, C.E.E., J. E. Barnard, R. S. Whipple, Major E. O. Henries, R.E., W. R. Cooper, E. N. Rayner, Major C. E. S. Phillips, O.B.E., Prof. W. H. Eccles, Comm. T. Y. Bakér, Prof. A. W. Porter, F.R.S., T. Smith, H. S. Allen, R. S. Clay, Prof. F. J. Cheshire and R. Knox.

The following is a list of those recommended by the President and Council of the Royal Society for election to the Council on Nov. 30: President: Prof. C. S. Sherrington, M.A., M.D., Sc.D.; treasurer: Sir David Prain, C.M.G., C.I.E., M.A., LL.D.; secretaries: Mr. W. B. Hardy, M.A., and Mr. J. H. Jeans, M.A.; foreign secretary: Sir Arthur Schuster, Ph.D., Sc.D.

Other members of Council: Mr. J. Barcroft, Sir William Bragg, Dr. A. W. Crossley, Prof. J. B. Farmer, Sir W. Fletcher, Prof. A. Fowler, Dr. A. C. Haddon, Sir Robert Hadfield, Bart., Sir Thomas Heath, Prof. J. Graham Kerr, Prof. Horace Lamb, Sir W. Leishman, Dr. S. H. C. Martin Prof. J. W. Nicholson, Mr. R. D. Oldham and Prof. W. P. Wynne.

The British Electrical and Allied Industries Research Association was registered on Sept. 27, and the word "Limited" is omitted from the title by licence of the Board of Trade. It is limited by guarantee and it has an initial membership of 300, with power to increase. The objects are to promote research and other scientific work in connection with the electrical and allied trades or industries, to found scholarships, to publish books and periodicals, &c. Membership consists of (*a*) ordinary members, who shall be members of the British Electrical and Allied Manufacturers' Association, or other association of manufacturers in the electrical and allied industries, carrying on business in the production of electrical machinery, plant, &c.; (*b*) trade members who shall be British subjects carrying on business in the production of electrical machinery, apparatus or materials which are accessory to the electrical and allied manufacturing industries, and corporations carrying on similar business; (*c*) associate members who must be British subjects, and shall be individuals representative of capital, management, science or skilled labour, or connected with limited companies, or other corporations or associations ineligible for, or not desiring admission as ordinary or trade members, and who are (in the opinion of the Council) likely to assist in the electrical and allied industries by the furtherance of the objects of the association; and (*d*) honorary members, who shall be British subjects, whether entitled to become members under the above provisions or not, nominated for membership by the Council for special services or causes and elected at a general meeting. The management is vested in a Council, the first members of which are C. H. Wordingham, C.B.E., Ll. B. Atkinson, Dr. C. C. Garrard, J. S. Highfield, C. C. Paterson, O.B.E., R. T. Smith, C. P. Sparks, D. N. Dunlop, A. R. Everest, A. P. M. Fleming, C.B.E., E. S. New, W. O. Smith, E. B. Vignoles, and A. D. Williamson.

The registered office of the Association is 19, Tothill-street, Westminster, London, S.W. 1.

Miscellaneous.

The National Trades & Industrial Exhibition will be held at Bingley Hall, Birmingham, from March 21 to May 21, 1921. Communications should be addressed to 27, Paradise-street, Birmingham.

We regret an unfortunate mistake in the advertisement of Spencer Bonecourt, Ltd., which appeared in our issue of the 5th inst. The size of the boiler is stated to be 4 in. by 15 in. This, of course, should be 4 ft. by 15 ft.

We regret that in our Editorial Notes last week Sir John Harmood Banner, Bart., was stated to be a director of the Partington Iron and Steel Company, Ltd. Sir John informs us that he retired from the Board on the acquisition of the Company by Messrs. Armstrong, Whitworth & Co., at the beginning of the present year.

As a sequel to the fatal accident at Baton Colliery, Shotts, in March last, Edward Sommerville, the manager, John Elder, the electrician, and John Murray, colliery oversman, were fined last week for a breach of the Electricity in Mines Regulations. Sheriff Shennan fined the manager and electrician £3 each and the oversman £2.

We regret that in the article on "Notes on Rolling Mill Drives," by Mr. L. Rothera, which appeared in our special Iron and Steel Issue last week, Fig. 2 was wrongly described as being a view of a 32-in. 3-high plate mill. This should have been 36 in. and we are also asked to state that the mill is of the Davy type and was built by Messrs. Davy Brothers, of Sheffield.

We are glad to hear that "Winter's Pie" will be published on the 15th inst., and, judging by the list of eminent authors and artists who have contributed to its pages, it will receive the usual welcome. The forthcoming issue will contain several features—the illustrations throughout will be in colours; there will be thirty-two pages of pictures with four variations of colour. "Winter's Pie" is published at 6, Great New-street, London, E.C.4, and is obtainable at all booksellers and bookstalls, price 2s. net.

Mr. Punch is nothing if not up to date. We therefore turn each year to his Almanack, not only to be entertained with scintillations of wit and humour, but to find out what is really going on in the great world. Punch's Almanack for 1921 is just out and proves no disappointment. The thought for the New Year is, we are delighted to find, domestic electricity. Who can doubt it? Listen! "The Bitter Cry of the Modish Flapper: 'I'm afraid I must ask for an additional electric stove in my room, sir. The cold there is intense.'" The oracle has spoken. We are content.

The County of London Royal Engineer Volunteers, London Army Troops Company, commanded by Lt.-Col. C. B. Clay, V.D., has now been disbanded, and the distribution of the funds is complete. In January last £94 8s. 5d. was paid through Sir John Snell to the Benevolent Funds of the Institutions of Civil, Mechanical and Electrical Engineers, and the final balance of £64 has now been handed to Earl Haig's fund. It is with considerable regret that we chronicle the inevitable disappearance of a body of men whose work, though not extensively advertised, was of great use during the continuance of hostilities.

We are pleased to observe from E.D.A. advertising that a serious attempt is being made to cultivate the great trade possibilities offered by the season of "Present-giving" in connection with electrical appliances. If supply engineers and contractors could only make a united effort to push the Electrical Xmas Box idea we feel sure they would not be disappointed in the immediate results, or in the new connections and goodwill they would establish by helping people to keep up a social custom which, delightful as it may be, is often a cause of anxious thought and frequently results in money being spent on articles of but transient attraction and little real value. It is a hopeful sign of progress and improved organisation that a real effort is being made by the various branches of the industry to push the Christmas trade in electrical upplies and domestic appliances.

Personal and Appointments.

Dewsbury Corporation has appointed Mr. R. W. Grubb engineer of the Municipal Electricity undertaking.

Mr. W. Brace, M.P., has been appointed labour adviser to the Ministry of Mines.

Mr. G. W. Partridge, M.I.E.E., chief engineer and manager of the London Electric Supply Corporation, Ltd., has been appointed managing director of the company.

Mr. E. A. Guthrie has resigned his position with Messrs. Ferguson Pailin, Ltd. to take up a position in the switchgear engineering department of Metropolitan-Vickers Electrical Company, Ltd. of Trafford Park, Manchester.

The Dean of the Faculty of Science of the University of London for the period 1920-22 is Dr. A. N. Whitehead, of the Imperial College of Science and Technology, and Prof. E. G. Coker, of University College, is dean of the Faculty of Engineering.

H.M. the King has given orders for the following appointments to the Most Excellent Order of the British Empire:—

O.B.E.—Wm. Edwin Parker, technical manager, Messrs. Hadfields, Ltd.; Wm. Ronald Young, Controller of Peking Station of Eastern Extension Telegraph Company.

M.B.E.—Wm. Callister Hubble, chief electrician, H.M. Trawler "St. Hubert."

Catalogues, Price Lists, &c.

In a neat folder issued by Pope's Electric Lamp Company, Ltd., particulars and prices are given of Vacuum and gas-filled types of Elasta drawn wire electric lamps.

The British Insulated & Helsby Cables, Ltd., Prescot, Lancs., have recently issued their revised catalogue of Telegraph and Telephone Line Construction Material. The firm supply all types of insulators, poles, tools, &c., for telegraph and telephone work, and the catalogue contains particulars and prices of a great variety of Helsby insulators bolts, poles, fittings, Leclanché batteries, &c.

In the general catalogue, just issued by Messrs. H. & G. O. Lewtas, Chester-road, Manchester, illustrated particulars and prices are given of a great variety of modern electric fittings. Among these there are several neat and artistic designs of table standards, brackets, lanterns, pendants, ceiling fittings, electroliers, semi-direct fittings, shades, ornaments, &c. The fittings listed in the catalogue are stocked by the firm, but other designs can be supplied to order.

In the new price list issued by the Arora Company, Loughborough, which gives particulars and prices of their electric heating and cooking apparatus, there are some new designs of Arora Electric fires, and also a new electric oven. The company have recently erected a new factory to meet the increasing demand in the home market and from overseas, and they are now in a position to supply a wide range of Arora fires from stock in all voltages and finishes. There is also a department for the supply of special apparatus to customers requirements.

We have received from the Cavendish Press, Cheam, Surrey, an example of a slide rule, which has been specially designed for making calculations relating to horse-power, bore, stroke, speed, &c., of internal combustion engines. The rule is very like an ordinary slide rule with one cursor and one slider. There are five scales dealing respectively with horse-power, mean effective pressure, speed, cylinder bore and cylinder stroke. These rules are at present made in two forms, one for large stationary engines, which is in English units and the other for motor-car work, which is in metric units. Similar rules for use in connection with large engines on the metric scale and for motor-car work on the English scale are in course of preparation.

In a leaflet issued by the Engineering & Equipment Company, Ltd., of St. Alban's, an illustrated description is given of their new Pendant Gallery Fitting, incorporating the famous anti-vibrator discs, which prevent the breakage of the most fragile lamps under otherwise impossible conditions. These discs are composed of two concentric rings connected by phosphor bronze gauze cut on the bias, *i.e.*, there is no actual lineal connection between the inner and the outer ring, and when the latter is clamped or fixed rigidly the whole weight of the lamp is carried by the friction of the weft of the gauze. We are informed that the device has met with great appreciation in shipyards and large works, where conditions are very severe and the new gallery will enable the device to be used even for domestic lighting. Alternatives of cord grip suspension or ceiling flange are provided.

Business Items, &c.

The Central Commercial Department of Sir W. G. Armstrong, Whitworth & Company has been removed to 10, Great George-street, Westmisnter, S.W.1.

Wm. Earl Weekes and Chas. Hy. Clarke, trading as W. E. Weekes & Co., electrical and telephone engineers, have dissolved partnership. Debts by Mr. Clarke, by whom the business will be continued.

Messrs. Laurence, Reynolds & Company, 13, Crutched Friars, E.C.3, have secured the sole selling rights for fire bars and mica elements from the Automatic & Electric Furnaces, Ltd.

Hubert Parker Hamson and Spurgeon Archibald Tayler, mechanical and electrical engineers, &c., Hanham-road, Kingswood, Bristol, have dissolved partnership. Debts by Mr. Tayler, who continues the business in his own name.

Joseph Wm. Finney and Harold Wm. Slater, trading as the Engineering Supplies Company, 24, Grey-street, Newcastle-on-Tyne, mechanical and electrical engineers, have dissolved partnership. Debts by Mr. Slater, who continues the business under the old style and at the same address.

Messrs. Jones & Pordes have placed on the market their "Elba" portable bell set for private houses, offices, warehouses, &c. The set consists of a 2½ in. iron cased bell, "Elba" dry cell, 2 in. wood push, 30 ft. twin twisted 22 wire and damp proof dry cell box, and is quite ready for immediate use. Further particulars and prices may be obtained from the firm at 8, Crawford Passage, Farringdon-road, E.C. 1.

Bankruptcies and Liquidations.

Wm. Hy. Stannard Ward, electrical engineer, 56, High-street, Acton, has been adjudicated bankrupt.

A meeting to receive an account of the winding up of British Electrical Accessories, Ltd., (in voluntary liquidation) will be held on Dec. 15 at the office of the liquidator, Mr. Wm. A. Judge, High-street, Skipton.

The Car Lighting Set Company, Ltd., is being wound up voluntarily and Mr. W. Blenkarn, 36, Maiden-lane, London, W.C.2, has been appointed liquidator. A meeting of creditors will take place on Nov. 16 at the Rehearsal Theatre, 21, Maiden lane, W.C.2.

A meeting to receive an account of the winding up of the Lancashire Light Railways Company, Ltd., will be held on Dec. 7 at 68, Dashwood House, London, E.C.

James Cruickshank Thomson, lately electrical engineer and contractor, Station-street, Mansfield, has been adjudicated bankrupt. The first meeting of creditors will take place on Nov. 17 at 4, Castle-place, Nottingham and the public examination on Dec. 2 at the County Court House, St. Peter's Gate, Nottingham.

A first instalment (1s. 8d.) of a composition of 5s. in the £, to be paid to creditors of Wm. T. Smith, electrical and mechanical engineer, Victoria-street, and 60, Hampden-street, Bolton, is payable at the Official Receiver's Office, Byrom-street, Manchester.

The Midland Electric Manufacturing Company, Ltd., makers of M.E.M. ironclad switch and fuse gear, have appointed Mr. T. Birkett, sales and publicity manager. Mr. Birkett was, until recently, publicity manager to Simplex Conduits, Ltd.

A receiving order has beeen made against Geo. Wm. Lester, formerly trading as Lester & Browne, at 44 & 46, Surbiton-road, Kingston, Surrey. The first meeting of creditors will take place on Nov. 15, and the public examination on Jan. 14, both at Bankruptcy-buildings, London, W.C.

Tenders Invited and Accepted.

Halifax Housing Committee invites tenders for wiring 366 houses at Holmfields and Boothtown. Particulars from the Borough Engineer, and tenders to the Town Clerk by Nov. 27.

The Sligo, Leitrim and Northern Counties Railway Company require tenders by Dec. 1 for 12 months' supply of telegraph materials, castings, oils, &c. Forms of tender from the Secretary, Enniskillen.

Manchester Electricity Committee invite tenders by November 22nd for supply and erection of motor-generators, battery boosters, switchgear, &c., at Barton power station. Specifications from Mr. F. E. Hughes, Town Hall, Manchester.

The Great North of Scotland Railway Company require tenders by Dec. 9 for six (or 12) month's supply of stores, including telegraph material, castings, oils, &c. Forms of tender from the Stores Superintendent, 80, Guild-street, Aberdeen.

Bradford Tramways Committee require tenders by Nov. 20 for one year's supply of stores, including lamp fittings, insulating material, controller contacts, rubber, vulcanite fibre, &c. Conditions of tender from the General Manager, Hall Ings, Bradford.

The date for the receipt by the Crown Agents for the Colonies, on behalf of the Government of the Uganda Protectorate for a concession of a portion of the Ripon Falls of the Nile for the generation of electric power has been extended from Dec. 20 to Feb. 19.

The Deputy Postmaster-General, Brisbane, requires tenders by Dec. 15 for the supply of cable (schedule 513) for the Australian Commonwealth Postmaster-General's Dept. Specifications can be seen at the Department of Overseas Trade, Westminster, S.W.1.

Recently the scheme of the Cia Sintra-Atlantico for the construction of an electric railway from Cintra (a Lisbon suburb) to Estoril, Cascaes and the Boca do Inferno received official sanction. Tenders are now being invited for laying down the necessary line and for its working during a term of 75 years.

Leeds City Council invite tenders for the supply and erection of three-phase switchgear for their generating station. Specifications, &c., from the manager of the Electricity Department, Mr. C. Nelson Hefford, Tenders to the Town Clerk, Sir Robert E. Fox, 26, Gt. George-street, Leeds, by December 13.

The Metropolitan Asylums Board require tenders by Nov. 24 for alterations and extensions to the electric lighting and power installations in motor workshops at Mead Ambulance Station, Fulham. Drawings, specifications, &c., can be obtained at the Board's Offices, Embankment, London, E.C.4.

The Victorian Railway Commissioners require tenders by Jan. 19 for the supply and erection or, alternatively, the supply and delivery only of an electric furnace for their Newport workshops (contract 33,419). Specifications may be seen at the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W.

The New South Wales Department of Public Works require tenders by 2 p.m. Dec. 6, for the supply and erection of (1) switchgear and transformers and turbines and generators for the Nymboida hydro-electric development, and (2) switchgear and transformers for the Barren Jack hydro-electric scheme. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the Australian Commonwealth Postmaster-General's Departments: New South Wales: Telegraph and telephone instruments and switchboard parts, schedule 753 (Nov. 25) Queensland: Protectors, schedule 505 (Nov. 30); submarine telegraph cable, schedule 513 (Dec. 15). Western Australia of telegraph and telephone instruments and parts, Schedule 689. (Dec. 8.) Tenders forms from the High Commissioner for Australia, 406, Australia House, Strand, W.C.2.

Mr. Geo. Morrison, of Blackpool, has secured the contract for wiring 160 workmen's houses for the British Alizarine Company.

Messrs. Boving & Company, Ltd., have obtained an order for water turbine plant from the Sociedad Hidroelectrica Iberica, Bilbao. This includes two 20,500 h.p. vertical shaft Pelton wheels, operating under a head of 450 metres, and running at a speed of 500 revs. per min. These will be installed in the Rio Cinca power station for driving alternators.

Patent Record.

SPECIFICATIONS PUBLISHED

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1918 Specifications.

150,752 Marks. (Akt.-Ges. Brown, Boverie et Cie.) Winding with equi-potential connections for drum armatures of electric commutator machines. (9/1/18.)

A winding with equi-potential connections for drum armatures of electrical commutator machines characterised by the feature wherein the under bar of each armature coil is not bent off, but is extended in a straight line as far as the outer end of the equipotential connections, which branch off right and left, whilst the top bar is connected directly at its exit from the armature iron to the equi-potential conductors.

150,756 B.T.-H. Co. (G.E. Co.) Methods of and apparatus for electric welding. (15/10/18.)
150,757 Turner. Construction of magneto-electric machines. (17/6/19.)

1919 Specifications.

128,197 Svenska Ackumulator Aktiebolaget Jungner. Electrodes for electric primary cells and storage batteries, and a process of making such electrodes. (13/6/18.)
128,556 Stephenson. Dynamo-electric machines and means for controlling the operation thereof. (20/6/18.)
136,537 Belli. Methods of starting and braking electric motors. (13/12/18.)
150,765 White. (Becker Bros.) Material for electric brushes. (29/4/19.)
150,766 Ateliers de Construction Oerlikon, Dawson, Fawdry, Luder & Wuthrich Method of indicating, locating and isolating faults in electric transmission or distributing systems. (3/519.)
150,793 Wild & Barfield. Electric furnaces. (4/6/19.)
150,798 B.T.-H. Co. (G.E. Co.) Wireless signalling systems. (5/6/19.)

Relates to a wireless receiving station having a receiving coil with an earth connection to the junction point of the two portions of the coil, the two portions being arranged with mutual inductance between them sufficiently large substantially to eliminate the effects upon the receiving coil of the electrostatic field of a neighbouring transmitting antenna.

150,810 Pouchain. Negative plate for electric batteries and process for making it. (6/6/19.)
150,811 Pouchain. Negative plate for electric accumulators and process for making it. (6/619.)
150,818 Banks. Attachment for electric lamp holders in motor-lamps and the like (7/6/19.)
150,824 Calverley & Highfield. Apparatus for converting alternating electric currents into direct currents and vice versa. (10/6/19.)
150,825 Calverley & Highfield. Apparatus for converting alternating electric currents into direct currents and vice versa. (10/6/19.)
150,845 Barr. Electric water heaters. (20/6/19.)
150,848 Palmer. Electric dry cell batteries. (23/6/19.)
150,853 Boyer. Electric storage-battery separators. (26/6/19.)
150,857 Efandem Co. & Owen. Electric fittings known as double-ended lamp-holders. (30/6/19.)
150,870 Tregoning. Electric display sign. (12/7/19.)
150,876 Palmer. Dry cell batteries. (21/7/19.)
150,878 Mepsted. Hand-operated electric switches. (26/7/19.)
150,907 Douvry. Wireless telephone apparatus. (30/9/19.)
150,908 Anciens Etablissements Barbier, Benard & Turenne, & Granat. Electromechanical variable-speed and reversing mechanisms. (6/10/19.)
150,951 Stephens. Automatic switch for electric heating appliances. (9/3/20.)
150,956 Rees. Electric telephones. (15/4/20.)

1920 Specifications.

150,595 Jackson & Mellersh. (Allen Electrolytic Cell Corporation.) Electrolytic cells. (5/1/20.)
150,597 Cowles & Cowper. Zinc battery elements. (8/1/20.)
150,615 Vidal & Kettlewell. Means for securing the field magnets of dynamo-electric machines. (28/1/20.)
150,622 Dawe. Electrical resistance apparatus. (9/2/20. Addition to 107,822.)
150,627 Kobzy. Electric switches. (23/2/20.)
139,486 Westinghouse Lamp Co. Thermo-electric cells for electrical measuring apparatus. (27/2/19.)
150,643 Myers. Electromedical treatment of the human body. (22/3/20.)
150,646 Smith. Electric switches. (26/3/20.)
150,656 Wilson. Thermo-electric apparatus. (18/2/19. Cognate application, 12,970/20. Divided applications on 144,757 and 18,612/19.)

APPLICATIONS FOR PATENTS.

May 18. 1920.

13,645 Siemens, Collyer & Petithory. Selecting devices for automatic telephone systems.
13,673 Herrmann. Electrical collectors, commutators, &c. (29/10/19, France.)
13,674 Herrmann. Electrical collectors, commutators, &c. (27/2/20, France.)
13,675 B. T.-H. Co. (G. E. Co.) Electric lighting installations.
13,692 Jullin. Voltage regulators.
13,694 Siemens-Schuckertwerke. High-tension electric depositing plants. (31/3/16, Germany.)
13,700 Igranic Electric Co. (Cutler-Hammer Mfg. Co.) Electro-magnetic switches.
13,714 Lanth. Generation of electricity by means of water turbines, &c.
13,721 Clover. Electric faucets.

May 19, 1920.

13,741 Monkhouse. Electrical measuring instruments.
13,766 Lofts. Sound indicator for protecting users of non-luminous electric heating appliances.
13,767 Lofts. Electrically heated articles.
13,753 Bean. Means for applying electricity to the soil for agricultural purposes.
13,775 Langer. Electrolytic separation of metals.
13,780 Campbell. Electrically heated perforator.
13,797 Johnson. Cut-outs for electrically heated appliances.
13,813 Western Electric Co. Telephone exchange system. (22/7/18, U.S.)
13,821 Graham & Rickets. Thermionic apparatus.
13,824 B. T.-H. Co. & Martin. Control of motors.
13,836 Campbell & Gow. Maximum demand controller, &c.
13,839 Sprengstoffwerke, Dr. H. Nahnsen & Co. Applying metal filament to carrier in electric lamps. (11/8/19, Germany.)
13,841 Automatic Telephone Mfg. Co. Trunk circuits for automatic, &c., systems. (18/9/19, U.S.)

May 20, 1920.

13,873 Tucker. Electric contacts.
13,895 Siemens & Christian. Automatic telephone systems.
13,905 & 13,906 Ledwinka. Duplex electric welding machines.
13,912 Ledwinka. Transformers.
13,913 Ledwinka. Electrically welding galvanised metal sheets, &c.
13,928 Fisk. Polarised electric bell, &c.
13,931 B. T.-H. Co. (G. E. Co.) Systems of electric control.
13,934 Hortix. Telegraph and telephone systems.
13,947 Metropolitan-Vickers Electrical Co. & Coates. Switches.
13,955 Greenwood & Batley, Leitner & Wood. Accumulators, &c.
13,968 Radio Communication Co. & Scott-Taggart. Apparatus for detecting or translating electric impulses.
13,969 Siemens & Jantzen. Electric machines.

Companies' Reports, &c.

A dividend of 5 per cent. (1s. per share) has been declared by Siemens Brothers & Company, Ltd., for the half year ended June 30 last.

Messrs. Brunner, Mond & Company, Ltd., have declared an interim dividend at the rate of 10 per cent.

The directors of the Anglo-Portuguese Telephone Company, Ltd., have declared an interim dividend of 3 per cent. (less tax) for the period to Dec. 31.

The report of the United Electric Tramways Company of Caracas, Ltd., for the year ended June 30, 1920, state that, after making due provision for excess and corporation profits taxes, the net revenue is £16,246. With amount brought forward, the disposable balance is £21,467. The directors recommend a dividend for the year of 8 per cent., carrying forward £7,867.

Important changes have recently been made in the capital of the Marconi Wireless Telegraph Company of Canada. In September, 1919, the capital was reduced from $5,000,000 to $2,500,000 by cutting down the value of each share from $5 to $2·50. Thereupon 500,000 new shares were created, 400,000 of which were issued at par in 1919. A large proportion of the present 1,400,000 shares is held by the parent company, Marconi's Wireless Telegraph Company. It is now proposed to increase the capital to $7,500,000, by the creation of 1,500,000 shares of the par value of $2·50.

The gross revenue of the Amazon Telegraph Company, Ltd., for the year ended June 30 was £85,130, and the working expenses were £43,239. After providing £4,163 for income tax, £6,548 for depreciation of investments, £10,981 for debenture interest, and £11,965 for sinking fund, the directors recommend payment of a dividend of 4½ per cent. (less tax on the share capital, leaving £7,131 to be carried forward, subject to Corporation profits tax. Owing to the heavy depreciation in the company's investments (which consist almost entirely of British Government securities) a large portion of the profits is required to write them down to their market value, and the directors are, therefore, unable to increase the general reserve account.

Forty Years Ago.

(The Electrician, November 13, 1880.)

Telephone Extension.—Telephonic communication is successfully carried on between Manchester and Liverpool.

Society of Telegraph Engineers.—The meeting of the 24th inst. will be devoted to the Photophone, the President, Mr. W. H. Preece, taking charge of the subject.

The District Railway.—The electric light is now in use at the Charing Cross station of this line, and arrangements are being made to use it permanently, not only at Charing Cross, but at Victoria and Earl's Court.

The Electric Light.—We understand that the Great Western Railway Company are seriously considering the question of the electric light for Paddington station, and that the Brush system is likely to be employed.

Nickel Plated Locomotives.—The Plating Company, of the Bishopton-lane Works, Stockton-on-Tees, are nickel plating the domes, covers, valve and other bright parts of seven locomotives engines for an English railway. This is something new in this country, but it will probably be in general use, as the finish is not only handsome, but the saving in labour and stores, such as oil and waste, is considerable.

"Horse-Power."—An American has invented a new kind of stable floor which, among other things, will, he thinks, be useful for driving dynamo-electric machines. The floor is an endless band of transverse "slats," and when one end is lowered the horse paces upwards, and keeps the floor rolling. A pulley attached to the roller conveys this one horse-power to anything you please. When a suitable horse has been invented this machine will be perfect

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics."—"Medical Aspects of Flying," "Commercial Airships"; and "The Human Machine in Relation to Flying," by Wing Commander Martin Flack.

"The Cabinet Maker."—"The English Interior Historically Considered"; "Renovation of Upholstery"; and "A Converted Piano."

"The Chemical Age."—"The Future of Finsbury College"; "The New Process for the Cold Vulcanisation of Rubber"; and "The Polymerisation of Fatty Oils."

"Farm and Home."—"Parliament and the Agriculture Bill"; "Another Revolution in Farming" (special); and "Revival of the Sheep Trade."

"The Fruit-Grower."—"Commercial Carnation Growing"; "Wages and Production"; and "Transport of Perishable Produce."

"Gardening Illustrated."—"Failure of the Fruit Crop"; "Pear Winter Nelis (illustrated); and "Evening Primroses."

"Hardware Trade Journal."—"Fitting Keys and Cotters"; "English Silversmiths' Ware"; and "The Leather Trade Reviewed."

"Ways and Means."—"Women in Industry and the Professions," by Mrs. Philip Snowden; "Priestman in a Printing Works," by H. Cooper; and "Welfare Notes," by E. L. Macassey.

"The Gas World."—"The Efficiency of Open Fires" by Margaret Fishenden, D.Sc.; and "Silent Gas Flames," by Hamilton David.

Prices of Metals, Chemicals, &c.

Tuesday, Nov. 9

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£99 0 0	£2 0 0	—
Electro Wirebars...	,,	£102 0 0	£4 0 0	—
H.C. wire basis......	per lb.	1s. 2¾d.	½d.	—
Sheet	,,	1s. 4⅜d.	⅛d.	—
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. 7¾d.	½d.	—
Brass 60/40—				
Rod, basis	,,	0s. 10⅛d.	⅛d.	—
Sheet, basis	,,	1s. 3¾d.	—	—
Wire, basis	,,	1s. 3¼d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£46 0 0	—	—
Lead Pig—				
English	,,	£37 5 0	—	—
Foreign or Colonial	,,	£35 15 0	—	2s. 6d.
Tin—Ingot	,,	252 0 0	—	£15 0 0
Wire, basis	per lb.	0 3 3½	—	2d.

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £17 15s.

,, (Roll Brimstone).—Per ton £17 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £39 10s.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 1s. 1d.

Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 5d.; plantation 1st latex, 1s. 1½d. to 1s. 1d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd.

Notice to Readers Abroad.

The following agents are authorised to receive subscriptions for this Journal from readers desirous of having it delivered to them regularly, and all orders should be accompanied by remittances at the following rates:—

6 Months, 27s. 12 Months, 54s.

Australia.—Gordon & Gotch, Ltd.: Adelaide, Brisbane, Melbourne, Perth, Sydney; G. Jervis Manton, 430, Little Collins-street Melbourne; The Commonwealth Magazine Agency, 317, Collins-street, Melbourne; The Tait Book Company, 90, William-street, Melbourne.

Argentine Republic.—Agence Générale de Librairie, 1571, Calle Rivadavia, Buenos Aires.

Belgium.—Agence Dechenne, 20, rue du Persil, Brussels; British Chamber of Commerce in Belgium (Inc.), 2, rue de la Bourse, Brussels; W. H. Smith & Son, 78/80, rue du Marché-aux-Herbes, Brussels.

Canary Islands.—Pedro Toron Garcia, Buenos Aires, 9, Las Palmas.

Cuba.—Universal Trading Company, Habana.

Cyprus.—George Sons & Company, P.O. Box No. 6, Nicosia.

Denmark.—B. T.'s Boghandel, Raadhuspladsen 55, Copenhagen.

Egypt.—Agence Générale Egyptienne de Librairie, 42, Place de l'Opera, Cairo.

Federated Malay States. L. H. Hoh & Company, Kuala Lumpur, Selangor.

France.—Messageries Hachette, 111, rue Reaumur, Paris; Brentano's, 37, Avenue de l'Opera, Paris; W. H. Smith & Son, 248, rue de Rivoli, Paris.

Germany.—Technische Verlagsanstalt G.M.B.H., Leipzigerstrasse, 101-2, Berlin, W.8.

Holland.—Firma voorheen H. W. Dusault, 25a, Botersloot, Rotterdam; Jacs G. Robbers, Singel 151-153, Amsterdam; Templeton & Company, Ltd., 55, Heerengracht, Amsterdam.

Italy.—Messaggerie Italiane di Giornali, 16, via Milazzo, Bologna.

Japan.—Maruzen Company, Ltd., 11 16, Nohinbashi Tori-Sanchome, Tokyo; T. Minami & Sons, 19, Sakurada-Kubocho, Shiba, Tokyo.

New Zealand.—Richard Hill, Matlock House, Devonport, Auckland; Gordon & Gotch, Ltd., Christchurch, Dunedin, Wellington and Auckland.

Norway.—Narvessens Kioskkompani, Stortingsgaten 2, Christiania.

Paraguay.—Federico G. Plate, 386, Calle Balma, Asuncion.

Spain.—Sociedad General Espanola de Libreria, 21 Calle de Ferraz, Madrid; E. Bendir, Rambla de Estudios, 6 Barcelona; Nuevas Industrias Reunidas Company, Ltd., Policarpo Sanz, 56-1 izq. Vigo; J. Iguaz Aguerri, 28 Gran Via, Bilbao.

Sweden.—Svenska Pressbyran, Drottninggatan, 50, Stockholm; Alfred Palson, Malmgatan 16, Malmo.

Switzerland.—Agence Naville, 5 7, rue Lévrier, Geneva; A. G. Azed S.A., 62 rue de Dornach, Basle; F. Zahn, 11 Maulbeerstrasse, Berne.

U. S. America.—The Moore-Cottrell Subscription Agencies, North Cohocton, New York; St. Paul Book & Stationery Company, 55 9, East Sixth-street, St. Paul, Minn.; F. W. Faxon Company, 83, Francis-street, Boston 17, Mass.; The Franklin Square Agency, Franklin-square, New York; Crowley, P.O. Station T, New York City; The J. V. O'Hare Subscription Agency, 224 R-street Northeast, Washington, D.C.

Arrangements for the Week.

FRIDAY, November 12th (to-day).

Physical Society.

5 *p.m.* At the Imperial College of Science, South Kensington, London, S.W. Papers on "Ionisation and Excitation of Radiation by Electric Impact in Helium," by Dr. F. S. Goucher; "Fringe Systems in Uncompensated Interferometers," by Mr. J. Guild; "The Location of Interference Fringes," by Mr. J. Guild; and "A New Relay for Moderately Heavy Currents," by Dr. Guy Barr.

Institution of Electrical Engineers.
Scottish Centre—Students' Section.

7.30 *p.m.* At the Royal Technical College, Glasgow. Opening Address by Mr. F. H. Whysall.

Electro-Harmonic Society.

8 *p.m.* At Cannon-street Hotel, London, E.C. Concert (Ladies' Night).

Junior Institution of Engineers.

8 *p.m.* At Caxton Hall, Westminster, London, S.W. Lecturette on "Hydraulic Sand Packing of Colliery Workings in India," by Mr. R. H. Squire.

SATURDAY, November 13th.

Manchester Association of Engineers.

7 *p.m.* At the Memorial Hall, Albert-square, Manchester. Address on "The Education Act of 1918 as it Affects the Engineering Industry," by Mr. S. Hey, and Discussion on "Liquid Pressure of Iron in Moulds," introduced by Mr. A. H. Goodger.

Birmingham and District Electric Club.

7 *p.m.* At the Grand Hotel, Colmore-row, Birmingham. Paper on "Some Aspects of Modern Works Management," by Mr. H. C. Young.

MONDAY, November 15th.

Institution of Electrical Engineers.
Informal Meeting.

7 *p.m.* At the Chartered Institute of Patent Agents, Staple Inn Buildings, London, W.C. Discussion on "Is Specialisation a Danger?" by Mr. Ll. B. Atkinson.

TUESDAY, November 16th.

Institution of Civil Engineers.

5.30 *p.m.* At Gt George-street, London, S.W Paper on "Cross Connections on the Elam Aqueduct of the Birmingham Corporation Waterworks," by F. W. Macaulay.

Institution of Electrical Engineers.
East Midland Sub-Centre.

6.45 *p.m.* At the Technical College, Loughborough. Paper on "Notes on Electricity in Agriculture and Plant Life," by Mr. W. T. Kerr.

Institution of Electrical Engineers.
North Midland Section.

7 *p.m.* At the Hotel Metropole, Leeds. Chairman's Address and Smoking Concert.

Institute of Metals. Birmingham Local Section.

7.30 *p.m.* At the Imperial Hotel, Temple-street, Birmingham. Discussion on "Hardness in Non-Ferrous Alloys."

WEDNESDAY, November 17th.

Royal Society of Arts.

8 *p.m.* At John-street, Adelphi, London, W.C. Inaugural Address on "Wireless Telegraphy and Telephony," by Mr. A. A. Campbell Swinton, F.R.S.

THURSDAY November 18th.

Institution of Electrical Engineers.

6 *p.m.* At the Institution of Civil Engineers, Great George-street, Westminster, London, S.W. Inaugural Address by the President, Mr. Ll. B. Atkinson. *Postponed from Thursday, November 11th.*

FRIDAY, November 19th.

Institution of Mechanical Engineers.

6 *p.m.* At Storey's Gate, London, S.W. Paper on "Sterilisation of Water by Chlorine Gas," by Capt. J. Arthur Stanley, O.B.E.

Institution of Electrical Engineers. Students' Section.

6.30 *p.m.* At the City and Guilds (Eng.) College, Exhibition-road, London, S.W. Address on "The Incandescent Electric Lamp from the Inside," by Mr. C. C. Paterson, O.B.E.

Junior Institution of Engineers.

7 *p.m.* At 39, Victoria-street, London, S.W. Annual General Meeting and discussion on "Economical Transmission of Power," opened by Mr. G. H. Ayres.

Institute of Metals. Sheffield Local Section.

7.30 *p.m.* At the University, Sheffield. Joint Meeting with the Faraday Society. Discussion on "Electroplating."

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Notes.

An Electricity Supply Crisis.

As will be seen from correspondence which we publish on another page of this issue a serious crisis has arisen in the electricity supply industry; so serious in fact that unless the issue is treated with calmness and statesmanship not only will great harm be done to industry and domestic life, but certain institutions will be shocked to their foundations. The cause of disagreement can easily be stated. By arbitration the Electrical Power Engineers Association secured an award which gave their members a bonus of 20 per cent. on their pre-war salaries plus £90 per annum. The award was accompanied by a recommendation that machinery should be set up to deal with salaries and conditions of service, and as a result the National Joint Board of Employers and Members of Staffs (Electricity Supply Industry) came into being. One of the first acts of this joint body was to approve conditions of employment and a schedule of salaries for technical engineers which was substantially the same as that in force, with an addition of £30 per annum. Since then both these awards have been combined in one salaries scale which was issued in May last. In spite, however, of the weight given to this body's decisions by its constitution and of the great care it had given to these important matters, a number of undertakings have failed to carry out the terms of the two awards. They are also standing out against the wages scales, and have treated all requests to behave otherwise according to the best traditions of Bumbledom. The Electrical Power Engineers Association have, therefore, threatened to withdraw their labour on December 14th next from all the supply stations in this country, unless the award to which they are entitled is adopted in its entirety by December 11th. The employers side of the National Joint Board is supporting the E.P.E.A. in their demands.

The Foundations of Peaceful Settlement.

It has often been said that one of the great drawbacks to the settlement of industrial disputes by arbitration is that employees cannot be relied upon to carry out the terms of any award, and will only accept an arbitrator's finding for just so long as it suits them to do so. However true this may be of the employees, it will now unfortunately be true of some employers. Whether the award now in dispute was just or unjust is beside the point; it was agreed upon by both sides and should have been carried out. From this point of view the Electrical Power Engineers' Association has a distinct grievance, and are to be commended for having borne with patience the delays and evasions which some employers, even when they are municipal authorities, know so well how to use when it suits their purpose. It is equally certain that the reason the award has not been honoured by those who ought to know better rests on the supposition that the E.P.E.A. are either unwilling or too weak to push matters to extremes. The resoluteness which is now being displayed will, therefore, doubtless have its effect, and we shall see another example of that undignified scurry which does so much to confirm Labour in the idea that the strike threat is the only weapon that is of any use in an industrial dispute.

The Place of the Whitley Council.

We hold, have always held, that in the Whitley Councils lie the best guarantee for industrial peace, provided these Councils are formed and used in the cause of justice, irrespective of vested interests. We are, therefore, glad to see that in this dispute the employers' side are backing up the E.P.E.A. in their claim, and this cannot be without its effect in making those concerned see reason. There remains, however, these important questions. How far are the E.P.E.A. prepared to go in this matter? If their claim is not conceded, will they adopt extreme measures? If their claim is only partly conceded, what proportion of acceptances will be sufficient to avert a national strike? And if there is no national strike, will there be local strikes in the areas served by the non-complying undertakings? These are questions which must be considered and answered, for the Association have raised a standard which they must now carry to the end, whether it be a fight or merely a trial of strength. And however much we may sympathise with them, we must deplore that in throwing over the Whitley Council and in determining on direct action they have taken a step which they will find hard to justify to the public and the industry generally.

The Cry of the Research Worker.

If the National Union of Scientific Workers is to be believed, the Department of Scientific and Industrial Research are profiteers of the highest (or is it the lowest ?) order. For, according to a resolution passed at the recent annual conference of the former, the latter have handed over to the private use of profit-seeking monopolies valuable knowledge obtained at the expense of the whole community, and have placed the research associations in a position to exploit the scientific workers of the country for their own (*i.e.*, of course, the research association's) benefit. Details of how this is being done are mercifully withheld, but, as far as we can gather, the trouble lies in the fact that the Department subsidises the worker or the Association carrying out the research until the work reaches a stage when it can be placed at the disposal of the industry or industries that can make use of it. The worker gets paid for his work, but naturally he is unable to garner those huge profits which, we are asked to believe, always fall to industrial undertakings under such conditions. This may be unjust. But, then, life is unjust. And we cannot see how injustice can be avoided or that the suggestion that the researcher should continue to draw royalties from the results of work which he has been enabled to carry out by Government grants is anything else than shifting the genesis of the exploitation of the community on to other shoulders. Or, in other words, the present trouble is just a squabble over the disposal of the carcase. If there is any other explanation we shall be pleased to hear it, but even so the members of the National Union of Scientific Workers would, in our opinion, be better employed in trying to improve their lot in some other way. We have already said that the Department of Scientific and Industrial Research should alter its methods, but this is not the sort of pressure that will make them do so.

Electricity Supply as a Key Industry.

WITH the publication of Mr. BEARD'S address to the North-Eastern Centre and Mr. NEWMAN'S to the Western Centre of the Institution of Electrical Engineers, in this week's issue, we have completed our duty with regard to the inaugural pronouncements of the chairmen of the Local Centres of the Institution of Electrical Engineers. Not all the chairmen were what is conveniently called central station men, but it is significant that without exception everyone of the addresses dealt with one or more of the vital problems connected with electricity supply. The reason for this is clear. The supply of electrical energy is not only the keystone of the electrical industry, but may justly be said to be one of the key industries of the country. At this stage in its development we are faced with a number of fascinating political and technical problems, all of which must be solved, and all of which are likely to be solved more quickly by clear presentation and frank and free discussion. It is the paramount duty of electrical engineers of all kinds to give these matters their closest attention.

Joint Electricity Authorities.

SOME people, including certain Members of Parliament, are becoming impatient at the delay in the formation of Joint Electricity Authorities, and would like to bring pressure to bear upon the Commissioners to expedite matters. For instance, Mr. SEDDON asked the Minister of Transport in the House of Commons last week whether the work of carrying out the various electricity schemes could be put in hand at once in order to give work to the unemployed, and to provide much-needed electric power for new industries. Mr. NEAL'S reply to this was somewhat indefinite, and added but little to our knowledge of the subject. He said that the Electricity Commissioners had provisionally determined electricity districts for the more important industrial parts of England and Wales, but only in the case of the Lower Severn district had a scheme been submitted to them. The time fixed for that purpose (save in the case of the Mid-Lancashire district) had not however expired. Arrangements were being made to hold the necessary inquiry in the case of the Lower Severn district, and similar arrangements would be made in other cases as soon as schemes were submitted. Meanwhile a large number of loans for electricity works had been sanctioned by the Commissioners, and extension work was being actively prosecuted in different parts of the country.

The Commissioners Blameless.

FOR any delay that has occurred in submitting schemes for the reorganisation of electricity supply the Electricity Commissioners are not to blame. It is simply due to the conflict between municipal and private enterprise, and to the petty parochial views of some local authorities, such as the Bath Corporation. With the exception of the Severn area, schemes are being prepared in the majority of the areas already defined, and no doubt they will be submitted in due course. But the difficulty is to know what will happen if no scheme is forthcoming, though in the case of recalcitrancy the Commissioners have certain powers. For instance, they might invoke Sec. 18 of last year's Electricity Act and erect electricity works of their own. They might also refuse sanction to loans for extensions of existing stations, and in other ways could successfully overcome obstructive tactics if they cared to push the matter.

The Electric Age.

WE wonder what blandishments were lavished upon the Electricity Commissioners, to produce in them the expansive mood exhibited in the article published in "The Times" of November 9th, under the title of the "Commissioners' Large Plans." The "Large Plans" cover, of course, that ideal of organisation which was put forward with such persuasiveness last year in the House of Commons by the Minister in charge of the Electricity Supply Bill, by GEDDES Brothers, Ltd., and others. For instance, we notice with interest that "electrical mains will be laid *throughout* the big electricity districts," and we certainly welcome the "throughout" if this is to occur during the next few years. We agree that the primary necessity is to cater for big industrial needs, but the other necessity second only to this is to lay the mains *throughout* the districts. This is a point which we do not remember having been specifically promised before. If the Commissioners can innoculate with their own energy all the various Authorities with whom they have to deal, these pleasant ideals of a "land flowing with milk and honey," not to speak of electricity, may be realised within a reasonable time. But otherwise there is likely to be a dreary wait. As we point out above some way remains to be devised whereby "local activity" can be stirred up and local animosity neutralised. We suggest with all humility the Commissioners might do worse than consult Dr. C. S. MYERS, the famous Cambridge Psychologist, who has so successfully tackled "psychological factors" in industry and commerce, as there would seem to be very fruitful ground for his investigations. To do so would give rise to some interesting facts on the symptoms of lethargy which are so pronounced amongst most of those who have anything to do with electricity supply schemes.

The Tramway Position.

THE report of the National Joint Industrial Council for the tramway industry, which was issued on Saturday, makes depressing reading. It was generally known that the financial position of many tramway undertakings was precarious, but we were not aware that it was quite so bad as this document leads us to believe. According to it, notwithstanding the greatly increased earnings per car-mile the tramways of the country were carried on at a considerable loss during the last financial year, as is shown by the answers to a *questionnaire* recently sent to local authorities owning tramways, replies to which were received from 81 undertakings employing 47,273 persons. These state that on October 1, when the cost of living had increased by 164 per cent., the increase in wages was, for drivers, 132 per cent. ; conductors, 147 per cent. ; car repairers, 140 per cent. ; and car cleaners, 163 per cent. The earnings per car-mile, have, however, increased greatly since 1913-14. For while 47 out of 80 undertakings earned not more than 11d. per car-mile in 1913-14, in 1919-20, there were 61 out of 80 whose earnings were not less than 18d. per car-mile, and in September and October last no undertaking earned less than 15½d., and only 17 out of 80 earned less than 20d. per car-mile.

Losses on Working.

Taken as a whole, however, the tramways of the country were carried on at a dead loss of at least £1,555,859, during 1919, notwithstanding the unprecedentedly high rate of mileage earnings. This result is due to the increase in wages and to the high cost of materials, and if the present application for increased wages be conceded there will be a further wages charge of approximately £1,481,100 a year, representing an additional 1·59d. per car-mile. At present the annual loss amounts to approximately £3,310,753, assuming that the same mileage is run in 1920-21 as in 1919-20, and the additional charge for wages now demanded would increase this loss to £4,793,597. The industry is, therefore, confronted with a most serious problem. The National Joint Industrial Council have laid down the proposition, with which the Ministry of Transport do not disagree, that the industry should be self-supporting, that it should not be subsidised by compulsory local taxation and, therefore, the passenger must pay the cost of the ride in the fare charged. This is a sound business principle with which there will be general agreement, but if it is adopted we must be prepared for a further substantial increase in fares, and some of the small provincial undertakings may suffer badly from any addition to the existing scale of charges owing to the fact that people will prefer to walk than to ride.

Proposed Increased Institution Subscriptions.

It is evident from the letter that we published last week from Mr. Sheldon and from the letter from Mr. Purse which appears in our Correspondence columns this week, that the resolution authorising the Council of the Institution of Electrical Engineers to increase the annual subscriptions is not likely to be passed without opposition. Now this is a matter about which no secret need be made and which should be closely considered and debated without heat as publicly as possible. We are therefore prepared to open our columns for an exposition of all sides of this question. This will, we think, have the advantage of removing any obscurity of policy and procedure that may exist in members' minds and of confirming waverers in one opinion or the other about a matter which affects every member personally. It will further tend to bring about the desirable end of saving time at the meeting itself by confining the discussion strictly to the point at issue. At this stage we have no wish to add to our comments last week other than to say that the Institution cannot become of greater use to members unless it is freed from financial anxiety and tightness, and that conversely to keep the subscriptions as they are will limit the usefulness of the Institution to members as a whole. It is from this point of view that the whole matter must be looked.

Self-Exciting Mercury Rectifier.

The part the mercury vapour rectifier will play in assisting the distribution of electricity is a question which is one for speculation at the present time, and great attention may well be paid to its design and applicability for this class of work. As it is, great progress has been made in the manufacture of this apparatus, and several installations are already satisfactorily working in this country in places where it is desirable to have some means of converting alternating to direct current without the use of revolving machinery and the necessity for constant attendance. One great disadvantage about most rectifiers has, however, been their lack of self-restoring ability after an interruption, though it would seem that this has now been overcome if the claims recently made for a new device in the "Elektrotechnische Zeitschrift" can be substantiated. The rectifier in question is provided with two auxiliary anodes which are fed from a special winding on the input compensator. This winding is tapped at its middle point and is connected to the cathode in such a way that it forms an auxiliary rectifier system. This latter auxiliary system is started in the ordinary way, but is always kept running so that it automatically excites the main apparatus when the direct current circuit is closed after a breakdown. This arrangement is said to ensure the necessary stability down to a small current strength. If such a device will work satisfactorily under practical conditions it should assist in giving a wide application to the use of this apparatus.

The Reason Why.

A Poet Laureate of the Victoria era once extolled the virtues of those who carried out an act of foolish bravery without stopping to ask "the reason why." He did not add that had they stopped they would have suffered death in a form quite as sure and much more ignominious than that which he was engaged in praising. While, however, the spirit of inquiry must be suppressed in the presence of military discipline it insists on exhibiting itself more and more in industrial life. It is a portent of which it would be well to take heed. Secrecy breeds suspicion and suspicion breeds trouble. To get rid of a very troublesome grandchild it is therefore as well to substitute for a somewhat over-rated grandparent openness and confidence between employees and employed ; to give explanations as to why things are done in a certain way ; to invite suggestions for improvements and generally to stimulate an interest in what is going on amid what are often dull surroundings. In a series of articles, the first of which we publish this week, Mr. W. J. Hiscox will give reasons why certain lines of action are necessary in a modern factory. The articles will, we hope, be of interest not only to those to whom they are specially addressed but to that wider public who is beginning to realise that in co-operation lies the best chance for industrial peace.

The Misuse of Gasfilled Lamps.

For many years we have consistently drawn attention to the harm that is being done, not only to the eyesight of the nation, but to the good name of the electrical industry, by the wrongful methods of installing high candle power lamps now so often in vogue. Examples of what we mean may be found without much search, and are at this time of year often forced upon the attention with the most unpleasant suddenness. Everyone of us probably knows the shop window illuminated (save the mark) by a row of some six or more 100-watt gas-filled lamps, all of them innocent of shade or reflector, thus forming a startling illustration of the way how not to do it. If such arrangements only damaged the shopkeeper's eyesight and business there would be little to be said ; but the shopkeeper remains ensconced in the background, whilst the harmful effects of exposing white hot metal in public places are communicated to the passer-by, who, poor fellow, wonders in his ignorance why he sees stars. But what interests us most is not the damage to the public eyesight, but the state of mind of electrical contractors who abet such installations being put in and of the supply authority who permits such a damaging advertisement to go unchallenged. We know that the latter have no legal powers, and that so far there is nothing illegal in a man depriving other people of their eyesight by indirect methods ; but, all the same, a little moral suasion might have an effect, and the whole question is certainly a matter to which close unofficial attention may well be given.

The Development of Specialisation.

The goal towards which the electricity supply industry is moving will inevitably mean greater specialisation. This movement began, of course, long ago when it was realised that the commercial side of an undertaking must be treated as a branch sufficiently important in itself to be divorced from the hitherto omnipotent activities of the chief engineer. Later on there was further breaking away of the management from the commercial side. To-day the constantly evolving state of the industry demands further specialisation—this time for the control of Labour, including all the intricacies inseparable from the many problems which come under that heading. This latest of specialisations was specially dealt with in one of the Whitley Reports on Works Committees which says : " We think that in every case one of the partners or directors, or some other responsible representative of the management, would be well-advised to devote a substantial part of his time and thought to the good working and development of such a committee."

A Labour Officer.

In large undertakings there is no question that if labour matters are to be adequately dealt with practically the whole-time attention of a leading officer or director of the undertaking is necessary. Further, it is not only that time is required to deal with this matter, but special knowledge. In the case of the electricity supply industry this is of particular importance. Not only the success of the individual undertaking, but the future of the whole industry depends on the employment of wise methods in dealing with the labour situation. Seeing that electricity supply is a key industry, and that the Trade Unions involved in it are among those which have a most marked political bias, it is not too much to say that national social problems must in the end be affected for good or evil by the influence exerted by those in the industry who deal with those questions during the next few years. The formation of the Joint Industrial Councils for electricity supply affords therefore a direct instrument by which such influence can be directed. But, and here we return to our original suggestion, the best will in the world will not help matters unless expert knowledge and trained administration are forthcoming—in other words, unless there is specialisation in industrial problems. That is an urgent necessity.

Gas and Electricity Supply.

The gas interests are to be congratulated upon their propaganda. We can do this the more unreservedly as their efforts are generally directed against electricity supply, and any pretext, the slighter the better, will do to ram their argument home. The latest protagonist is a correspondent to the " Glasgow Herald," who quotes with approval a statement of Lord Moulton that the supposed proposed concentration of the generating plant of the country in a few large stations will in case of breakdown bring paralysis and financial loss to large areas. He rubs his statement home by referring to the temporary unemployment of 9,000 men at the Midland Railway works at Derby owing to the cables supplying them catching fire, and complains that no reasoned reply has been given to Lord Moulton's statement. But one does not make reasoned replies to unreasonable statements. The fact that the people of Louth were flooded out is no argument against the use of water, and though we deplore the occurrence at Derby, we are sure it will not in the least retard the increasing use of electrical energy even in that city. The chances against such an accident are even now remote, and will become more so as our knowledge increases.

The Minimum Charge Again.

We have already given it as our opinion that those undertakings which are standing on their legal rights and demanding the payment of a minimum charge for the energy they provide, are doing the cause of electricity supply a disservice. This view is confirmed by a correspondent to a daily newspaper, who protests against being charged 5s. " minimum charge for one lighting meter " whereas before the war he paid 2s. 6d. for the self-same meter. He points out that nothing " besides being read occurs to the meter " and suggests testing the legality of the matter, not the meter. We fear, however, that if he did take this course he would obtain little satisfaction. But it will be agreed that to make such an increase in meter rent, though it may be legal, is neither equitable nor logical, and that the undertaking in question would have done better to exercise its activities in persuading the consumer to use more energy rather than in trying to increase its revenue in this fashion. In our opinion meter rents are an anachronism and might well be abolished.

Government Control in Germany.

In order to enable industrial companies and manufacturers to obtain credit on easy terms it was proposed to organise a State Industrial Credit Bank in Germany ; but owing to the opposition of the existing banks this scheme had to be modified, and it may be ultimately dropped. The present suggestion is to attach the new credit institution to the " Girozentrale," whose operations are principally carried out with municipal and savings bank capital. The ordinary banks, however, declare that all justifiable demands of industry for credit are being and can be met, and that the assumption that the banks have failed in this respect will injure their credit. The Government's reply is that no competition with the private banks is intended, and that the new credit institution will collaborate with them. There is also a Bill to prevent the closing of industrial works and the dispersion of plant. During the trade stagnation of last summer a number of factories closed down, and in some trades factories were dismantled and the machinery exported. The new Bill provides that industrial concerns intending to stop work or to dismantle their factories must give notice in the first case four weeks, and in the second case six weeks, in advance. In the interval before the notice operates an official expert investigation will be made as to whether the proposed measures are justified. If there is any possibility of continuing work efficiently and economically, the concerns will be compelled to keep going, probably with State assistance. We hope this policy will not be adopted over here. It is better to sink than to keep afloat with Government assistance.

Engineering and Industry in South Africa.

The proper relation of the Mother Country to the Colonies and of the Colonies to the Mother Country is a subject more suited for discussion in a political than a technical journal. Nevertheless, since the Colonies are, even now, largely undeveloped from an engineering standpoint and the industries of this country require a wider outlet for their production than the home market can supply, the conditions existing in these countries and the facilities that are available for trade are worth some study by engineers and commercial men.

This applies particularly to South Africa, where, as pointed out by Prof. A. E. Snape, of the University of Cape Town, in an address to the Engineers' Club, Manchester, the war has caused not only a great impetus to trade but a re-orientation of its direction by subordinating the once-important exports of gold, diamonds and feathers to coal and thus changing the direction of flow of the heavy traffic to instead of from the coast. Coal has, in fact, converted the South African ports into bunkering centres where fuel can be obtained more cheaply than anywhere else in the world. Unfortunately, the country is saddled with a narrow gauge railway system, and though large schemes of development and improvement are being carried out, the principal obstacle at present is, as elsewhere, difficulty in obtaining material required for post-war reconstruction.

Electricity Supply and Electric Traction.

In connection with the railway problem electrification has, of course, been considered, and as a result of the report recently made by Messrs. Merz & McLellan, not only are various sections of the system to be converted immediately, but the supply of electrical energy required by the industry of the country is very wisely to be dealt with as a whole. It is in such matters that relatively new countries have the advantage of older ones like the British Isles, for by starting afresh they can use our experiences and mistakes to carry out their schemes in the best possible manner.

Out of an examination of the conditions present an interesting point arises. This country is often commiserated on its lack of water power and glances of envy are cast at countries which are supposed to be better off in this respect. But in South Africa coal will mainly have to be relied upon for generating purposes. Water power is not over abundant and what there is is very localised, while the existence of domestic and agricultural rights makes development difficult on anything like an adequate scale. Here, again, however, South Africa is really fortunate, for the pit-head price of coal is even now only about 6s. per ton, while its quality is good and its calorific value, upon which it is purchased, averages 12,500 B.Th.U. It is enough to make English engineers' mouths water. Electricity supply development should, therefore, be extensive, and there should be no difficulty in making the fullest and best use of this form of energy.

British Traders and South Africa.

At present, however, South African trade is still in that stage of development when outside help is required, and it is evident that could satisfactory trade relations be established we could do a great deal to help South Africa and South Africa could do a good deal to help us. It is one of those cases of mutual service which often grow into relationships of the best and most permanent kind. The outlook is the more satisfactory in that, as Prof. Snape points out, there is a strong sentiment for British goods, though, he adds, the old, old complaint, of which we are becoming so weary, that the British manufacturer still fails to supply the goods that are wanted, complains that colonial trade is bad and wishes to prevent orders from being given elsewhere than in this country by the erection of a tariff wall against imports into South Africa. "This is not the way," says Prof. Snape, "to meet American competition, if an export trade is desired. The only way to compete is by organisation, better technical design and by imitating that wonderful service which American manufacturers have arranged for repair (he is speaking of motor cars), quick supply of spare parts and every convenience for users of their cars." Putting questions of labour troubles and increase of costs aside, he asks "Is British technical ability in the forefront? Do British firms supply the same service as American ones? Do not British firms give one an impression of indifference? Is there united brain work among British manufacturers? Are British engineers self-satisfied and self-complacent? Will they study the requirements of the country in which they desire to sell their goods?" These are questions which demand an answer.

An Opening for the British Electrical Industry.

A short time ago we deprecated an attack by a British consular representative on the methods of our manufacturers in South Africa. There were two reasons for this: one that we thought the duty of consular representatives was to help manufacturers not to criticise them, the other that the strictures referred to 1919 when the effects of war were still being felt. Nevertheless, having read what Prof. Snape has to say we feel that the criticisms may be justified and that it is time British manufacturers turned over a new leaf. As we have shown, South Africa at the present time offers a great opening for the electrical industry. The work English electrical engineers have done in applying the uses of electricity to traction, to the coal and to the iron and steel industries have often been demonstrated in these columns, so that the advice and experiences of the best engineers on these matters should be most helpful to South Africa. But what do we see? At the present most of the electricity supply undertakings in that country are suffering severely from plant shortage, so much so that in Cape Town the erection of factories is waiting on a supply of energy being available. The plant necessary to relieve their position is on order from this country, but delivery cannot be obtained. Is it to be wondered at then that the thoughts of South Africans are turning to the American market and that between us and this field of new enterprise we are, by our failure to fulfil our engagements, erecting a barrier more impassable than any tariff wall. We do not wish to minimise the difficulties under which our manufacturers are now working, we know that they are great. But we do deplore that more well-directed efforts are not being made to hold these markets by every means in our power, and that the much vaunted British industrial enterprise is so singularly lacking in carrying out a policy which can only operate to its good.

Statical Methods of Calculating the Potential Relationships and Fault Resistances of Direct Current Networks.

By G. W. STUBBINGS.

The analogy between many electrical problems and corresponding problems in statics has often been the subject of comment, and in the case of at least one electrical problem—that of the design of cable networks—the use of theorems in statics has led to considerable simplification of the calculations, and has enabled much greater conciseness to be obtained in the algebraical work than would have been possible without the use of conceptions which, though having a real significance in statical problems, bear but a fictitious meaning when applied to the electrical investigation. The ease with which problems concerning the potential distribution in direct current networks can be solved by the aid of statical methods appears not to have been fully recognised, although the applicability of such methods has long been known, and, indeed, has been incorporated into colloquial electrical phraseology, in such expressions as "a heavy fault," and "anchoring the potential of the neutral." The methods of testing the fault resistance of a direct-current network depend upon the investigation of the potential relationships of such a network under artificially varied conditions, and for this reason a brief method of investigating such relationships is not altogether devoid of practical moment.

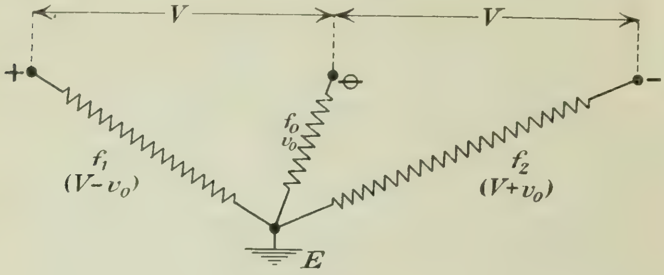

Fig. 1.

A three-wire direct-current system with an unearthed neutral is illustrated diagrammatically in Fig. 1. The voltage between each outer main and the neutral is V, and the conductivities of the leakage paths from the positive, neutral and negative mains respectively are f_1, f_0, f_2. Since the algebraic sum of the leakage currents from the three mains is zero, the following relationship holds :—

$$f_1(V-v_0)-f_0v_0-f_2(V+v_0)=O,$$

where v_0 is the potential of the neutral main.

Considering now the case of the loaded weightless beam shown in Fig. 2, in which the weights W_1 and W_2 are equidistant from the weight W_0, which is placed at the centre of the beam. If the point of application of the resultant of these three parallel forces act at the point X, distant l_0 from W_0, the following relationship holds—

$$W_1(L-l_0)-W_0l_0-W_2(L+l_0)=O.$$

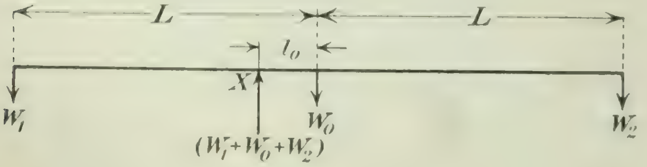

Fig. 2.

The point of application of the resultant is the centre of gravity of the system, and the magnitude of this resultant is $W_1+W_0+W_2$.

The analogy between the two equations is at once evident, the fault conductivity f in the electrical case corresponding to the weight W in the statical case, while the potential with respect to earth corresponds to the distance from the centre of gravity of the loaded beam. Hence it appears that earth potential in an unearthed direct current network can be regarded as possessing similar properties to those of the centre of gravity of a loaded beam, and the resultant of the three leaks $F=f_1+f_0+f_2$ can be regarded as analogous to a resultant force acting at the centre of gravity of the beam.

By the aid of this conception many problems which involve somewhat cumberous algebraical expressions when worked out in the usual way, can be solved with the utmost ease. Considering the three-wire network with an unearthed neutral, the effect of adding an artificial fault by connecting a resistance between the middle wire and earth is easily calculated. The statical diagram for the new condition is given in Fig. 3, in which the conductivity of the artificial fault is shown to have the value φ. From the diagram it is clear that the conditions are similar to those of a system of two parallel forces, the one corresponding to the resultant leak of the system $F=f_1+f_0+f_2$, the other to the artificial fault φ, the distance between these two fictitious forces being v_0, the potential of the neutral when unearthed. When the artificial fault is applied the potential of earth will move relatively to the system to a new position situated a distance v_1 from the neutral. Taking moments about the new potential point

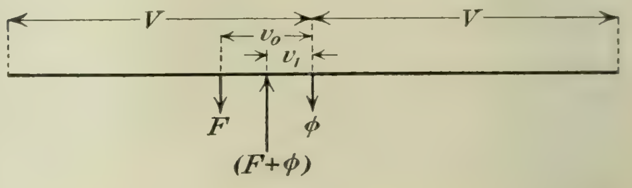

Fig. 3.

$$\phi v_1=F(v_0-v_1) \quad \ldots\ldots\ldots \quad (1)$$

$$F=\frac{\phi v_1}{v_0-v_1},$$

ϕv_1 is the current in the earthing resistance $=i$,

then $$F=\frac{i}{v_0-v_1}.$$

If R be the combined insulation resistance of the network, and ρ be the ohmic value of the earthing resistance—

$$R=\frac{v_0-v_1}{i}=\frac{v_0}{i}-\rho,$$

this result being utilised in Russell's well-known test for the leakage resistance of a live network.

From equation (1) is obtained at once—

$$\frac{F}{\phi}=\frac{\rho}{R}=\frac{v_1}{v_0-v_1},$$

and if by adjustment of ρ, v_1 be made equal to $\frac{1}{2}v_0$, then $R=\rho$; this result forming the basis of another method of network testing which, however, is not of great practical use.

Returning to equation (1)—

$$\phi v_1=F(v_0-v_1).$$

If the resistance of the artificial fault be halved, the potential of earth will travel, relatively to the system, to a position nearer to the neutral, and the new conditions are represented by

$$2\varphi v_2=F(v_0-v_2).$$

Hence, $\varphi(2v_2-v_1)=F(v_1-v_2)$

and $\frac{1}{F}=R=\rho\,\frac{v_1-v_2}{2v_2-v_1},$

this result being the basis of a useful network test first put forward by Mr. F. C. Raphael, which possesses the advantage the value of v_0 does not require to be known, and that it is therefore not necessary to break the earth connection.

Returning again to equation (1), if φ be increased without limit, the quantity $\varphi_1 v_2$ will remain finite and determinate being the current in the earth connection, when the neutral is put solidly to earth. In these circumstances—

$$\varphi_1 v_2=i_2=F(v_0-v_2)=Fv_0,$$

since v_2 is negligibly small. Continuing with equation (1)—

$$i_2-i_1=Fv_1,$$

and $R=\frac{v_1}{i_2-i_1}=\rho\frac{i_1}{i_2-i_1},$

this result forming the basis of a useful network test requiring one earthing resistance only.

Considering now a system with an artificially earthed neutral, in which a fault of conductivity φ_1 comes on the positive main. In these circumstances the statical diagram is given in Fig. 4. Taking moments about the new centre of gravity, distant v_2 from the neutral point—

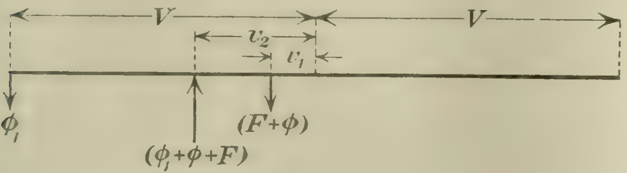

FIG. 4.

$$\varphi_1(V-v_2)=(F+\varphi)(v_2-v_1) \quad . \quad . \quad . \quad . \quad (2)$$

from which $v_2=\frac{\varphi_1 V+v_1(F+\varphi)}{F+\varphi+\varphi_1},$

v_2 will be negative if v_1 be negative, and—

$$\varphi_1 V<v_1(F+\varphi)$$

if v_1 be negative and—

$$\varphi V_1>v_1(F+\varphi),$$

v_2 will be positive, and the polarity of the neutral will be changed. If $v_2=0$

$$\varphi_1 V=-v_1(F+\varphi),$$

and $F=\varphi_1\frac{V}{v_1}+\varphi,$

a result which, the writer believes, was put forward some years ago, but which obviously suffers from the disadvantage of requiring an adjustable resistance capable of standing a voltage greater than V. It may be noted that by putting $\varphi_1(V-v_2)=i_2$, and $v_2=0$ in equation (2), the result can easily be obtained in a slightly different form

$$R=\frac{v_1}{i_2-\frac{v_1}{\rho}}.$$

A practical problem, in which the method set out above can be effectively utilised might be such as the following. Assuming average values of F and v_1, determine the resistance in the earth connection such that the potential of the neutral shall not be more than v_2, to blow a circuit fuse, rated at i amperes, controlling a faulty circuit. From equation (2)—

$$i=(F+\varphi)(v_2-v_1)$$

$$\varphi=\frac{i}{v_2-v_1}-F$$

$$\rho=\frac{v_2-v_1}{i-F(v_2-v_1)}.$$

Taking for the purpose of a numerical example $L=50$ amperes, $v_2=75$ volts, $v_1=5$ volts, $R=10$ ohms—

$$\rho=\frac{70}{50-7}=1{\cdot}64 \text{ ohms}.$$

From what has been written above it is clear that the problem of the determination of the combined fault resistance of a direct-current network whilst working, is analagous to that of finding the total weight of a loaded beam by adding a known weight at a definite point on the beam and finding the new position of the centre of gravity. It is also clear, from a consideration of the statical analogy, that the resolution of the total fault conductivity F into its components f_1, f_0, f_2, is not possible by the method of adding artificial faults to the networks. The position of each potential, relative to the network, after the addition of an artificial fault depends only upon the value of φ_1 F_1 and v_0, and there are an infinite number of sets of values of f_1, f_0 and f_2 that will satisfy the conditions. The resolution of F can only be accomplished by varying the potential distances between f_1, f_0 and f_2, that is, by altering the voltages across the two sides of the three-wire system. Tests based on this method are not difficult to devise, but have been found to be of little practical use, owing to the fact that the alteration of voltage allowable is small, and that the accuracy of the method depends upon the finding of a relatively small difference between two quantities.

The use of statical analogies leads to some interesting simplifications in dealing with the problem of the power wasted in the leaks on direct-current systems. The method has already been used by Dr. Alexander Russell in his treatment of the subject, and the following investigation is an example of the simplification referred to.

Considering an unearthed three-wire system, the wasted power due to leakage is given by—

$$f_1(V-v_0)^2+f_0v_0^2+f_2(V+v_0)^2.$$

This expression corresponds to one giving the second moment or moment of inertia of the loaded beam. Since the voltages are measured from earth potential, corresponding to the centre of gravity, it follows that this power is a minimum for given values of f_1 f_0 and f_2, and that the addition of any artificial fault to the network must increase the power wasted in the leaks.

Denoting this minimum power by P_0, and considering this effect of connecting an artificial fault φ to the neutral main, if the total power wasted in these circumstances be P_1

$$P_1=P_0+F(v_0-v_1)^2+\varphi v_1^2,$$

since the conditions are similar to the determination of the new moment of inertia through an axis distant (v_0-v_1) from the centre of gravity. The increase in power wastage is P_1-P_0

$$P_1-P_0=F(v_0-v_1)^2+\varphi v_1^2,$$

$$F(v_0-v_1)=\varphi v_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\therefore \quad F(v_0-v_1)^2=\frac{\varphi^2 v_1^2}{F}$$

$$P_1-P_0=\varphi v_1^2\left(1+\frac{\varphi}{F}\right).$$

Of this increased power, part is dissipated in the artificial fault, this amount being φv_1^2. The increase of power wastage in the leaks is, therefore, $\frac{\varphi^2 v_1^2}{F}$, or $\frac{i^2}{F}$, where i is the current in the earth connection, this last expression giving the increased power loss when the neutral main is put solidly to earth, and φ is very large, and v_1 negligibly small.

Mr. J. R. Beard on Post-War Conditions in Electricity Supply.*

When national recovery is viewed from the material side, it is apparent from the experience of nations in the past that the most important factor in quickly raising the burden of taxation is some special development of applied science. The general application of steam power to industry was the main source of England's recovery from the Napoleonic Wars, whilst more recently the burden of the American Civil War was forgotten in 10 to 15 years owing to the discovery and development of the enormous mineral wealth of the country. In what direction should we look for similar assistance to-day? The most likely solution is apparent in the general application of electric power and the necessity for all electrical engineers to exert themselves to the utmost is, therefore, urgent.

Electric Power and National Recovery.

In the United States the consumption of electricity per annum per head of the population in 1919 was 368 units, whilst even on the North-East Coast the corresponding figure was only 260 units. Electricity will be the most important factor in dealing with the question of over-concentration both of industry and population, and its application in large towns will result in a considerable reduction of smoke. Regarding international electrification of industry, this country holds a natural advantage due to the low cost of distribution resulting from its dense population and relatively small area, while frequent rivers and widely-distributed coalfields make it economical to generate separately in each of the much-discussed 16 areas. The steady pioneer work in the electric power supply industry during the last 20 years bore most astonishing fruit during the abnormal growth of certain of our industries in the war period, it being estimated that 95 per cent. of the new mechanical power was supplied by electric motors. The Electricity Commissioners have already made considerable progress in the way of delimiting areas and initiating schemes for unified systems of power distribution, but it would be unfair to place the whole responsibility for this reorganisation upon them alone. They require the constant and energetic support of the industry as a whole, and it is to be hoped that supply undertakings will succeed in setting a high standard of team work for other classes of the community to live up to.

Adjustment to Post-war Conditions.

The average cost of engineering labour has increased by approximately 323 per cent., whilst the corresponding average rise in the cost of engineering materials is 340 per cent. Nevertheless, electrical transmission and distribution are relatively favourably situated as regards material owing to the comparatively low increase in the prices of copper and lead, while the electricity supply industry benefits from the small proportion of unskilled labour employed, so that in general the industry has not been affected by the changed conditions any more than, for instance, the gas industry.

As regards any technical advance towards economy the importance of always bearing in mind that it is the true over-all economy which is the ideal to be aimed at must be emphasised. The greatest economy can be achieved by supplying the requirements of each industrial area from a single unified system, the first requirement of which is a network of mains of the same frequency, but not necessarily the same voltage, covering the entire industrial area, and as much of the agricultural fringe as can be conveniently incorporated. With such a network full advantage can be taken of the diversity between the periods at which individual consumers and the separate industries require their maximum supplies. Spare plant can be pooled and surplus energy absorbed into the system or shortage of energy for local requirements made up from the system.

Another direction in which economy can be obtained without capital expense is by concentrating the attention of the power station operating staff on the boiler house and by increasing the technical skill of those responsible for supervising the burning of the fuel. To some extent, this is already appreciated by many undertakings, but on the whole our American friends are much more alive to the point than we are.

Transmission Problems.

While efficiency in generation is the most important item in electric power supply, once the power station is left behind, the most vital consideration is low capital cost. Considerable attention has recently been directed to the use of distribution pressures above 20,000 volts, and several schemes are already under construction in which 33,000 volts has been adopted, while in other cases still higher pressures are in contemplation. With such pressures, the cost of mains and switchgear is too high per unit of plant to permit of their use for general distribution, and this has resulted in the adoption of a transmission system using a very high pressure, covering the whole area and feeding at a relatively few points a high pressure distribution network, which in turn supplies direct to the larger consumers, and to substations for transforming to low pressure for detail distribution. We do not generally require to use distribution pressures above 20,000 volts in this country from the point of view of pressure drop, but to reduce the cost of transmission high pressures are required. This country is so densely populated that it would be impracticable to adopt a standard pressure which involves overhead construction throughout, and given sufficient load the most economical pressure will be at least 50,000 to 55,000 volts, though if the load per feeder were limited, lower pressures would be advantageous.

The co-ordination of railway electrification to the general power supply will have a great influence in facilitating the development of transmission systems. When the railways were built, they followed the industrial channels as far as possible, and since they were built new industries have developed along them, hence transmission lines generally following the railways are in a position to pick up both railway and power loads. This combination increases the loading per feeder and permits of more economical transmission and the use of higher pressures. It is most important that the railway power should be taken at the same frequency as the standard frequency for the corresponding power supply area.

Non-duplicate or Semi-duplicate Supplies.

Although any prejudice against taking a public supply is fortunately a thing of the past, the tendency to unnecessary duplication still survives; for instance, when a mill driven by a single engine is electrified, often two cables and two transformers are used, each of the full capacity. In view of the present high capital charges, the question of using a single cable, or single transformer, or both, is worthy of the most careful attention.

With regard to the increased use of overhead lines, it is advisable to use a system of protection which would be equally suitable for underground cable or overhead line, so that there would be no difficulty in using overhead lines on sections where it is otherwise permissible. A further necessary feature of the protective scheme is that it should be suitable for T connections in view of the increasing use of non-duplicate supplies. Recently some progress has been made in reducing the standard thickness of dielectric on high-pressure cables, and as further reduction is probably permissible as methods of manufacture improve, it is desirable to arrange for the existing standards to be automatically reviewed from time to time.

The extent to which unnecessary switchgear is often installed is also surprising. For instance, it is quite usual when a non-duplicate supply is given to find a switch on both the high and low-pressure sides of the transformer. In such a case, a switch on the high-pressure side is sufficient in itself to protect the transformer and to enable the whole apparatus to be made dead when required, so that there can be no objection to coupling the low-pressure side of the transformer direct to the distributing switchgear.

Outdoor Sub-stations.

In order to save in the cost of buildings serious consideration should be given to the adoption, in whole or in part, of the American practice of outdoor sub-stations, with such modifications as are necessitated by our climate. It is doubtful whether outdoor high-pressure switchgear is suited to our climate, but the transformer can be readily adapted for outside use at small expense, and, in fact, sub-stations of this type are being installed. The capital cost per kilowatt of consumer's maximum demand in the case of lighting only is £55·3, while in the case of lighting, with occasional heating and cooking, the cost is reduced to £17·5 per kilowatt, and in case of the all-electric consumer is further reduced to £12·5 per kilowatt. A direction in which improved methods are urgently required is in tapping small demands from high-pressure network, and considerable progress in this respect would probably be made in the future.

If economies are to be realised from power-factor correction, the industrial consumer must be penalised for bad power factor. The simplest way of doing this is to bring the question of power factor into the tariff. On the domestic side a standard single-meter tariff would do much to promote the general use of electricity. At this time of continuously varying values, the piecemeal revision of maximum prices should be abolished and replaced by a universal sliding scale based on some convenient official index figure.

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* Abstract of an address delivered to the North Eastern Centre of the Institution of Electrical Engineers on November 8th.

CO-OPERATION BETWEEN UNDERTAKINGS.

Since it is economically desirable to have super-power stations and large supply districts, co-operation is the first and most vital necessity of future progress. If the Joint Electricity Authorities decide to carry out their duties themselves, it is very desirable that large consumers should be fully represented, and that there should not be a preponderance of non-technical representatives of local authorities. Cheap generation affects large industrial consumers more directly than the domestic consumer. Consequently, a strong representation of large consumers will tend to the concentration of the authority on its main functions. Efforts should also be made to bring about periodical meetings of representatives embracing all sides of the industry on the lines of the N.E.L.A. convention of America, as some such means of bringing rival groups into friendly contact would seem the most likely method of breaking down the non-technical barriers which have impeded our progress.

The Reason Why:

I.—This Feature Has Been Adopted.

By W. J. HISCOX.

Organisation is now the order of the day in the engineering factory, and so many things are being done, so many innovations introduced and put into practice, that it can scarcely be wondered at that the average foreman, charge hand and operator are somewhat bewildered at the unceasing changes which are taking place. The factory to-day is a complete contrast to what it was 10 years ago, and although in many respects it is a much better place from the mechanic's point of view, he most certainly misses the free and easiness of bygone days, and as a consequence chafes against the rigidity of the present-day system.

There is much that he does not understand, and it is apparently no one's duty to enlighten him. A certain change is made, a new regulation is brought into being, which he is expected to observe and to conform to, without really understanding what it is all about. The factory is filled with experts and specialists, who are continually introducing changes, and the majority of these changes intimately affect both the foreman and the operator. Yet, in spite of this, no explanation is forthcoming, and so a certain amount of suspicion and distrust is engendered.

THE FOREMAN AS A MECHANIC.

It will be observed that the foreman and the operator are put upon the same plane, and, lest this should cause some misunderstanding, it will be well at this juncture to set forth the reason. In practically every factory the shop foreman is looked upon as a unit in the management, and it may be assumed, therefore, that he thoroughly understands and appreciates every change of method. Unfortunately, however, such is not the case, and in a great many instances he is called upon to supervise the carrying out of instructions the significance of which he is quite unable to grasp. The foreman most certainly is not to blame, for he has neither been consulted or instructed. He is told that on and after a certain date a certain rule will come into operation, and he must see that that rule is observed. He is not told the why or the wherefore, and although he may draw his own conclusions it by no means follows that his assumption is correct. Like the operator, he is the recipient of instructions, but not of confidences, and he may be likened to a non-commissioned officer who is instructed to order his men to do a certain thing without having been told why such a move has been considered necessary.

It will be seen, therefore, that there is every reason why the foreman should be bracketed with the operator, and the object of this series is to demonstrate the futility of issuing non-understandable and mis-understandable instructions if the maximum results are desired. Management, however highly organised, cannot be termed scientific whilst such a state of affairs exists, and as the readers of THE ELECTRICIAN comprise every phase of the engineering industry—operators as well as managers—it is felt that an endeavour should be made to bring to the notice of the people primarily concerned the *reasons why* certain innovations are considered necessary.

A SERIES FOR FOREMEN AND OPERATORS.

This series, therefore, is written to appeal to foremen and operators—although perchance more than one works manager will get inspiration as a result of their perusal. Undoubtedly the foreman and the operator have been ignored to some considerable extent by the present-day organisers, by the assumption that their mental capabilities are not high enough to enable them to take an active part in the organisation. THE ELECTRICIAN, catering for all classes, is all for equal opportunity, and would press for the utilisation of *all* brains.

SOME RESULTS OF A MISTAKEN POLICY.

It may be fitting to show here briefly the results attendant upon the adoption of the policy protested against, and these will no doubt give the works manager food for thought. Ignorance is the cause of a great deal of harm, and misconstruction (based upon assumption) may be productive of disastrous results. The organiser should aim at the elimination of the " do this and do that " man—the man who does exactly as he is told, and then awaits further orders. He is the most glaring instance of wasted time—that bugbear of industry, the elimination of which is exercising the minds of our greatest business men to-day.

Instructions are received by foremen and operators with (*a*) active resentment, (*b*) passive resistance, (*c*) stolid acquiescence and (*d*) enthusiasm. The last is by far the rarest, and it is a feeling the operator scarcely ever feels. Those who do feel it are earnest young charge hands and foremen, anxious to improve their lot, and who recognise that the surest way of accomplishing this is to interpret the instruction as fully as possible. Thus, whilst not at the commencement being conversant with the reason, they appreciate that there must be a reason, and so they set out to discover what it really is. Their zeal cannot be subdued, and in time success crowns their efforts.

Active resentment does not command a large number of adherents, for most people are astute enough to bow to the inevitable, and it is recognised that ringleaders are always conspicuous. This group may be said to consist of foremen of many years' standing, men who have been autocrats in their departments, and who bitterly resent any innovation which appears to usurp any of their authority. It is, however, rapidly diminishing.

PASSIVE RESISTANCE AND STOLID ACQUIESCENCE.

Passive resistance is of the negative variety, but it is particularly effective, for it has an embarassing effect upon the object of its displeasure. It is subtle in its movement, and, as it never fights, it is difficult to kill. Active resentment can be encountered and overcome, but this is not possible with passive resistance. An order is issued, it is carried out; but its effect is nullified because it is interpreted in the letter and not in the spirit. It is reactionary, because it is passive, and being passive it cannot assist. More harm is occasioned in the factory by this than from any other cause, and it is made strong by ignorance. If one does not understand, the common policy is to " wait and see," and this fact should be borne in mind by the works manager and the organiser.

Stolid acquiescence may be said to represent the attitude of the bulk of the operators, for undoubtedly the average working man evinces no considerable interest in organisation. A rule is made, and he obeys it as a matter of course, unconcerned whether it be right or wrong. So far as he sees, organisation does not touch him directly. He notices the changes which are constantly taking place, but he does not realise that he is vitally concerned. He may protest when the result of organisation runs directly counter to his immediate desire, but that protest is only similar to the protest against the raising of tram fares or the cost of living. He does not understand the why or wherefore, because he has never been taught, and he cannot assist any development because he does not understand.

We are not advancing fast enough, because we are allowing brains to remain dormant. We want the help of everybody, in every position, to ensure progress, and it is with a view to enlightening those who do not understand that this feature has been adopted.

Hydro-Electric Power in Germany.*

By Dr. SYMPHER.

After preliminary reference to work, which was largely done in the early days of the electrical industry, *e.g.*, the hydro-electric transmission of energy from Lauffen to Frankfort, the author proceeds to deal with the nationalisation of the electrical industry, which was legally enacted on December 31, 1919. This law empowers the State to take over any property, which deals with the generation of power at pressures above 50,000 volts, or any installation exceeding 5,000 kw. in capacity, not used almost exclusively for private purposes, or, under similar circumstances, any water rights used for the generation of more than 5,000 kw. of energy. The existing owners are to be suitably compensated. Therefore the prospect is that in the future the State will be the possessor of all the high-tension lines, which will be suitably interconnected, and that these will be worked by the State in conjunction with local companies, though it by no means follows that the present intention is that the State shall nominate a majority of the directors. The political and economic aspects of this proposal are next considered, and a variety of general propositions are discussed.

New Schemes.

The author next deals with details of particular schemes, which are under consideration. The first plan relates to the canalisation of the Neckar from Mannheim to Plochingen, which is on the other side of Stuttgart. For many years schemes of this character have been proposed, by constructing a canal to Esslingen and connecting with the Upper Danube. Funds have hitherto been lacking, though Dr. Bosch, of Stuttgart, proposed to contribute 13,000,000 marks. But Dutch interests were involved on the Rhine, and Holland decidedly objected to certain proposals in connection with that river. Over a distance of 200 km., the Neckar falls 160 metres between Plochingen and the Rhine; and it might be possible to deal with this by means of 34 locks, with falls between 2·6 and 8·5 metres, allowing for the navigation of ships of 1,200 tons. Estimates are very uncertain with present-day prices; but it seems certain that this project would not pay its way if the traffic on the ship canal were the sole source of revenue. But if the water-power could be utilised, the matter assumes a different aspect. It is considered that 300,000,000 kw.-hrs. could be generated annually after allowing for all losses; and in view of this fact it is considered that the scheme might pay. It is, therefore, likely that this proposal will materialise.

Rhine-Danube Canal.

The same thing happens in Bavaria in connection with the canal, connecting the Rhine and the Danube. The details of this proposal are complicated and in view of the fact that the difficulties mainly refer to hydraulic questions in connection with the construction of the canal and to the points to which the various constructive links are to be connected, these local details are here omitted. The canal would utilise the tortuous course of the Main, and pass through Würzburg, Nuremberg, Aschaffenburg, &c. The construction in certain places would be very difficult, and though certain sections might pay, others would probably not do so. It seems certain that at the one end the canal will be constructed as far as Nuremberg, and at the other end the Danube will be canalised from Kahlheim to Passau. This would produce an annual output between 700,000,000 kw.-hrs. and 1,000,000,000 kw.-hrs. A good deal depends on the precise particulars of the scheme; if the canalisation at the one end were extended as far as Ulm, the output would be largely in excess of 1,500,000,000 kw.-hrs.

Other projects relate to the hydro-electric energy to be obtained from the Inn and Isar; any ship-canal scheme might be considered separately. Hallinger estimates that for 200 days in the year there would be 800,000 H.P. available, which would give annually about 4,300,000,000 kw.-hrs. But it cannot be said that the details have as yet been fully considered.

There has also been a scheme for constructing a ship-canal on the Rhine above Basle. The author presented a report in 1914 dealing with the section between Basle and Strassburg. Here again the hydro-electric energy is very important, as a supplement to the revenue derived from the traffic on the canal. Conservative estimates showed that 1,800,000,000 kw.-hrs. could be generated annually from the falls below Basle, and 1,200,000,000 kw.-hrs. from the falls above Basle. But under present conditions, owing to the Treaty of Versailles, it is probable that the energy from the falls below Basle will go to France.

Moselle-Saar Canals.

Similar problems arise from the proposed canals on the Moselle and lower portion of the Saar. There were formerly objections which were raised by the iron magnates of Westphalia and Lorraine; but probably nothing further will be heard from these quarters. Still it is quite likely that new questions will be raised by the cession of Lorraine to France, and by the present occupation of the left bank of the Rhine.

The firm of Lahmeyer, in Frankfort, has been much interested in questions connected with Main and Lahn, and the utilisation of the available power. But further investigations will be needed before coming to a conclusion, though it is likely that certain projects in connection with the Lahn will be carried out.

In North Germany, the same sort of thing has also happened, though in this case there is no possibility of developing any large amount of electric energy. There are questions in connection with the Weser and the Fulda, and it is proposed to alter the existing locks and to substitute others of larger size. Further alterations would be made at places above Cassel. It is estimated that 70,000,000 kw.-hrs. can be annually obtained from the Fulda, which would be sufficient to cover the expenditure. It was formerly intended to canalise the Weser, but this will involve a variety of considerations at the present moment. Then, again, there is the question of the Oder, which will involve 100,000,000 kw.-hrs. of energy. Finally, there is the Masurian canal, which could be used for supplying energy in East Prussia; the output would amount to 20,000,000 kw.-hrs.

The present Paper deals with one aspect of these hydraulic questions, which concerns itself with utilising the energy available at the weirs on canalised rivers. If all the water-power of Germany were to be included, the question would be much more complicated; it would include cases where no kind of navigation was possible. The total of such water-power would probably be 10,000,000,000 kw.-hrs., which is four times the amount of energy, generated from steam, in the year 1912.

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* Abstract from the "Elektrotechnische Zeitschrift." Paper read before the Institution of German Electrical Engineers at Hanover.

Electric Steels.*

By C. G. CARLISLE.

During the war, the electric furnace proved its value as a means of meeting the sudden increased demand for high quality steels. While giving every credit for this to inventors, due regard must be paid to the skill of the metallurgical workers, notably the men in charge of the furnaces. It is farcical to attempt to run electric furnaces by the clock and regard them as automatic machines.

Steel making during the last 30 years has resolved itself largely into an attempt to keep down sulphur and phosphorous. The acid Siemens process is a distinct advance on the Bessemer, and the basic processes a further step; but the electric basic-lined furnace has made it possible to obtain steel containing 0·02 per cent. sulphur, and sometimes 0·01 per cent.

Little information is available on the composition of electric furnace slags, and the author presents, in the original Paper, some tables of analysis. An important factor is that the slag must be free from metal oxides in order that sulphur may be effectively transferred from metal to slag. The size of furnace has an important effect as the oxidising slag can be more easily and completely raked off in a small furnace. Phosphorous cannot be reduced in like degree so easily.

Tests are quoted to show that electric furnaces can make excellent nickel-chrome steels; in fact, a larger percentage of success is attained than with Siemens steels of similar composition. Equal success has been attained in cutting steels, though here the method of testing requires great care, and lack of homogeneity of material imposes difficulties. Here again some interesting comparative tests are given, one remarkable case being an electric steel which survived the ordeal of drilling 200 holes 2 in. in depth, leaving a tool capable of considerably more work—a result never recorded by the author for crucible steel.

The author has formed the opinion that a 15-20 ton electric furnace would produce as cheaply as a 50-ton acid Siemens furnace, The question of cost must never, however, take first position in the steel-maker's mind. There is no compromising in steel-making—a good heat, even though costing 5 or 10 per cent. over the second best, will prove the cheaper by the time the steel reaches bar form.

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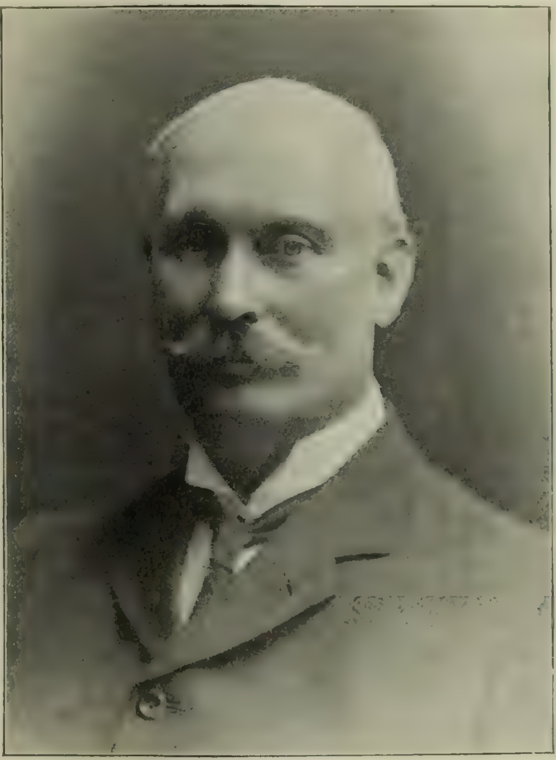
* Abstract of a Paper read before the Iron and Steel Institute.

The President of the Institution of Electrical Engineers.

An Appreciation.

Some months ago we suggested that the time had now come when the President of the Institution of Electrical Engineers should be a man who was, as far as possible, equally representative of the technical, commercial and political interests which are to be found within the electrical profession and industry. There was a simple reason for this. The Institution must now be prepared to take its place as the body which will, by right, be consulted when electrical matters are under consideration, and which will be recognised as representing electrical opinion by those who respect organisation rather than individuality.

Now it is always pleasant when our advice is listened to, and still more pleasant when our advice is taken. We, therefore, felt a glow of satisfaction when the Council nominated Mr. Llewelyn B. Atkinson as president of the Institution of Electrical Engineers for the coming session, and that glow had not lost its radiating power when Mr. Atkinson actually became president on October 1. Leaving sound ground for prophecy we do not doubt that that glow will still be radiating its moral heat and giving us pleasure a year hence, nor do we doubt that during that period Mr. Atkinson will have done much to advance the Institution and the causes we have at heart along those lines which we feel sure are the right ones.



Mr. Llewelyn B. Atkinson.
President, Institution of Electrical Engineers.

Biographical Detail.

Some biographical detail is called for on such occasions as these; personalities appeal to everyone; and the past is not seldom the key to the future. And while the election of the President of the Institution of Electrical Engineers is not hedged about with either the secrecy or the uncertainty which surrounds the election of a Pope, yet in Mr. Atkinson's case it is not untrue to say that he would hardly have been considered a hot favourite for the position even so short a time as twelve months ago. For a much longer period than that, however, his work has been of high value to the electrical industry, though more unobtrusive than public, and the experience he has gained in his varied career has been as useful to himself as it is now likely to be to the Institution. Having emerged from the background he has rapidly come to the front, and there is no doubt that in these troublous times the choice could not have fallen on a better man.

Mr. Atkinson comes of a family of engineers. At the time of his birth at Builth Wells in Breconshire, his father (an Englishman) was laying out the Mid-Wales Railway, hence the name Llewelyn. It would be interesting to speculate in these days of the Celtic influence how much this name has helped Mr. Atkinson in his subsequent career. He was educated at Merchant Taylors' School, and thence obtained an Exhibition to St. Thomas's Hospital. There are numerous instances where men have started in one career only to achieve success in another. Mr. Atkinson is one of them. Before leaving school he had commenced to attend Prof. Ayrton's electricity lectures, and never, in fact, took up the medical scholarship. So successful was he at his new work that he obtained the first prize and silver medal in the City and Guilds examination in electrical technology, subsequently proceeding to King's College, London, where he gained the Telford medal at the end of both the second and third year courses. This was in 1883.

Early Engineering Experiences.

At the conclusion of this period of theoretical training he became an apprentice at Kitson's locomotive works at Leeds, and was subsequently articled to the firm of Goolden & Trotter, where he assisted Mr. A. P. Trotter and Mr. H. W. Ravenshaw in the experimental work they were then conducting into dynamo design. This firm has been the cradle of many prominent electrical engineers. On the retirement of Mr. Trotter in 1888, Mr. Atkinson became a partner in the firm, with which he remained during its subsequent somewhat chequered history until 1897.

During these years the electrical industry had been growing and changing. It was the time of the boom in the erection of both municipal and privately-owned power stations, the beginning of a development of which we have not yet begun to see the end. Mr. Atkinson was naturally playing a fair part in this development, his most important venture being a share in the foundation of the Trafford Park Power & Lighting Supply Company, an undertaking which was an integral part of the scheme for an erection of an "industrial city" on the Trafford Park estate, near Manchester. The enterprise was embarrassed with troubles which Mr. Atkinson had successfully overcome by the time he joined the directorate of Messrs. W. T. Glover & Company, also of Trafford Park, as manager of their London office, and thus began his long connection with the cable making industry, which he still retains. Here also he began his connection with the Cable Makers' Association, the affairs of which gradually absorbed a greater and greater part of his time, until in 1916 Mr. Atkinson became secretary of the Association in succession to Mr. A. H. Howard, and in 1919 retired from the board to W. T. Glover & Co., Ltd., to devote himself wholly to the work of that body.

The Work of the C.M.A.

We need not here speak of the aims and objects of the Cable Makers' Association or of Mr. Atkinson's enterprise and success in carrying them out. These are well known to readers of The Electrician. But the Cable Makers' Association is interesting as being one of the first of those associations which are illustrations of that great fact that in combination of interests lies a great proportion of ultimate progress. From this point of view, Mr. Atkinson's long connection with the Cable Makers' Association and his subsequent election as President of the Institution of Electrical Engineers are doubly interesting, and form a combination of facts from which a useful moral could be doubtless deduced.

The Future of the Institution.

Though in future the work of the Institution of Electrical Engineers will have to be carried out on a wider basis than it has been in the past if it is to retain its usefulness to the profession, this does not mean that less attention will be given to matters of scientific and technical interest. Nor is Mr. Atkinson's grip of these subjects less because his work is mainly of a commercial character. Anyone who heard him speak in the discussion on Mr. Sydney Evershed's recent Paper on "Permanent Magnets" will realise the truth of this. As a speaker on both theoretical and practical subjects he is eloquent and clear, but restrained and precise. There is no wandering off into side issue, and no one need have the least doubt as to what his real opinion is. Nevertheless, he is no bigot, and his successful work as Chairman of the Joint Industrial Council of the cable makers industry shows that he can be conciliatory. Perhaps the true explanation of these seeming contradictions lies in the fact that he is both a humourist and a lover of music.

Such a training and such experience tend to give a broad-mindedness which, valuable though it is, is acquired with difficulty in any other way. This broad-mindedness cannot help being of use to Mr. Atkinson in directing the administrative work of the Institution and in dealing with the diverse interests that help to make up the whole. His wide experience of the many phases of electrical science and practice have a utility which cannot be denied, while of equal value will be his financial and business knowledge. We wish him the sucess in his present high position which we feel sure he will attain.

Electrically-Driven Tin Plate Mills.

A Comparison of Welsh and American Practice.

By W. E. TAYLOR.

It may perhaps be advantageous in view of the very serious competition which we have been experiencing from our neighbours across the Atlantic to make a comparison between current practice in the rolling of plate in our Welsh mills with those in America. The general Welsh mill layout differs somewhat from the layouts in American mills. Only one or two American plants are laid out on the "two mill system" as generally adopted in this country, that is, one roughing and one finishing stand per mill.

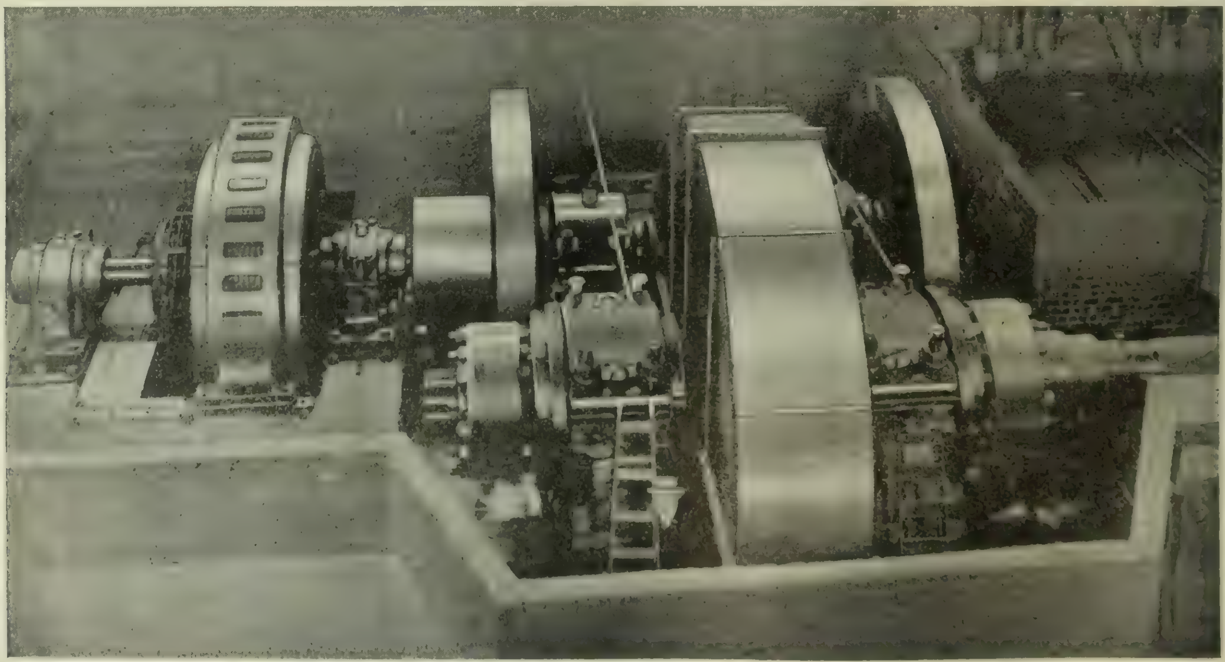


Fig. 1.—Motor Operated Mills at the Works of the Canton Sheet Steel Co., U.S.A.

Welsh practice usually consists of four or six mills, consisting of eight or 12 stands in line from end to end grouped in twos—one roughing and one finishing. The usual roll diameters vary between 19 and 24 inches, with corresponding speeds of 38 to 35 revs. per min, giving a surface speed of approximately 200 to 220 ft. per min. The lengths of the rolls vary between 26 and 36 in.

The size of the tin bars used varies, but a typical example would have initial dimensions 19 in. by 8½ in. by ½ in. thick, the average weight about 16 lbs. per ft. The usual carbon content of the material is 0·1 per cent., and occasionally up to 0·12 per cent. The initial rolling temperature is 900° to 1,000° C., finishing, in each heat, at a dull red, except the last heat, when the plate, as finally finished, is almost black.

Heat Procedure.

The heats are usually as follows :—

1*st Heat*.—The two bars worked together, that is, one is passed through the rolls whilst the other returns over the top. Bars are put in with length parallel to the roll axis. Four passes are given on the roughing rolls, giving final dimensions of approximately 28 in. by 19¼ in. by 5/32 in.

2*nd Heat*.—After reheating the slabs are returned to the roughing rolls and are given a further two passes, so that final dimensions of approximately 48 in. by 19¼ in. by 3/32 in. are obtained. These sheets are then doubled and returned to the furnace.

3rd Heat.—Each doubled sheet is then given two passes on the finishing rolls, the final dimensions again being approximately 48 in. by 19¾ in. These are then redoubled, making four thicknesses, each about 0·04 in. thick, and are again returned to the furnace.

4th Heat.—After this heat a further two passes are given, making the final dimensions approximately 49 in. by 20 in. The sheets are then redoubled a third time, making eight thicknesses, each about 0·02 in. thick, and are again returned to the furnace.

5th Heat.—Only one pass is now given, giving final dimensions after the last pass of 49 in. to 50 in. by 20 in. of an average of 30 down to 35 gauge.

There is one sheet and one pair furnace to each pair of stands, or mill, and a gang of four men work each mill. The cycle is started with 30 to 40 bars in the first furnace, taking about ¾ of an hour to reach the first heat, whilst the successive heats take slightly longer than the time required for rolling. The average output of each mill is 800 boxes per week of 128 hours, each box consisting of about 108 lbs. of finished plate made up of 112 sheets 14 in. by 20 in. by 30 in. gauge.

AMERICAN PROCEDURE.

American practice consists of six or eight stands, each stand constituting a mill, on which both the roughing and finishing are done. Each stand is complete with sheet and pair furnaces, and doubling shear and squaring shear on the catcher's side. The diameter and roll width are generally 28 in. and 34 in. respectively, but since the usual speed is from 29 to 32 revs. per min. the roll surface speed is about the same as in Welsh practice. Both sheet and pair furnace temperatures, as taken with the use of a thermo-couple, are from 1,800° to 2,000° F., and since the plate is somewhat below furnace temperature this indicates approximately the same as Welsh practice. The finishing temperatures of each heat are similar to that given above.

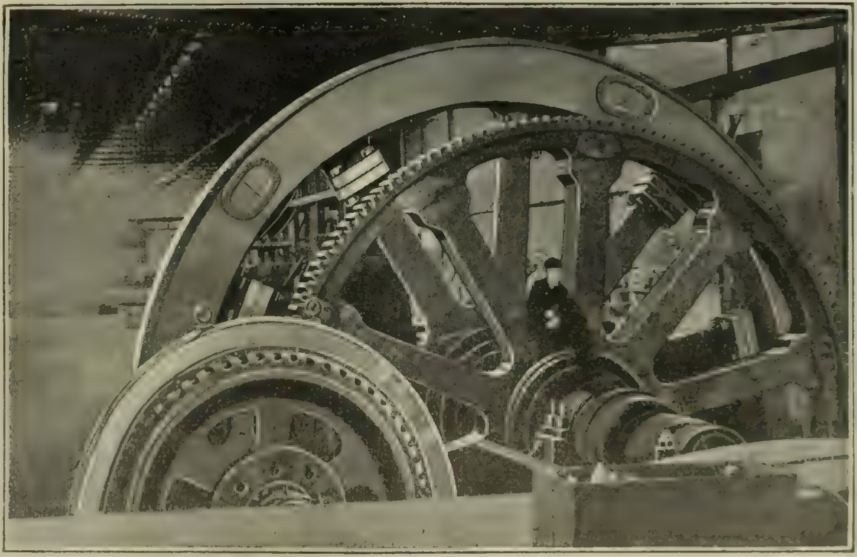


FIG. 2.—CHARACTERISTIC DRIVE IN BRITISH SHEET AND TIN PLATE MILLS.

In America only four heats are used—the first heat is similar to Welsh practice, except that in most cases it is done in three passes. The slabs are then paired off and put into the furnace. An amusing incident is told of a tin mill superintendent who noticed a rougher breaking down in three passes. Going up to him he asked, "Why do you use three passes for roughing"? The rougher answered, "Because I cannot break them down in two." The second heat consists of rolling the two paired slabs, after which they are doubled, making four thicknesses, and returned to the furnace. In the third heat the double sheets are rolled to the desired thickness, and are again doubled before returning to the furnace. The redoubled sheets are finally finished in the fourth heat to the desired gauge required. The number of passes per heat varies with the individuality of the roller, but since his "bogey" is tonnage he always aims to get the proper finished size with as few passes as possible.

The sheets are then sheared to size and opened, pickled, black annealed for about eight hours (against 10 or 12 hours in Welsh practice), and cold rolled as in this country. The sheets are now white pickled (white annealing for 7 hours precedes this in Welsh practice), tinned, cleaned, sorted and packed, as is the practice here.

THE USE OF POWDERED COAL.

The tonnage in America is somewhat greater than in England, but this is easily accounted for by the greater widths and smaller number of passes and heats. It might be interesting to note that several tin mills in America have adopted the use of powdered coal for fuel for their heating furnaces, and there is no question but that the heat and reducing atmosphere produced are eminently satisfactory for the rolling of tin plate, but there are a number of disadvantages in its use, which may possibly be corrected in the future.

The number of men to a crew in American mills is usually nine, but not all these men are working on the mill at the same time, in fact, although they are at the plant in eight-hour shifts, their actual day's work consists of about four hours. The tonnage produced by an exceptionally good crew will often run as high as 1,600 boxes of finished plate per mill per week, but the average will probably lie in the neighbourhood of 1,400, but each box only averages about 100 lbs. weight, made up of 100 sheets 20 in. by 14 in.

ELECTRIC MILLS IN THE MAJORITY.

The great majority of tin mills in America are electrified; gear and rope drives are both used to a considerable extent. Rope drive makes possible the placing of a motor in a separate motor room, thus securing a cleaner location, and requiring less space in the mill train. On the other hand, the gear drive leaves available space on the furnace shearing sides, and interferes less with traffic and the handling of material.

Dirt troubles at the motor have been eliminated in two cases by completely housing the motor gear and oiling systems in a structural steel framework covered with flat or corrugated sheets, and furnished with an air blower to provide ventilation. At the same time this prevents the entrance of dirt particles by reason of the air escaping through all the small openings in the motor room covering. The control equipment at one of these installations is placed underground, and at the other is placed overhead between the furnaces on each side of the drive. In each case, however, the starting panel containing the oil switches and instruments is located at about the level of the mill standing, and so situated that the operator can see the mills on each side of the drive. Further control consists of push buttons located on the columns between the furnaces which furnish emergency stops.

Generally speaking, the gear drive requires less maintenance, and, in the cases above mentioned, has been found perfectly satisfactory when two motors driving eight stands each, and so situated that they were eight mills apart, were cared for by only one operator.

THE GEAR DRIVE.

Fig. 1 shows the motor and gear drive for the sheet mills of the Canton Sheet Steel Company, which is characteristic of all sheet and tin mill gear drives. The coupling used between the motor shaft and the pinion shaft is always of the flexible shock absorbing type, and relieves the motor materially of the shocks inseparable from the breaking down process. This coupling also allows for a certain amount of wear in the pinion bearings, but this should never be permitted to become excessive. There is some difference of opinion as to whether the direction of rotation should be such that the thrust is against the bottom half, or the cap, of the pinion bearings, but the installations which have the thrust downward are running quite satisfactorily, although nothing has been put on record about an installation with the thrust acting upwards on the cap. Fig. 2 shows the drive of the Ebbw Vale Sheet Mills, which is characteristic of the sheet and tinplate gear drive in this country.

Both mills are driven by induction motors through gearing, but, as will be seen from the illustrations, the disposition of the flywheel is different in the two cases. In the American case, with the high speed fly-wheels, the gears have to be made to withstand the maximum peak load of the mill, while with the slow speed flywheel the gear has only to deal with the motor peaks. To compensate for this the weight of the flywheel, as well as its equipment, is increased, but this may be more than compensated for in price by the fact that the high-speed flywheels will be made either of rolled plate or cast steel. The use of either form of flywheels in connection with some form of control that allows the slowing down of the motor under heavy loads improves the input curve very materially, especially with the use of an automatic liquid slip regulator. This is shown on the charts, Figs. 3 and 4, which were taken under actual operating conditions on the same motor with and without the liquid slip regulator. It will be seen from Fig. 3 (without slip regulator) that the maximum peak reaches 1,700 kw. while the introduction of the slip regulator, Fig. 4, the maximum is only 1,200 kw. A type of slip regulator similar to that used in the test is shown in Fig. 6.

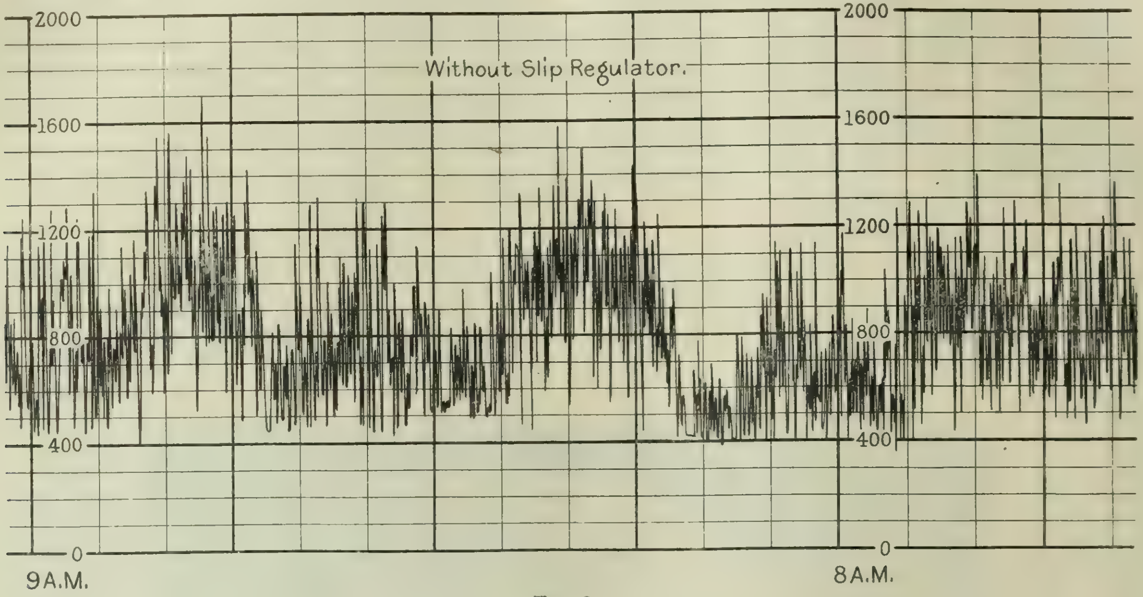


Fig. 3.

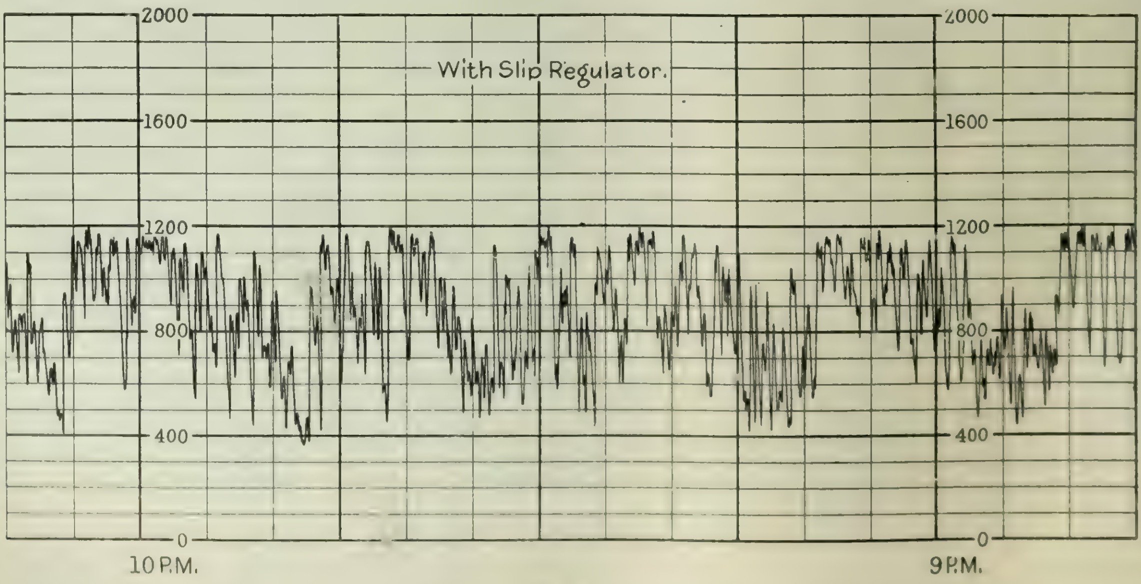


Fig. 4.

Energy Consumption.

Further particulars relating to these curves may be of interest, both to the mill engineer and to the power supply engineer, as this mill used central station power. The mill drive was from a 1,000-h.p. three-phase 25-cycles 6,600-volts, wound rotor induction motor, running at 80 revs. per min., driving a sheet mill consisting of roughing and finishing stands, and rolling sheets from 1 to 20 gauge. The speed of the mill was approx. 30 revs. per min. The load curve on the mill gave the following results :—

Kilowatt hours per year	3,840,000
Kilowatt maximum demand	1,150
Load factor (annual)	38·1 per cent.

It will be noticed that although Fig. 3 shows a maximum peak of 1,200 kw., the maximum kilowatt demand on the station is only 1,150 kw., due no doubt to the time allowance for such maximum demand. The particular advantage of the liquid type of control over a magnetic control is its ability to act immediately upon the introduction of a peak load. With magnetic control having a notching-in relay which introduces additional resistance by causing a switch to open, there is a time element introduced which may delay the relief of the motor long enough entirely to miss the peak.

RIVAL METHODS OF CONTROL.

A series of tests were made on a 1,500 h.p. motor driving an 8-mill train of sheet mills at the American Rolling Mill Company. Their original installation included magnetic control with a notching in relay; but it was found this scheme was not inherently designed to protect the power station from sudden loads. To relieve their power plant a liquid slip regulator was installed, which reduced their extraordinary maximum peak loads of the sheet mill drive from 2,400 kw. to 1,700 kw. Fig. 5 indicates the load characteristics of the two methods of control. After the test was made with the magnetic control the motor was immediately switched on to the liquid slip regulator. The curves (Fig. 5) record maximum peaks of 1,900 kw. with magnetic control, and 1,300 kw. with the liquid slip regulator. It will be noted that the peaks with magnetic control are not sustained, indicating that the magnetic control must have a certain increment of time before it is able to reduce the peaks on the motor. When the magnetic control was in operation the notch in and notch out had to be set for operation on about 400 kw., so that an allowance in input was necessary to operate these switches. With the liquid regulator it was easy to adjust within a variation of 100 kw. under ordinary conditions. By this close regulation the economy of the power station operation was increased as it reduced the peak loads from 2,400-2,500 kw. to 1,600-1,800 kw. The liquid regulator can be adjusted easily for any desired input on the motor to suit various conditions of service, whereas, due to the magnetic control being designed to operate the motor at its full capacity, adjustment is only permissable within certain ranges.

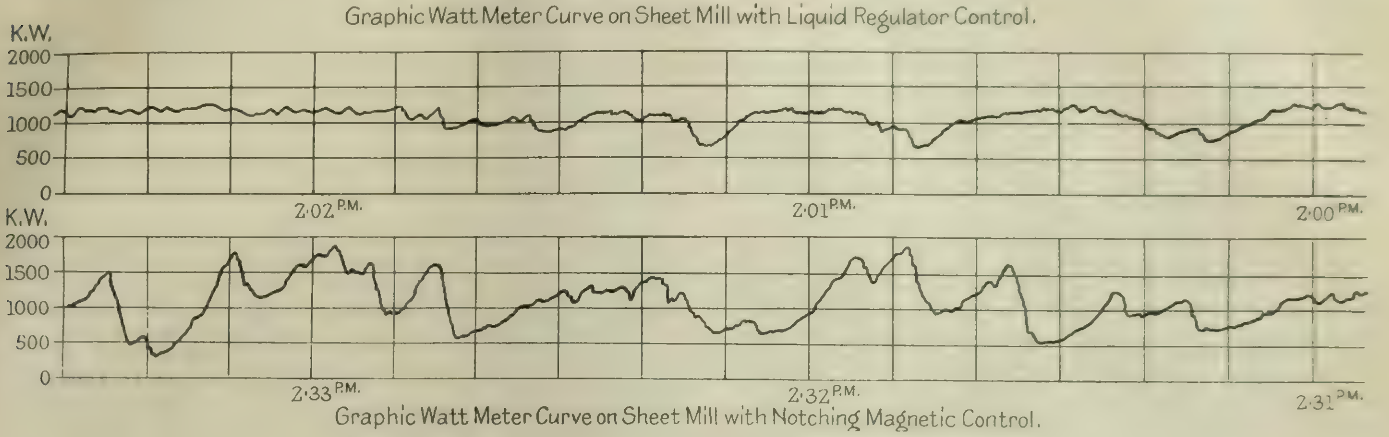


FIG. 5.

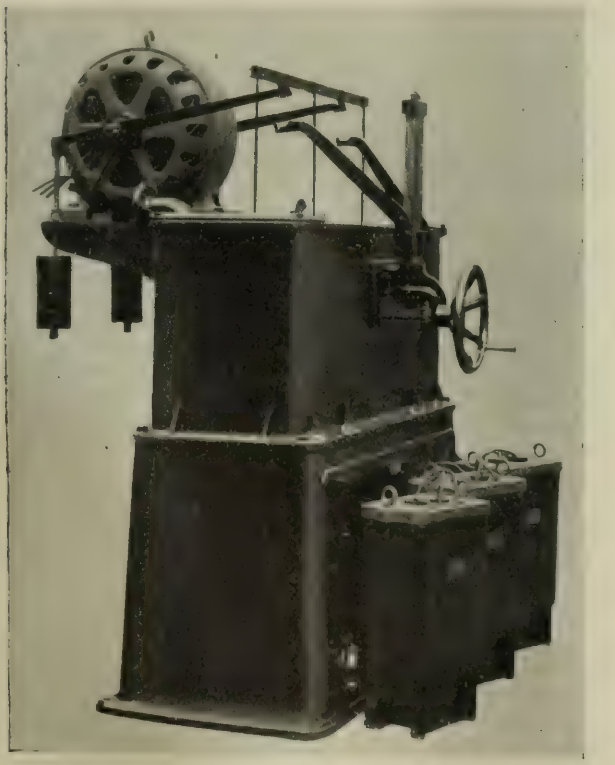


FIG. 6.

So far as the size of motor is concerned the usual assumption for tin mills is 150 h.p. motor capacity per mill. This figure leaves a fairly wide margin, since at one time a 1,200 h.p. motor furnished power for 11 mills, with an average consumption for 24 hours not exceeding the motor capacity, although momentary peaks as high as 1,800 to 2,000 h.p. were not uncommon. However, the unit consumption per ton of finished tin plates will probably be about the same under either Welsh or American practice, since the reductions in the cross sections of the metal are about the same. This will mean approximately 150 to 160 kw. hours per ton of finished tin plate, excluding the power taken for the cold rolls, or the equivalent of 7·3 to 7·72 kw. hours per box of 108 lbs.

There has been more or less discussion regarding the use of individual drive, that is, one motor of 150 to 200 h.p. per mill, and it has even reached the point where complete designs have been made up. At the present time individual drives are being installed at a mill in Ohio, but have not yet reached the point where any data can be obtained regarding them.

Makers of Modern Technology.

Hand in hand with the development of engineering knowledge, which has been one of the outstanding features of the last hundred years, has gone the preparation of books on scientific and technical subjects, crystallising that knowledge in a form for ready use and forming a starting point from which future progress can be made without unnecessary retracing of the steps of the pioneers. The history of an undertaking whose life work has been connected with such developments cannot fail to be interesting, and it was therefore with great expectations that we opened the handsome volume containing the hundred years history of the well-known firm of Messrs. CHARLES GRIFFIN & COMPANY. This firm was founded in 1820 and almost at once made it its special business to produce scientific and technological works of all kinds. Dull and arid as such work might seem, it is in reality surrounded with quite a halo of romance, as Mr. L. P. Sidney in his chapter on Makers of Modern Technology shows with great clarity. The book is excellently illustrated, not only with portraits of contributors to the volume and of some of the many authors with whom Griffins' name has been inseparably bound up, but with reproductions of title pages and documents which have historical or technical interest.

Mr. A. J. Newman on the Design and Construction of Electrical Apparatus.*

In the course of his chairman's address to the Western Centre of the Institution of Electrical Engineers, Mr. A. J. Newman said that the general desire for more money and shorter working hours could only be economically met by great provision of efficient machinery of production, of which power was the most important.

There is no golden rule to secure a cheap and abundant supply of electricity, and the locality, size and number of generating stations for any area can only be determined by a close study of local conditions. Naturally the super-station permits larger units, more economical working, more elaborate labour-saving devices, &c. Further, the recovery of bye-products of coal during the process of oxidation is most likely to be achieved in big stations. Linking up existing stations is also an important step, rendering the various sources of supply mutually supporting.

The Electricity (Supply) Act.

It may reasonably be expected that in most areas Joint Authorities will be formed, and progress from now onward will be more rapid. There should be no excuse for Joint Authorities failing to pay their way, as they will have a practical monopoly of business. It is most important that there should be unity of idea and purpose in each district, and steps towards standardisation should be taken at once. The great national scheme may have far-reaching effects; for example, in rural manufactures, and in largely solving the problem of domestic labour by the wide introduction of labour-saving devices. The position of the electric vehicles should also be much improved, and it has, in the author's opinion, a great future before it.

As regards general design and construction, certain practices appear to have become standardised in new stations—*e.g.*, alternators are usually provided with reactances, and the main 'bus bars are also divided into sections by the same means. Where step-up transformers for distribution are used, they are generally solidly connected to the alternator, both being treated as one unit, and the switching done on the high-tension side. Protective systems for generators, cables and step-up transformers have been developed, but no existing arrangement has yet been generally accepted. It is to be hoped that a generally acceptable method will be devised in course of time, otherwise a number of protective systems, covering all difficult cases, should be standardised. In view of the problems of securing adequate supplies of water and the maintenance of a continuous supply of fuel in case of internal disturbance, floating power stations have been proposed. Such a station, mounted on a large raft, would have certain advantages. Oil could be readily derived from tankers, and an adequate supply of cold water for condensation would always be available. Further, if the station consisted of several units, it might be subdivided, any unit being removed without dismantling to another site should occasion arise. The construction of such a station would, however, present certain difficulties. The raft might be of celullar construction, certain cells being used as the condenser basement, oil and water storage tanks, &c. Adequate water supply is practically only obtainable on tidal water, and large estuaries have the advantage that they allow the super-station to be placed more centrally with respect to the area of distribution. Effective mooring devices, such as those used already for floating docks could be readily arranged. Though the construction of the raft would naturally be expensive, the cost ought not compare unfavourably with the cost of a suitable site, foundations, &c., on land, and it would have the incidental advantages of avoiding coal sidings, cooling towers or culverts, &c. As an alternative, such a station might be built by the sea shore.

The Manufacture of Central Station Plant.

Turning to the manufacture of generating and auxiliary apparatus for central stations, orders were in hand for seven turbo sets of 10,000 kw., or larger, five of these being each of 12,500 kw. All modern turbo-generators use forced cooling, and the air cooler seemed to be preferred to the wet air-filter

In regard to switchgear design, some advocated totally-enclosed or ironclad gear, others installations in masonry or fireproof material. During the past year totally-enclosed ironclad main gear has been installed at the Dalmarnock (Glasgow) station, and has proved very successful. In future, greater robustness, greater current-carrying capacity and insulation for higher voltages will be expected. Switches are already built for rupturing up to 2,000,000 k.v.a., and there appears practically no limit to what can be done in this direction. On air-break gear wear must be reduced to a minimum, and improvements should aim at quicker break and effective extinction of the arc. In oil-break switchgear the problem is to provide for explosions liable to occur in breaking heavy currents and yet to keep the oil chamber sealed. Increased cost of building structures leads to a tendency towards compactness in indoor switchgear. Outdoor weatherproof plant and switchgear are also being developed. The attitude of the Home Office towards the fuller use of such apparatus for high-tension work will be awaited with interest.

In view of the increasing demand for bulk supply, power metering has also received attention. Large supply authorities realise the advisability of employing a competent meter engineer for three-phase power measurement. Correct metering is important, both from the revenue standpoint and as assuring satisfied consumers. As a good power factor is commonly stipulated in agreements, some form of check, such as a sine meter, in conjunction with a watt-hour meter is desirable. Progress has been made in the high-frequency synchronised relay, which might be applied to the case of customers who are supplied with off-peak or two-rate tariffs.

High-tension Rotary Converters.

As regards converting plant, the most recent development on rotary converters has been the adoption of higher speeds. Improved design of field and armature windings, so as to eliminate "hot spots," better damping windings to secure stability and absence of hunting, and devices to secure better commutation, may also be mentioned. In future a demand for 1,500-volt rotaries for traction work appears probable. In America and abroad 1,000 kw. rectifiers are said to have been used successfully, but more experience on this point is needed. In the near future very big transformer units are probable for super-supply.

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* Abstract of an address delivered to the Western Centre of the Institution of Electrical Engineers, November 8th.

Reviews.

Electric Welding: Its Theory, Practice, Application and Economics. By H. S. Marquand. (London: Benn Brothers, Ltd.) Pp. 204. 12s. 6d. net.

This publication comes very opportunely owing to the great interest which is now being taken in electric welding and particularly in arc welding.

Electric arc welding is a new industry and one which is very rapidly growing, and it is surprising that until now no important work dealing with the art has been published. Chap. 2, referring to "The properties of metals considered from the welding point of view," is particularly good and should be closely studied as it contains information of the greatest value to those seeking to improve the quality of their work. Chap. 4 is a comprehensive survey of the progress of resistance welding with a very interesting reference to electro percussive welding.

It is difficult to agree with the author when he states that the rating of a petrol engine for a single arc unit should not be less than 20 H.P. By modern methods it is possible to get the same amount of current at the arc by the use of a 10 H.P. engine with the generator giving the voltage required across the arc. Resistances in the main circuit of a single unit direct-current arc plant are now obsolete. The reference on page 28 to *phosphorous* or aluminium to be added to *iron* or brass is a slip on the author's part, but possibly the reference on page 58 to 5 per cent. carbon steel is a clerical error. From the reference to welding by alternating current on pages 82 to 86, it is evident that the author has gained most of his experience with direct current, and has not followed the improvements which have been made in connection with alternating current supply. There is no difficulty now in obtaining transformers to give single phase current from a two or three phase supply only slightly out of balance, and if a neutral wire is available the phases can be balanced.

It is always a very dangerous thing to be too sure of one's opinion, especially in connection with a new art. On page 187 "the author ventures to state emphatically that no external covering of the electrode . . . can in any way influence the chemical or physical state of the weld apart from protecting the metals in fusion from the surrounding atmospheric gases," and then goes on to say "the constituents intended to alloy with the deposited metal are on the wrong side of the arc." The author's opinion here is completely wrong and he needs to look further into this matter.

Electrodes have been manufactured for some considerable time past in which the materials incorporated in the coating do influence the weld metal most materially and, as a matter of fact, any desired alloy may be made from materials incorporated in the coating. The difficulty in manufacturing electrodes is to prevent the materials of the coating from influencing the chemical or physical state of the weld metal in the case of the liquid flux.

Apart from these few blemishes, Mr. Marquand has done his work well. E. H. Jones.

Flow and Measurement of Air and Gases. By A. B. Eason, M.A. (London: Charles Griffin & Company.) Pp. xii.+252. 25s.

The solution of a new engineering problem is often facilitated if reference can be made to the results of experimental work in problems which are similar to, or have some bearing upon, the particular problem under consideration, but too often the engineer is either ignorant of the fact that such experimental work has been performed or else he is unable to obtain the results of such work without a tedious search in the publications of the scientific societies and institutions.

The publication of this book should do much to relieve from this trouble the engineer who is concerned with problems relating to the flow of gases, for the author has collected together in a convenient form most of the results of experiments which have been done in this subject.

In the first chapter the author gives a concise statement of the purpose of the book and he schedules the sources of information which he has consulted. Such an introduction is a welcome change from the method adopted in so many books in which the opening chapters are devoted to elementary parts of the subject which are quite well known to the reader and a knowledge of which might well be taken for granted. The book contains numerous graphs, many of which are plotted on logarithmic paper, a method which is most suitable for the quantities under consideration and one which, as the author rightly maintains in the preface, deserves to be much better known and more frequently used in this country.

It is, perhaps, in the chapter dealing with the coefficient of friction in pipes that the reader will most appreciate the collection of the large number of experimental formulæ recommended by various authorities. These formulæ have been reduced to standard forms so that the constants are comparable, and as the conditions obtaining in the experiments from which the formulæ are deduced are generally given, this chapter should prove most useful in the solution of problems relating to the design of pipe line for the conveyance of gases.

The author has dealt carefully with questions arising in connection with pneumatic tubes, and the various losses incurred in such installations are fully discussed. The factors influencing the time of transit of carriers for any particular tube are also considered in detail.

In the chapters devoted to the estimation of quantities of gas, prominence is given to the orifice and Pitot tube methods of measurement. Of all methods these two are probably the most trustworthy if the quantity of gas to be measured is at all large, and even if the flow is small they are more accurate than the majority of displacement meters. The author gives numerous references to the experimental work which has been done in the determination of the coefficients of such meters, and such references are by no means the least valuable part of this portion of the book.

Although much of the work is mathematical, yet no great knowledge of mathematics is required in order to be able to follow the text.

The author has every reason to assume that the book will be of value to "those who want to know upon what foundations graphs and formulæ are based."

Correspondence.

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CRISIS IN THE ELECTRIC SUPPLY INDUSTRY.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: All electricity supply undertakings have received a letter from the Electrical Power Engineers' Association, dated November 12, 1920, stating that unless the conditions of employment and schedule of salaries agreed to and issued by the National Joint Board of Employers and Members of Staffs (Electricity Supply Industry) are adopted in their entirety by all undertakings by November 27, 1920, they will withdraw the services of the whole membership in the electricity undertakings covered by the schedule on November 30, 1920.

At a meeting of the National Joint Board held at the Ministry of Labour on Saturday morning last the position was fully discussed, and at the special request of the employers' side the Electrical Power Engineers' Association agreed to alter the dates given in their notice to December 11 and 14 respectively. The object of this postponement is to enable the employers' representatives to communicate with every electric supply undertaking, urging them to give effect to the agreed conditions and schedule.

In view of the serious crisis which has arisen in the industry, the employers' representatives on the National Joint Board have decided to make a clear statement as to how the present position has come about. As a result of an arbitration on a claim made by the Electrical Power Engineers' Association on behalf of their members, an award was given on February 27, 1919, conceding a bonus of 20 per cent. plus £90. This award was only operative for a limited time, and was coupled with a recommendation that machinery should be set up to agree to salaries and conditions of service. For this purpose the National Joint Board of Employers and Members of Staffs (Electricity Supply Industry) was set up on December 12, 1919, with the approval of the Ministry of Labour to deal with all matters arising between the employers (municipal and company) and the staffs of electricity supply undertakings. The Board consisted of representatives of all the employers' associations and of representatives of the staff. This Board, after prolonged negotiations, unanimously approved conditions of employment and a schedule of salaries for the technical engineers.

The position to-day is that many undertakings have failed to give effect to this agreement, and in consequence the Electrical Power Engineers' Association have decided to take extreme measures. In face of this grave crisis the employers' side of the National Joint Board think the public ought to be informed of the critical state of affairs, and they are urging all undertakings to avert the possibility of a national stoppage with all its consequences by adopting the schedule which has been agreed by representatives of every section of the industry.—I am, &c.,

W. Walker.

Chairman National Joint Board of Employers and Members of Staffs (Electricity Supply Industry).

London, Nov. 15.

In view of the extreme importance of the subject, we publish below a copy of the letter referred to above that has been sent by the Electrical Power Engineers' Association to all electricity undertakings in the United Kingdom with a capacity of 1,000 kw. and over:—

Conditions of Employment and Schedule of Salaries for Technical Staffs in Electricity Undertakings.

Sir: I am directed by my National Executive Council to refer to the above matter and to point out that, as a result of the most unsatisfactory treatment which the members of the technical staffs have received at the hands of so many electricity undertakings, a serious situation has arisen which may have very disastrous consequences to the industry.

For the information of your Council (or Company), I desire briefly to explain the circumstances which have led up to the present crisis On February 18th, 1919, an arbitration was held in London as a result of a claim made by the E.P.E.A. upon electricity undertakings throughout the kingdom for a war bonus for the technical staffs. The award, known as the 9281 Award, conceding a bonus of 20 per cent. plus £90, was given on February 27th by Mr. W. H. Stoker, K.C., who acted as arbitrator. Embodied in the terms of the award was a recommendation that the bonus should be operative until a certain date, which was to be mutually agreed upon, and that in the meantime both parties were to meet and proceed to settle basic rates of remuneration for the various grades. In order to facilitate these negotiations, and in conformity with the advice given by the Ministry of Labour, it was decided to form a Whitley Council for the staffs in the electricity supply industry This Council came into being on December 12, 1919, with the title of the National Joint Board of Employers and Members of Staffs (Electricity Supply Industry), and was formally approved by the Ministry of Labour as being the competent body to deal with all questions affecting the members of the technical staffs in the electricity supply industry. It represents on the employers' side, through their respective associations—such as the I.M.E.A.—all the various undertakings, both municipal and company—and on the employees' side the members of the staffs through their respective associations—such as the E.P.E.A. Immediately after its formation the Board appointed a committee to negotiate conditions of employment and schedule of salaries for the technical staffs. The negotiations were completed, and a Schedule of Salaries approved in May, 1920, by the National Joint Board. This Schedule was issued by the National Joint Board as an agreed claim on all statutory electricity undertakings of over 1,000-kw. capacity on May 21, 1920, with the recommendation that it should put into operation from June 1st. Several official communications on the matter have also been sent since that date to all the undertakings, both from the National Joint Board and from the constituent associations represented on that Board; further, the constituent associations have on several occasions urged their members to accept the findings of the Board.

It is now nearly six months since the Schedule was submitted to the undertakings, and a claim made for its adoption, but, up to the present, only a small proportion of such undertakings have adopted the Conditions of Employment and Schedule of Salaries. The members of this Association are extremely disappointed with the treatment meted out to them, and the extent of their dissatisfaction is evidenced by the fact that 84 per cent. of the total membership of the Association has, by a ballot vote, empowered the N.E.C. to take whatever action they consider necessary to enforce the adoption of the Schedule. The N.E.C. have considered the matter in all its aspects, and I am directed to inform you of their decision that if the Conditions of Employment and Schedule of Salaries are not adopted in their entirety by all undertakings concerned by November 27, 1920, they will be compelled to withdraw the services of the whole membership in the electricity undertakings covered by the Schedule, on November 30, 1920.

My Council desire me to emphasise the extreme gravity of the situation which will be created by the withdrawal of the services of the technical staffs, as it is bound to cause an interruption of the supply of electricity, and they would urge that in order to obviate such a crisis occurring, all undertakings will adopt the agreed recommendation of the National Joint Board, by November 27th.—I am, &c.,

W. Arthur Jones, Gen. Secretary,
Electrical Power Engineers' Association.
London, November 12th.

[As will be gathered from Mr. Walker's letter, the dates given by Mr. Jones have as the result of negotiations been altered from November 27th and 30th to December 11th and 14th respectively.—Ed. *E.*]

SOME LARGE AMERICAN INSTALLATIONS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Our attention has been directed to an editorial which appeared in the September 3rd issue of The Electrician, entitled "Some Large American Installations."

In speaking of electrical propulsion machinery the statement is made that there are three hundred and twelve (312) ships either built or building in this country, equipped with electrical propulsion machinery by one firm, and that the port of New York is visited every twenty-four hours by at least one ship so fitted.

To the best of our knowledge the only electrically-driven sea-going vessels at present in service built in this country are the U.S. Navy Collier, "Jupiter," with electric machinery by the General Electric Company, Schenectady, N.Y., which was the first application of electric drive to a vessel of any size, the battleship, "New Mexico," the first electric capital ship also equipped by the General Electric Company; the battleship "Tennessee," one trawler, and one private yacht. In addition to the capital ships mentioned as building in your article, the General Electric Company has contracts for the electric propulsion machinery for five battleships and four battle cruisers for the U.S. Navy; the latter having a total horse-power of 180,000 each. This Company also has on hand the electrical equipment for four coastguard cutters for the U.S. Government, twelve equipments for cargo vessels for the United States Shipping Board, and one for an express cargo and passenger vessel. The first of the cargo boat equipments has been installed, and the trials of the vessel have just been completed with very great success. The cargo boat equipments are of 3,000 h.p., and are installed in vessels of about 12,000 tons dead-weight. These are the first applications to be made in this country of electric propulsion machinery to ocean-going cargo vessels.

In view of the attention being given to electric drive at the present time, we feel that the important statement contained in your article should be corrected.—I am, &c.,

Schenectady, N.Y., Oct. 30th. J. Livingston Booth
(Marine Engineering Dept.).

NOMENCLATURE.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In a recent issue you described the Blériot-Scott starting and lighting system for motor cars. Those who read this article will doubtless remember that a single machine is employed, which functions automatically as a motor, or a dynamo as circumstances demand. This machine was called a "motor-dynamo" and it is in this connection that we should appreciate the assistance of readers of your paper. The fact is that no proper term is in regular use which describes a machine of the type referred to. The word "dynamotor" is employed in the U.S.A. and also in this country, but is one, we think, which would not be recognised by the majority of electrical engineers. In our opinion "motor-dynamo" is preferable, but is by no means ideal. We hope that some satisfactory term will be suggested which may then become standardised and recognised by all.

There is a great tendency towards the use of inaccurate terms and the invention of hybrid words, especially by the semi-technical press, and, as the matter under discussion belongs entirely to the field of electrical engineering, we feel it is one which should be submitted to electrical engineers for settlement.—We are, &c.,

Blériot Limited.
London, Nov. 9. C. H. Stephenson, Technical Manager.

[We shall be glad to have our readers' opinions on this question.—Ed. *E.*]

ELECTRO-DEPOSITED IRON.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: With reference to the article that appeared in your issue of November 5th, entitled "Electro-Deposited Iron—its Value for Engineering Purposes," Mr. Hughes omits to mention that the first practical plant for the production of electrolytic iron tubes originated in this country, experiments being carried out by the writer at Blackwall in 1898 at the works of the Thames Iron Works and Shipbuilding Co., Ltd., which resulted in a licence being granted to Mr. Boucher for Switzerland and France and works being erected at Grenoble for the manufacture of electrolytic iron tubes on a commercial scale which are the first works of the kind. The process has been very successful and works are now to be erected in England.—I am, &c.,

Sunbury-on-Thames, Nov. 9. Sherard Cowper-Coles.

INSTITUTION OF ELECTRICAL ENGINEERS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I can only hope your readers did not so completely misunderstand my letter as you did. The third paragraph surely made it clear that I know quite well what is meant by voting by proxy.

The whole point is, that if I am against the Council's proposals I must seek out someone attending the meetings who is willing to accept my proxy—by no means an easy task for some of us. If, on the other hand, I am indifferent or in favour of the proposals, I have only to write a few words on a form and by enclosing this in a ready stamped envelope my vote automatically goes to the Council.

If, as you state, this method of voting was adopted to give the many absent voters a chance, why could not the one word "Yes" or "No" be recorded, and sent to the Council? It is difficult to believe that you are unaware that proxy voting, where the "powers that be" only accept votes in their favour, often reduces shareholders' meetings to a farce. The chairman's proxies swamp the voting. It is well known that to organise an effective opposition against votes canvassed in this way requires circularising all the members, and who is to arrange and pay for this?

I hope some member intending to be present on December 2nd will indicate in your columns that he is willing to receive proxies against the proposals, although, of course, since the Council has canvassed *all* at the expense of *all*, they or the Secretary should be willing to take proxies from *all* whether backing them or not.—I am, &c.,

Birmingham, Nov, 15. 1920. ROBERT A. SHELDON.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: It is quite clear that the proposal contained in the circular issued by the Institution on the 4th inst. should, for reasons it is not desirable now to discuss, be opposed.

It is equally clear that the only opportunity afforded by the Council for those who cannot attend the meeting to oppose the recommendations, is to send their proxy paper to some member who can attend the meeting and is likewise opposed to the proposals.

As I propose to attend the meeting I shall be agreeable to receive the proxy papers of those members who would desire me, on their behalf, to use their vote in opposition to the Council's proposals, and at the same time I shall be glad to have any comments from such members on the matter.—I am, &c.,

[FREDK. W. PURSE.

Stratford, E., November 13, 1920.

[We commend Mr. Sheldon to Mr. Purse's tender mercies, and shall be glad to publish opinions by members for and against the Council's proposals in order that the matter may be ventilated in advance.—ED. *E.*]

[We regret that owing to extreme pressure on our space we have had to hold over some correspondence.—ED. *E.*]

The Glasgow Engineering Exhibition.

The Shipbuilding, Engineering and Electrical Exhibition, promoted by the Glasgow Corporation, was officially opened at Kelvin Hall, Glasgow, on November 8th, by Sir Alex. Gracie, K.B.E., Dean of Guild. The Exhibition is the first of its kind held in Glasgow, and the largest of the kind held in Scotland. There are altogether 317 stands representing about 300 firms, and a very comprehensive range of goods is exhibited. Not only is the quantity of stands large, but the quality of the exhibits is high and great credit is specially due to the many firms who were enterprising enough to install large units of machinery. Among the units so exhibited may be mentioned a 43-ton locomotive frame, fitted with cylinders and running gear, a large marine Diesel engine, and rotary converters with outputs of 500 kw. and 1,500 kw.

It is, however, a matter for regret that there is not a more representative display of electrical insulating materials, as in this sphere the electrical industry is particularly weak. It would appear also that more attention might have been given to the display of apparatus for electrical engineering research, by, for example, the exhibition of instruments for high tension voltage measurement.

ELECTRICAL EXHIBITS IN DETAIL.

Messrs. BRUCE, PEEBLES & Co., Edinburgh, are exhibiting a 500 kw. 50 cycle Peebles-la-Cour motor-converter, one of six sets ordered by the Mersey Docks and Harbour Board. They are also exhibiting a 1,500 kw. 25 cycle rotary converter, one of 12 ordered by the Glasgow Corporation. This firm has recently designed a special line of A.C. and D.C. motors for use in iron and steel works and similar concerns, and as an example of what they can do along these lines they exhibit a steel works motor of the slip ring type with an output of 40 B.H.P. Of ordinary standard industrial electric motors, both of the A.C. and D.C. types, there is a good representation on this stand, and there are also samples of high tension windings, insulation, &c.

Messrs. SIMPLEX CONDUITS, LTD., Birmingham, show examples of their well-known Conduit system, complete with the latest designs of accessories for use in conjunction therewith. Samples are also shown of their latest type of ironclad distribution boards, designed to comply with the Home Office Regulations. A display of heating and cooking apparatus and electric irons is another special feature, as is a variety of examples of ships' signs which give quite a nautical air to the place.

The most interesting exhibit on the stand of THE IGRANIC ELECTRIC Co., LTD., 50, Wellington Street, Glasgow, is a contactor panel for use with an ore unloading crane. This panel will control a 70 H.P. motor crane. On the hoisting side the acceleration is under the control of current relays, and automatic deceleration is also provided on the lowering side, so that it is impossible to cause any sparking or flashing over of the brushes, no matter how the master controller is operated. A load discriminating feature is provided on the panel, so that the speed of the motor is governed by local conditions. In a crane of this type it is necessary for the grab to be brought down at a high speed, so as to dig into the ore, and it is partly for this reason that higher speeds than would be normally obtained are necessary. The crane even when working at its highest speed can at any time be brought to rest as quickly as desired, and even should power fail when handling a load, the latter is not brought violently on to the brake, but is still under absolute control, and can be lowered gradually on to the brake, or indeed can be lowered to the ground without the operator knowing of the failure.

This firm also shows a number of panels for steel work service for use on screw downs, live rolls and racks. These panels are all of the butt contactor type, and where necessary the reversal is by plugging. A magnet operated brake is also on exhibition. This is applied by means of a spring in the centre of the coil, which tends to force the armature and magnet apart. The force acts directly in line with the centre of the brakes. The magnet works on a small air gap and is quiet in operation.

A NEW THREE-PHASE MOTOR.

Messrs. WATT MOTORS, LTD., of London, are exhibiting a range of their Watt motors, which combine the good points of both a slip ring and squirrel cage motor with additional advantages. For instance, the motor starts with full load starting torque, which is to say the best of it unused, while the starting current with full load starting torque does not exceed 50 per cent. of the full load current. No starting devices are required, and control is by star-delta switch on the stator frame.

NEW TRUCK TYPE SWITCHGEAR.

Messrs. FERGUSON, PAILIN, LTD., Manchester, exhibit three types of sub-station switchboards: The truck type, the interlock cubicle type, and the non-interlock cubicle type. The first named type has a number of interesting features. The truck cannot be withdrawn until the oil switch is off, and cannot be replaced with the oil switch on. When the truck is withdrawn, shutters automatically close over the holes through which the plugs have passed, so that no live part of the gear is exposed. Contact is made by a circular plug, and the plugs are self-aligning. The truck is provided with machined wheels running on a track, so that the latter does not easily get out of alignment. Roller bearings are provided for the wheels so that the truck can be wheeled with ease. The cubicle, which is self contained, can be fixed against the wall, and a switchboard is made up by combined individual units, similar to those we have just described. The interlock type and cubicle has one hand wheel only which operates both the isolating switches and oil switch, in the correct sequence. The interlock is very simple, and there is nothing likely to get out of order.

The non-interlock cubicle is generally similar to that just described, excepting that no interlock features are provided. The oil switch is operated by a lever instead of a handwheel, and the trip coil mechanism is supported on an auxiliary plate which enables the door to be opened without disturbing the mechanism.

Messrs. Ferguson, Pailin also exhibit a variety of oil switches, having breaking capacities of 50,000, 100,000, 250,000, and 500,000 k.v.a., also a medium pressure oil switch of 4,000 amperes capacity.

New Welding Sets.

Messrs. Alloy Welding Processes, Ltd., London, show in actual use a special single unit motor-generator welding set, the generator of which has been specially designed for welding, and has efficiency characteristics which make it one of the smallest and most economical welding sets on the market. The motor has a capacity of only 7·5 h.p. The plant shown is designed for direct-current supply, and is specially suitable for tramway and light railways use where a direct-current supply is readily available. Mounted on a suitable truck and connected to a trolley wire or third rail, the whole plant is very portable, and owing to its light weight can be easily removed from place to place.

There is also shown a portable welding plant for use on alternating-current supplies, consisting of a static transformer, special resistance coil and necessary switchgear. Demonstrations are given showing that with A.W.P. Electrodes highly efficient welding can be done with either alternating-current or direct-current plant. Samples of electrodes, welds, and welded articles are shown, together with the actual test pieces submitted to Lloyd's Register of Shipping.

Lifting Magnet Control Gear.

Messrs. Marryat & Place, of London, are exhibiting a standard B type lifting magnet, and a set of their latest contactor pattern control gear for controlling large lifting magnets. This is shown under working conditions in conjunction with a new automatic cable coiling drum, which is being extensively adopted in place of the more usual spring drum. Scale models of patent plate, billet and circular type magnets are also shown. The welding machine department of this firm are exhibiting a standard spot welding machine ready for immediate demonstration. This machine will weld smallest gauge mild steel up to ⅜ in. added thickness. A new roller spot electrode is shown in use in conjunction with the machine.

Messrs. Waygood-Otis, Ltd., of London, exhibit a model of an electric passenger lift with full automatic push-button control, and fitted with interlocking gear designed to prevent the lift being started unless the gates are closed, and to prevent the gates being opened unless the car is opposite. Other models of lifts are shown, as well as an electrical controller and samples of electrical and mechanical interlocking devices.

Messrs. Electromotors, Ltd., of Openshaw, are exhibiting a semi-enclosed motor with an output of 44 h.p. when running at 670 revs. per min. It has Admiralty-pattern bearings, a strong shaft ground all over, adjustable box brush gear, and coils impregnated under vacuum and pressure. A cowl ventilated motor, with a capacity of 5 h.p. when running at 1,150 revs. per min. is also shown. This machine is hose and spray proof, and is intended for semi-protected shipboard positions, while it is also made in water-tight pattern for deck positions. A small steam dynamo with a capacity of 2·75 kw., and intended for ship lighting or wireless work is also on view.

Messrs. Campbell & Isherwood, Ltd., are showing an electric hoist suitable for ship and other purposes. This is made in three sizes with ranges between 1½ and 5 cwt. It is particularly suitable for use as an ash or baggage hoist, and as appliances of this kind are liable to be put into the hands of unskilled workmen, a simple construction has been adopted. All the working parts are enclosed in a cast-iron case, the winding drum and the operating handle being the only exposed moving parts. No clutches are employed, and lifting is carried out by the movement of a jockey pulley, which tightens the endless belt passing over the motor and hoisting pulley. This movement is controlled by a handle, which must be held over in order to keep the jockey pulley in action. When the handle is free the belt is slack, and no drive takes place. The electric motor runs continuously. On this stand are also to be found a number of steam-driven ship lighting sets, switchboards, portable electric drills and electromagnetic drilling plants.

The Harland Engineering Company are showing an example of their patent speed interlock for use in connection with paper-making machines, driven by individual electric motor. It will be remembered that this interesting equipment was fully described in The Electrician for March 26, 1920.

Heating and Cooking Notes.

Switch Control for Electric Fires.

Now that a so-called standard specification for electric cookers has been published, the time seems opportune for a discussion on the methods of switch control for electric fires. At first electric radiators rarely exceeded 1 kw. in capacity, but it has now been realised that for electric heating to be a success larger units than this must be employed. Consequently 2 and 3 kw. fires are in popular demand. On low-voltage circuits the currents involved on breaking circuit of such apparatus often give trouble, and if the fires are not fitted with liberally designed switches there have on occasion been mishaps due to overheated switches caused by the heat given out by the fire and the resistance offered at switch contacts. Modern practice seems to be tending toward the use of rotary snap switches for electric fires, and since these cannot be operated with the foot as a tumbler switch can (a pernicious practice), the operation of the switch involves stooping. A rotary switch mounted at a convenient height on the wall, and permanently connected by wiring, not flex, to the fire, is an added convenience in that it overcomes this necessity, and obviates the need for wall plugs with their attendant heating troubles and liability to be pulled out before the current is switched off. After all, many claims have been made for the portability of electric fires, but in practice the householder does not often seem to take advantage of it, and it is a bother, any way, to move a fire about.

On the other hand, with permanent-wiring switches mounted on the wall, and using a 4-point switch, it can be arranged that on the first point the circuit is made one element is put in circuit, at the second point two more elements are put on, and at the third point full heat is obtained. This method would overcome switch heating troubles, the fire could be fitted with three terminals fixed at the side, well away from the elements, resulting in simpler connections, and a saving of one switch per fire, together with the present inevitable wall-plug, would be realised. The fire would, of course, be a fixture, and therefore in large rooms it would be necessary to distribute the heat by employing more than one fire, a practice which should be followed more than it is at the present time.

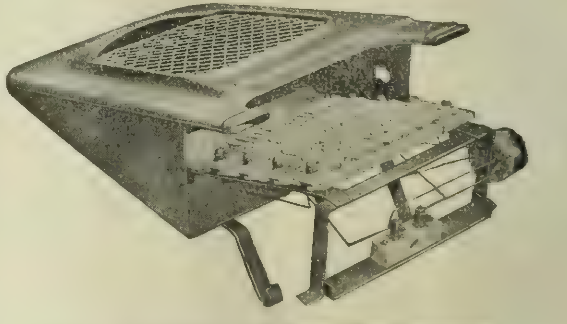


Fig. 1.—Model "A" Magnet Fire, showing Method of Removing Elements.

Undoubtedly there is room for the establishment of a standard practice regarding sizes of fire bars, switch control, methods of connection, &c., without in any way retarding progress. At the moment there is much diversity of practice regarding the I.E.E. rule requiring one firebar to be directly across the terminals. Some makers comply with this requirement, and others do not, with the result that some fires require the installation of wall-plug and switch, whilst others are controlled entirely by switches mounted on the fire and need only a wall-plug. We shall be pleased to receive our readers comments on these remarks, and whilst realising that there may be diversity of opinion, we hope that some uniformity of practice may be ultimately decided upon.

New "Magnet" Fires.

The General Electric Company, Ltd., have introduced a new type of fire designated Model "A," the new features in which are a segmental type of element bar, and the method of mounting the elements and connections on a girder frame which is easily removed from the main carcass of the fire. The elements are made in two loadings, 500 and 750 watts respectively, so that the same carcass can be used for four elements, giving either 2 or 3 kw. consumption as required. Only one switch is provided, this being mounted on the side of the fire frame, the intention being that two elements shall be connected directly across the mains and two controlled by the switch. Three styles of carcass are made, viz., plain, semi or ornamental, and ornamental, the essential difference being the amount of stamped relief work. Each type of frame can be had finished in a variety of styles, *e.g.*, matt black, oxydised, brass, &c. We illustrate this fire in Fig. 1, which shows the method of removing the elements, while Fig. 2 shows the general appearance of the ornamental type of fire.

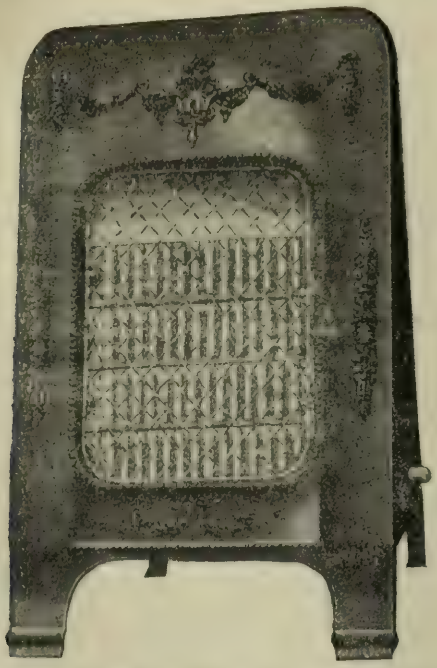


FIG. 2.—MODEL "A" MAGNET FIRE, ORNAMENTAL-TYPE FRAME.

AN ELECTRIC LOG FIRE.

The GENERAL ELECTRIC COMPANY, LTD., have also designed and placed on the market an electric log fire which provides a very pleasing imitation of the actual article, without any of the disadvantages of cleaning away ashes, storing logs, &c. This fire is illustrated in Fig. 3, and essentially consists of an iron cradle stand on which are mounted three imitation logs made of earthenware. The moulding of the logs is such that horizontal channels are run in the bark of the log, and in these channels are mounted the heating coils. The heating coils are loaded to 2,000 watts, and attain a bright radiant heat, producing a very natural effect of a burning log. This design of fire is very serviceable for use in open fire grates and in connection with furnishing schemes of period design where an ordinary electric fire would look incongruous.

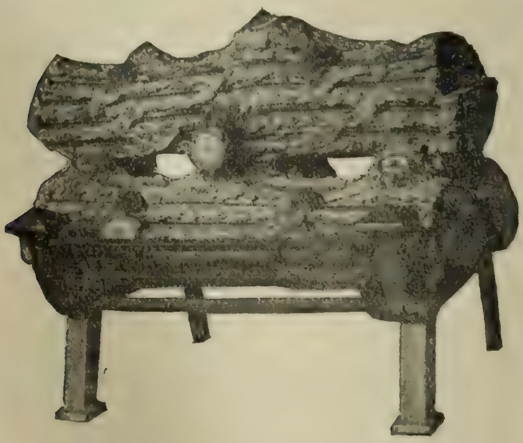


FIG. 3.—THE "IDEAL" ELECTRIC LOG FIRE.

THE "SUNCO" FIRE CAMPAIGN.

We note with pleasure that the SUN ELECTRICAL COMPANY, LTD., are to be numbered amongst those progressive firms who have decided to advertise electrical appliances in the general Press. Activity of this nature not only helps dealers to dispose of "Sunco" fires, but, incidentally, forms valuable propaganda for the industry as a whole. In addition to the general Press advertising scheme to help sales, this firm are offering dealers supplies of printed literature in the form of post cards, booklets, leaflets, showcards, &c. The range of "Sunco" fires comprises four styles, viz., Jacobean, Adams, Hepplewhite, Igene, each made in 1 and 2 kw. sizes respectively, and also a small portable 1 kw. fire. A number of finishes are offered in each style, so that a fire can be chosen from the range which will tone in with any desired scheme of home decoration.

ELECTRICITY FOR HOUSING SCHEME.

Difficulties have apparently arisen in connection with the supply of gas for the housing scheme at WORMHOLT ESTATE, and consequently the Hammersmith Borough Council have been investigating the question of installing electric cooking in addition to electric lighting. The Brentford Gas Company required a substantial payment toward the cost of the installation of gas supply, and also intimated that they were unable to supply cooking stoves on hire. It has therefore been recommended that the Electricity Committee prepare an estimate of the cost of furnishing a supply of electricity for cooking purposes to 50 of the houses on this estate which are nearing completion, and if this estimate compares favourably with the cost of gas, the matter is to be submitted to the London Housing Board for final consideration.

It is to be hoped that it may be possible for the plan to go through, as the installation of electric cooking in connection with a London housing scheme would allow for facts and figures to be collected which are badly needed at the present time. There is little doubt that there are many advantages to be gained by using electricity as much as possible in connection with housing schemes, and it is only the need for proof of initial success which is at present preventing progress.

Insulated Tools for Electric Railways.

The introduction of the third rail on electrified railways has rendered it difficult to beat up the sleepers, to tighten up the fishplate bolts or to drive in loose keys or force them out when using ordinary permanent way tools without causing a short circuit between the conductor rail and the running rail. Many short circuits have thus been caused, some through carelessness, but the great majority of the short circuits has been due to accidental causes. The effect of these short circuits on the men who cause them is often serious and always distressing. In one case the man's clothes were set on fire, in another case of a man using a spanner the flame burnt the back of both his hands and the right side of his face including his ear.

Several methods have been tried to insulate the tools, such as winding insulating tape or vulcanised indiarubber, bitumenised tape, bitumen and such substances round spanners, and the handles of crowbars. But, as

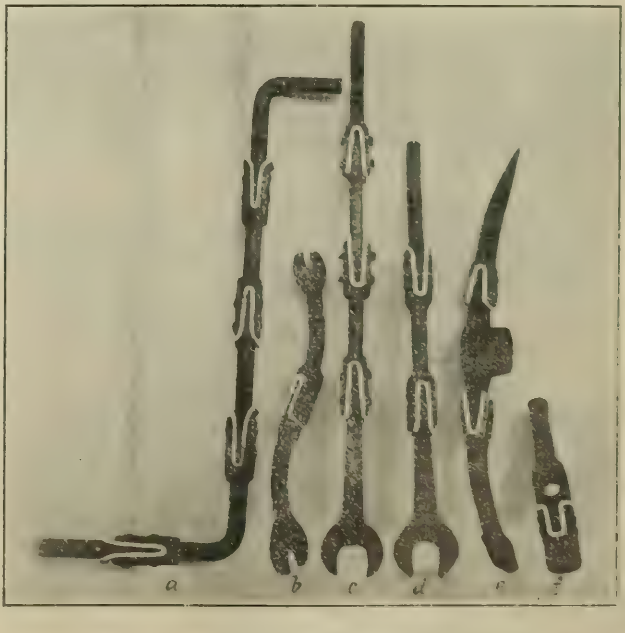


FIG. 1.—INSULATED PERMANENT WAY TOOLS.

is common knowledge, platelayers' work is heavy and continuous, consequently their hands get warm and they grasp the tools tightly, with the result that: (1) The insulating material in the tape or the vulcanised indiarubber or bitumen softens and sticks to the man's hands; in some cases it has torn the skin away when the platelayers have endeavoured to remove their hands; (2) Obviously a double-ended tool or a pick, beater, or a hammer head cannot be insulated in this way; (3) If the tape or composition gets damaged ever so slightly it is likely the tool will prove a source of danger rather than a protection to a man, several accidents have occurred owing to this defect; (4) Indiarubber gloves have been tried but without success for one reason or another; on the electrified area of the London & South Western Railway permanent way insulated tools, by means of which this class of short circuit is altogether prevented, have therefore recently been introduced.

The principle used in attaining this result is that the tool, whatever it may be, is divided into lengths which are shorter than the minimum distance between the iron part of the running rail and the power conductor rail, and the parts are joined together so that they are insulated, one from the other. The result is that the tool can be thrown down on the conductor rail and running rail without causing a short circuit, as no single piece of metal is long or big enough to bridge the space between the conductor and running rail. At the same time the strength of the finished insulated tool is practically equivalent to that of an uninsulated tool. Fig. 1 illustrates a group of insulated tools: (*a*) Rail adjuster; (*b*) double-ended spanner; (*c*) platelayers' long spanner; (*d*) platelayers' ordinary spanner; (*e*) platelayers' beater; (*f*) platelayers' keying hammer. Fig. 2 (*g*) shows an insulated rail carrier; (*h*) an nsulated scraper used for cleaning points, fouling bars, &c.

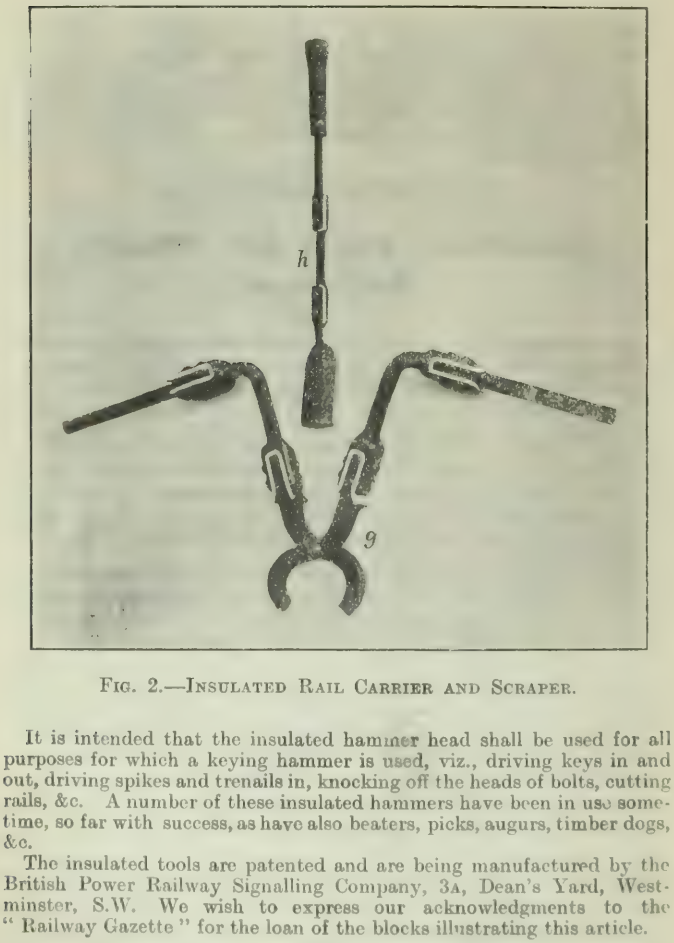


Fig. 2.—Insulated Rail Carrier and Scraper.

It is intended that the insulated hammer head shall be used for all purposes for which a keying hammer is used, viz., driving keys in and out, driving spikes and trenails in, knocking off the heads of bolts, cutting rails, &c. A number of these insulated hammers have been in use sometime, so far with success, as have also beaters, picks, augurs, timber dogs, &c.

The insulated tools are patented and are being manufactured by the British Power Railway Signalling Company, 3a, Dean's Yard, Westminster, S.W. We wish to express our acknowledgments to the "Railway Gazette" for the loan of the blocks illustrating this article.

Books Received.

[Copies of the undermentioned works can be had from The Electrician Office on eceipt of published price, plus postage.]

"'Griffin" Centenary Volume." (London: Charles Griffin & Company.) Pp. xx.+290.

"Electricity and Magnetism, Theoretical and Practical," by Mr. C. E. Ashford. Third edition. (London: Edward Arnold.) Pp. xii.+303. 4d. 6.d.

"A.B.C. of Storage Battery Management," by E. C. McKinnon. (London; Electrical Press.) Pp. 95. 3s. 6d. net.

"A Course of Modern Analysis," by E. T. Whittaker, Sc.D., F.R.S., and G. N. Watson, Sc. D., F.R.S. (Cambridge: University Press.) Pp. 608. 40s. net. 3rd edition.

"Coal in Great Britain," by W. Gibson, D.Sc., F.G.S. (London: Edward Arnold.) Pp. vii.+311. 21s. net.

Labour Movements.

By ARTIFEX.

We give below a summary of the more important movements in the Labour world during the week, together with particulars of the recent demands for higher wages and better conditions made by the workers' associations in engineering and allied industries.

Edinburgh tramwaymen struck work on Monday. The men object to certain dismissals, and refuse to allow standing passengers in the tramcars.

No member of the Electrical Trades Union in the London district is to be allowed to work overtime, unless in emergency, and by permission of the London District Committee.

At York, on the 12th inst., a conference of representatives of the E.T.U. and the Engineering Employers' Federation considered the question of putting into operation the national rates as agreed to by the National Federated Electrical Association. No decision was arrived at, and the question was adjourned to the next monthly meeting.

The five-day tramway strike in the Potteries and Newcastle-under-Lyme has been settled, and the men have resumed work. The dispute arose out of the limited service given during the coal strike. Similar disputes at Burnley and Bury have also been settled.

A settlement of the strike in the Glasgow vehicle building trade has been effected. The men demanded 2s. 5d. per hour, but have agreed to a standard rate of 2s. 4d. per hour for woodworkers and smiths, with 1d. per hour advance above the standard to men engaged on pleasure cars and passenger-carrying vehicles.

The adjourned claim for an increase in wages of 12s. per week for all adult employees in the tramways industry was again considered by the National Joint Industrial Council on Wednesday, but no satisfactory decision was reached.

The men employed in the tramway service of Ashton-under-Lyne are demanding payment for loss of time during the recent coal strike. In the event of an unsatisfactory settlement by the National Industrial Council within seven days, they will cease work.

The Amalgamated Society of Carpenters and Joiners are disputing the notice given by the Shipbuilding Employers' Federation, to reduce ship-yard joiners' wages by 12s. a week, from Dec. 4.

An advance of 2s. per day for all men employed in the shale oil industry has been agreed upon by representatives of the men, and Scottish Oils (Ltd.).

Mr. W. A. Appleton, secretary of the General Federation of Trade Unions, states that the revolutionary politicians within trade unions, have brought industrial Britain to the edge of destruction.

The Plumbers' Association has appointed Mr. F. Hoey as a whole-time national executive officer, necessitating his resignation as secretary of the Liverpool Central Labour Party.

A mandate is demanded by the Executive Committee of the National Federation of Building Trades Operatives to suppress all overtime except on housing schemes, or under special permission of the Federation.

The Shipbuilding Employers' Federation has replied to the men's claim for 6d. an hour increase in wages, with equivalent advance for piecework, by submitting an alternative proposal for payment by results.

By the fusion of the National Warehouse and General Workers Union and the Amalgamated Union of Co-operative Employees, a new organisation has been formed with a membership of 200,000. It will be called the National Union of Distributive and Allied Workers, and will operate from January 1st next.

On the understanding that the Council's proposals would receive confirmation by the Gas Federation, the Porthcawl Council has agreed to level wages to £5 3s. 8d. per week. The men have agreed to accept this settlement and the threatened strike of stokers at the gas works has been averted.

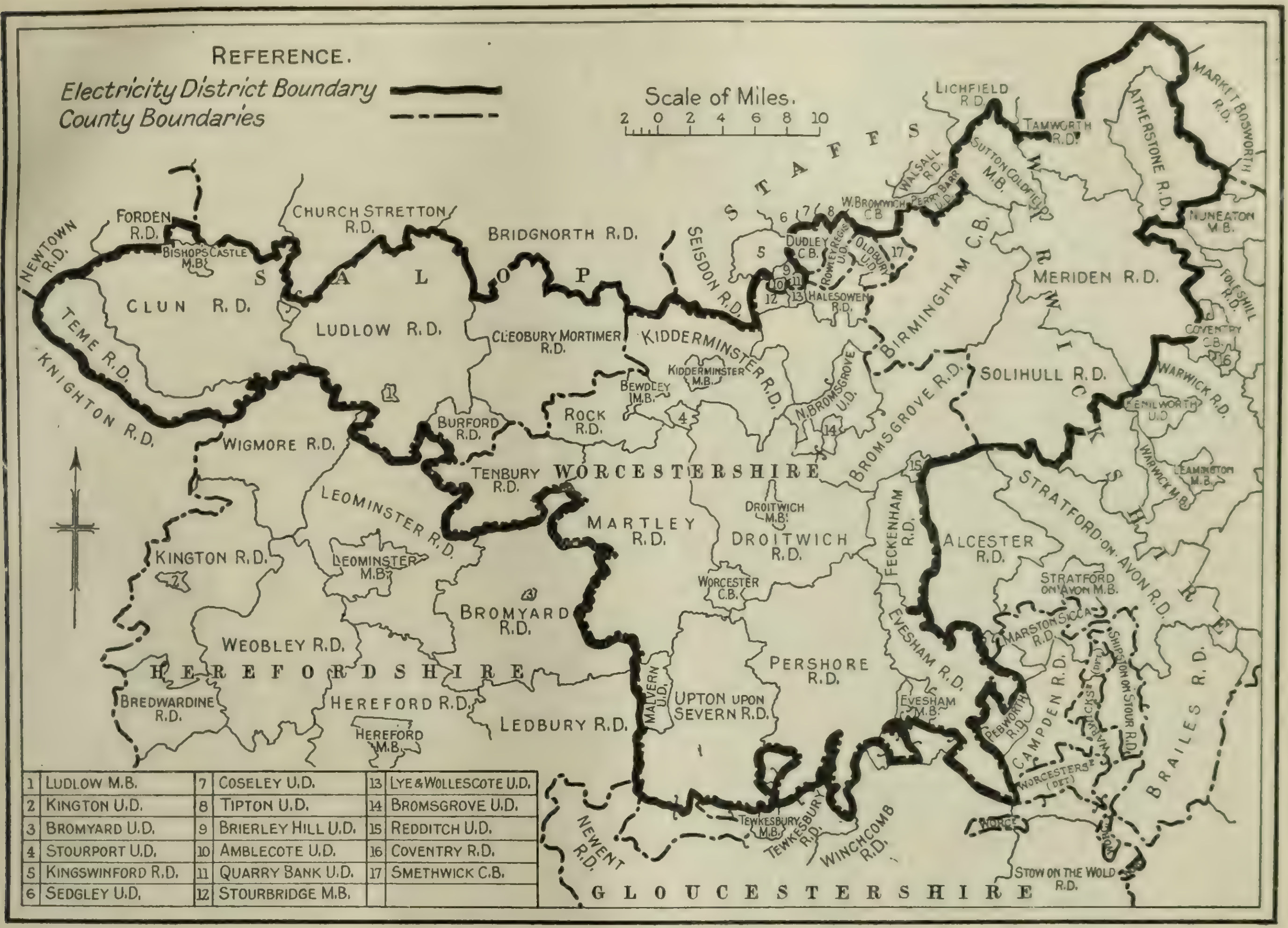
Representatives of the workers employed at South Wales Siemens steel works have asked the employers to reconsider their decision not to place percentages on a level granted to tinplate workers, that would apply to steel as well as tinplate works. A reply was requested within 14 days.

A charming little leaflet advertising Mazda lamps has just been published by the British Thomson-Houston Company, Ltd. It is intended for distribution to householders, and, although small enough to fit the tiniest envelope, it contains a great deal of useful information about lamps and lighting. The leaflet is arranged as an eight-page folder. On the four inside pages, under the captions, "When Guests Arrive," "Entertaining and Artistic," "The Intimate Circle," and "Where the Work is Done," a few generally applicable suggestions are made as to the kind of lighting and size of lamps to use in various parts of the house. These pages are embellished with artistic drawings indicating in each case an appropriate method of illumination. Prices and other particulars of Mazda Vacuum and Gas-filled Lamps are given on two other pages, while a seventh page is devoted (apart from the space reserved for overprinting) to a short resumé of Mazda history. This pithy summation of the revolutionary developments which have emanated from the Mazda research laboratory during the last ten years is extraordinarily impressive. Quantities of this new folder (No. L-165), overprinted with dealer's name and address, may be obtained on application to the Company, 77, Upper Thames-street, E.C.4.

Electricity Supply Districts.

The Electricity Commissioners, having provisionally defined the areas of electricity districts in some of the more important industrial areas in England and Wales, are now turning their attention to Scotland. There is a good deal of waterpower available in the Highlands and other parts of that country; already schemes are being prepared for the utilisation of this power, and it seems to us advisable to proceed at once with the work of defining the Scottish electricity districts so that the mattter may be dealt with on broad general principles, and that no company or local authority shall be able to secure preferential treatment by means of a private Bill.

An official of the Ministry of Transport, who was interviewed by a press representative last week on the work of the Electricity Commissioners, reminded us again that one of the lessons of the war was that electricity supply was a key industry. Without the power from public generating stations it would have been impossible to have made such rapid extensions of factories engaged on war work. Between 1888 and 1914 the annual amount of electricity generated had risen to some 2,000,000,000 units; by 1918 it was 4,628,000,000 units. He instanced the Greater London area, where there are 90 separate electricity authorities with 83 separate generating stations, employing 50 different systems, 10 different frequencies, and 24 different pressures. The Commissioners, who had been asked to map out the country into large electricity districts to enable electricity to be generated economically on a large scale, had completed the provisional delimitation of districts, and they were now working towards a standardisation of systems. The official went on to give an optimistic outline of the developments expected by the Commissioners in industrial areas, and concluded by stating that the extension of electric distribution systems throughout the country, especially in rural areas, would enable very many sources of water power now remote and neglected, to be used.



1	Ludlow M.B.	7	Coseley U.D.	13	Lye & Wollescote U.D.
2	Kington U.D.	8	Tipton U.D.	14	Bromsgrove U.D.
3	Bromyard U.D.	9	Brierley Hill U.D.	15	Redditch U.D.
4	Stourport U.D.	10	Amblecote U.D.	16	Coventry R.D.
5	Kingswinford R.D.	11	Quarry Bank U.D.	17	Smethwick C.B.
6	Sedgley U.D.	12	Stourbridge M.B.		

S.W. Midlands Electricity District.

Parliamentary Intelligence.

LONDON ELECTRIC POWER SCHEME.

In the House of Commons last week Mr. Neal stated, in reply to a question by Mr. Holmes, that the West Kent Electric Power Company had proposed to erect a power station at Erith. The West Kent and the South Metropolitan Electric Light & Power Company were understood to be closely associated. No decision had been given in regard to the application. The West Kent Company had no generating station, but the capacity of the South Metropolitan Company's station on December 31, 1919, was 19,500 kw., and no extensions had been since sanctioned by the Electricity Commissioners; the maximum demand recorded for the year ending December 31, 1919, was 7,900 kw. It was hardly correct to describe either of these companies as a subsidiary company of the County of London Electric Supply Company, but it was understood that a certain amount of their capital was held by the latter company. The Electricity Commissioners were fully alive to the necessity for avoiding taking any action which would prejudice the setting up of a joint electricity authority for Greater London.

In reply to a further question, Mr. Neal stated that an inquiry had been held into the County of London Company's application for consent to erect a power station at Barking. Important questions of law and policy were involved to which the Commissioners must give careful consideration before arriving at a decision.

THE GOVERNMENT ATLANTIC CABLE.

In the House of Commons last week, in reply to a question by Mr. T. Wilson, who inquired when he proposed to commence working the Atlantic cable recently acquired by the Government from the Direct United States Cable Company, the Postmaster-General (Mr. Illingworth) stated that, as the cable had hitherto been worked by the Western Union Company under lease from the Direct Company, he had agreed to continue the lease temporarily for six months, and thereafter subject to five months' notice, pending other arrangements.

Legal Intelligence.

Morrow v. Stepney Borough Council.

In June last Mr. Justice P. O. Lawrence granted an injunction restraining the defendants from discharging dust, grit, or ashes from the chimney stacks of their generating station in Limehouse. The operation of the injunction was, however, for some months to give defendants time to remedy the nuisance, and on Friday the injunction was further suspended until the first Friday in the Easter sittings, with liberty to apply for a further extension of time, if necessary.

Extension of Patents.

On Wednesday last Mr. Justice Sargant granted an application by Mr. H. S. Hatfield and the Reason Mfg. Company for an extension of two patents, Nos. 20500 and 20770 of 1905, the former relating to "Improvements in Mercury Electrolytes for Electrolytic Cells" and the latter to "Improvements in Cathodes." Sir A. Colefax, K.C., who appeared (with Mr. Whitehead) for the applicants, said the ground of the application in the case of each patent was that the applicants had suffered loss and damage by reason of the war interfering with the working of the patent. There was no opposition by the Board of Trade, and his lordship extended the patents for four years from the date of expiry in 1919.

The Gas-Filled Lamp Patent.

On Monday the Court of Appeal (the Master of the Rolls, and Warrington and Younger, L.JJ.) dismissed the appeal of the British Thomson-Houston Company from the decision of Mr. Justice Sargant, dismissing their action against the Corona Lampworks, Ltd., for alleged infringement of their patent (No. 10,918 of 1913) for "improvements in incandescent lamps." The defendants pleaded non-infringement, that the alleged invention was not a proper subject matter for a patent, having regard to the previous common knowledge of the public, and that the complete specification did not sufficiently and particularly describe the nature of the alleged invention. Mr. Justice Sargant decided that, assuming that the patent was valid, there had been an infringement of it, and that there was proper subject matter. However, the plaintiffs claimed in effect the sole right to apply the principle comprised in the discovery, and they had sought to prevent any other competitor from availing himself to any material extent of that principle. In so doing they had failed sufficiently to define the ambit of their claim. The result was that on that reading of the first claim the letters patent were bad, and he dismissed the action, with costs.

From that decision the plaintiffs appealed, and in delivering judgment the Master of the Rolls went into the history of the development of the electric lamp. He said plaintiffs' lamp had proved in practice to have the qualities claimed for it, and there had been a great and increasing sale of lamps made under the patent. The essential discovery was to use with a suitable gas at a suitable pressure a tungsten or other suitable metal filament of large diameter or cross section. The specification pointed out that a "large" or thick filament might be obtained either by increasing the size of a straight filament or by coiling a smaller filament closely so as to produce something approaching a cylinder. It did not point out the necessity for coiling the filament in a small lamp of low candle power, but appellants' counsel admitted that in such a lamp it was so necessary. He agreed with Justice Sargant that the disclosures contained in the earlier patents were not such as to deprive appellants' patent of subject-matter or inventive merit. The new element introduced into the old knowledge was the discovery that by using a filament large in diameter or cross section, or so closely coiled as to have the effect of a thick filament, the advantages of the introduction of gas might be obtained. The real point was whether the patent was bad from insufficiency because there was no sufficient definition of "largeness." The description of the filament in the first claim was "a filament of tungsten . . . of large diameter, or cross section or of concentrated form," the latter expression referring to the filament when closely coiled so as to produce the effect of a large cross-section. The actual degree of "largeness" must vary according to a number of varying circumstances in the manufacture of different lamps, and it seemed that the only way in which the requisite degree of largeness could be ascertained was by making a number of experiments under the special conditions in which a particular lamp was manufactured. Similarly, the only way in which a lamp maker could ascertain whether he was infringing the patent was by making experiments to ascertain whether a gas-filled lamp attained such a degree of efficiency and such a length of life as to fall within the patent. In his opinion that was too vague a definition of "largeness" to describe the nature of the invention, and therefore the appeal must be dismissed, wuth costs.

Lord Justice Warrington delivered judgment to the same effect, and Lord Justice Younger concurred.

The Bishop of London, Chairman of the Council of King's College, will take the chair at the 23rd annual dinner of the Engineering Society of King's College. The guests will be: Mr. Ll. B. Atkinson. M.Inst.C.E., M.I.M.E., A.K.C., President of the Institution of Electrical Engineers, and Mr. F. W. Macaulay, M.Inst.C.E. The dinner will be held at the Connaught Rooms, Gt. Queen-street, on Friday, next at 7.30 p.m. Tickets (13s.) from Mr. A. L. F. Simpson, or Mr. W. R. T. Skinner, Hon. Secs., King's College, Strand, W.C.

Commercial Topics.

The Canadian Market.

Mr. F. W. Field, His Majesty's Trade Commissioner in Toronto, who is at present at the Department of Overseas Trade prepared to interview firms interested in the extension of British trade with the Dominion, states that there was never a better time for United Kingdom manufacturers to establish or strengthen their trade connections in Canada. The present lull in demand is only temporary and likely to be of brief duration. Canadian importers are anxious to place their orders in the United Kingdom, and they can pay cash for most of their requirements. They have been compelled during recent years to purchase large quantities of merchandise in foreign countries, but there is an earnest desire to transfer this trade, as far as possible, to the United Kingdom, and to other parts of the British Empire. Canada is probably a more difficult market than others, but it offers considerable scope for the development of British trade. It is necessary, however, to approach the market in the manner best suited to local conditions, having in view its geographical position, its extended area, and the competition likely to be met.

* * * *

Scandinavian Financial Conditions.

Important reports relating to the financial position in Norway and Denmark have been issued by the British Electrical and Allied Manufacturers' Association, from which we take some extracts. The condition of affairs is undoubtedly difficult, but there are signs of an improvement.

In regard to Norway, it is stated that the prohibition of the importation of articles of luxury has hardly yet had time to take effect, as it only came into operation on Aug. 19. The statistics for the first half of 1920 show that 3,000 motor cars of the value of 21,400 kr. were imported. The export of sawn wood and cellulose has doubled. Cellulose and wood pulp factories consider their opportunities to be most favourable, and the owners of forests are placing speculative prices on wood. The recent financial crisis in Scandinavia has been very serious, but in the opinion of competent judges this was very largely due to panic. During the war, English, French and American money poured into Norway in an unprecedented manner. Everybody seemed to be speculating madly. New shipping and manufacturing concerns sprang up like mushrooms, and the banks seemed to lose their heads as much as the people. Even the Government has been accused of being attacked by speculation fever, by which mines and waterfalls appear to become worth their weight in gold. The State debts mounted from about 300 mill. kr. to one milliard; taxes were imposed, especially on shipping, to such an extent that it is said to have amounted to 80 per cent. Articles of luxury were imported in unlimited quantities, and it was only when freight began to fall that people began to realise that all was not well in the Kingdom of Norway. The bank capitals proved the disastrous position into which Norway was drifting. In January, 1919, the private banks of Norway held in foreign banks about 300 mill. kr., which by January, 1920, had sunk to 156 mill. kr., and in May, 1920, to about 40 mill. kr. It was then realised how necessary it had become to increase production and diminish importation. As an instance, it may be mentioned that in May, 1920, motor cars were imported to a value of about 6 mill. kr., or five times as much as in May, 1919; during the first five months of 1920 motor cars were imported to a value of 17 mill. kr., or seven to eight times as much as during the same period in 1919. In May, machinery was imported to a value of 9 mill. kr. and to a value of 39 mill. kr. during the first five months of 1920. There were also large importations of watches, wine and silk. An examination of the statement that the fall in the value of the kroner was largely due to Norwegians having placed so many orders in the United Kingdom for ship-building, has resulted in 66 firms declaring that they had placed in all 150 contracts for 663,000 tons dead weight in English yards, the contracts for which showed a balance still due to be £15,200,000. This was expected to be met by freight, leaving them to find about £4,200,000 in 1920, £2,840,000 in 1921 and £1,820,000 in 1922, in all about £8,860,000 uncovered. It is, therefore, obvious that the economical crisis is serious. The difficulties were increased by the demand of all workmen for a large increase in wages. They were raised about 20 per cent., with longer holidays, &c. It is felt, though, that much more must be done to stop speculation and to introduce household economy if the catastrophe is to be avoided. The opinion of the leading bankers seem to be that the situation can be saved as all the banks are taking the matter seriously in hand. A table of assets and debts for each of the six months from February to July is appended.

Dealing with Denmark, it is pointed out that the Valuta (rate of exchange) council has ceased to exist. The financial standing of the country has not improved as the foreign rates of exchange are higher than ever before. A new Council is being formed by the Government. Statistics to the end of March, 1920, show that Denmark has an outstanding credit in foreign countries of 803 million kr., and a debt of 839 million kr., to which must be added 398 million kr. for goods purchased on running accounts. Of the different foreign debts, Denmark appears to have far the greatest debt to England (432,000,000 kr.), while Denmark's outstanding credit in England is 161,700,000 kr. After England comes U.S.A., to which country Danish debt is 214,000,000 kr., while its outstanding credit in U.S.A. is 128,500,000 kr. Next comes Sweden, Germany, &c. On the other hand, the country that owes Denmark most is Germany (231,800,000 kr.), followed by England and U.S.A. Tables of credits and outstanding debts are included, and in conclusion it is stated that the economical condition of Denmark is considered seriously to require prompt attention.

Electricity Supply.

Southend Council has decided to wire the new dwellings in Ruskin-avenue.

Clacton Urban Council has received sanction to a loan of £9,670 for new Diesel generating plant.

Eastbourne Corporation have been authorised to borrow £15,114 for electric supply purposes.

Whitehaven Council has applied for loans of £2,500 for a condensing plant, and £4,000 for meters.

Gravesend Council has decided to increase the salary of the electrical engineer, Mr. C. F. McInnes, from £550 to £600 per annum.

Rotherham Corporation has decided to raise a loan of £750,000 for electricity supply, housing and other schemes. The amount required for the electricity undertaking is £200,000.

Bootle Corporation has decided to raise £500,000 by the issue of new 6 per cent. redeemable stock, of which £43,500 is required for electricity supply purposes, and £424,250 for housing.

An inquiry was held at Colne on the 11th inst. into an application of the Council for permission to borrow £2,365 for the purchase of electric vehicles for use in connection with refuse disposal.

Huddersfield Corporation has applied to the Electricity Commissioners for a special order to authorise the supply of electricity within the urban districts of Kirkheaton, Kirkburton, Lepton and Meltham.

The Walsall Corporation electricity department has been authorised by Tamworth Council to extend their high tension cables to give a supply of electricity in the district, including the Whittington barracks.

After long negotiations, the Clyde Valley Electric Power Company has agreed to give a supply of electricity in the Giffnock district. The work of extending the cables will be begun in March, and be done in sections.

The modified electricity supply scheme for Lurgan (Co. Armagh), prepared by Mr. Pleasance, of Belfast, has been approved by the Urban Council, and if the plans are approved the L. G. Board will be asked to sanction a loan.

The Keighley Corporation has applied for authority to borrow £30,000 for the electricity department. Of this sum £9,000 is for excess expenditure, £3,000 for motors to be let on hire, and the balance is for two years' mains and services, &c.

The Urban Council of Marsden recently decided to instruct Mr. J. E. Schofield, of Bradford, to submit a report on the proposal to introduce electricity supply. The Electrical Distribution of Yorkshire has offered to give a supply to the Council, and this will also be reported upon.

The people of Antrim, a town about 14 miles from Belfast, are evidently progressive and wish to be up to date for they have by a 97 per cent. vote approved of an electric lighting scheme. Two and a-half per cent. of the people were in favour of another illuminant, the odd half per cent. being indifferent apparently.

The Electricity Commissioners have authorised Willesden Urban Council to borrow £2,446 for lamp columns and lanterns for lighting the Brentfield and the Metropolitan Railway estates, £4,461 for laying supply mains to the estates, £10,000 for transformers and switchgear, £2,000 for transformer stations, and £5,000 for meters.

Last week the Worcester City Council adopted a recommendation to increase the salary of the electrical engineer (Mr. C. M. Shaw) to £800 per annum as from Sept. 1. The salary of the mains foreman (Mr. Baylis) was also increased by £25. The question of increasing the wages of workmen employed at the elctricity works has been referred to the electricity committee.

Barking Urban Council has had to increase its charges for electric current and as the latest advance made is above the maximum allowed in the Council's Provisional Order, the Clerk has been directed to make application, under the provisions of the Statutory Undertakings (Increase of Charges) Act, 1918, for an alteration in the maximum price allowed to be charged for electricity from 8d. to 1s. per unit.

The accounts of Willesden Council's electricity department for the year ended March 31 show revenue £77,349, compared with £57,215 in previous year, and working and general expenses £51,615 (£44,297), including £34,767 for purchase of electricity in bulk, leaving gross profit £25,734 (£12,918), and, after providing for interest, instalments of loans and special expenditure, the net profit on the year's working was £8,314, compared with a debit balance of £1,607.

The accounts of the Newport (Mon.) Electricity Department for the year ended March 31, show revenue £100,001, compared with £80,083 in previous year. The working expenses were £66,491 (£54,696), leaving a gross profit of £33,510 (£25,387). Interest and sinking fund required £24,699 (£22,318), and net profit was £8,811 (£3,069). Units generated were 9,977,085 (10,409,868), and sold 7,258,847 (7,671,281). Costs per unit sold were 2·198d. (1·71d.), exclusive and 3·01d. (2·41d.) inclusive of capital charges.

At the meeting of Nelson Corporation last week the Chairman of the Electricity Committee (Ald. Cooke) referred to the recent accident to a generator at the electricity works and paid a tribute to the coolness shown by two apprentices named Hunt and Kenyon. The machine went to pieces without warning. As it was collapsing, with metal flying about, Hunt promptly stopped the machinery, while the other apprentice attended to the switches. The Council could not do less than warmly compliment the boys for their pluck, and it was suggested that they should receive financial recognition.

Efforts are being made by Chester and Wrexham Corporations and by some local authorities in North Wales to secure a supply of electricity from the plant at H.M. Factory, Queen's Ferry, for a wide district over North Wales and Chester, and a request has been forwarded to the Secretary of State for War to meet a deputation from a joint committee of the interested authorities. It is contended that the plant at Queen's Ferry, having a capacity of 7,000 H.P., is capable of giving a supply which is more than adequate for the immediate development of the districts. It is suggested to erect transmission lines to Hawarden, Buckley and Wrexham, Holywell, and a third to Chester. The lines would cost £60,000, and the cost of power, after paying interest on the capital, would be 1½d. to 1⅛d. per unit.

Members of the Bradford Textile Society recently visited the municipal electricity works, and were shown over the station by the engineer and manager, Mr. T. Roles. Great developments in the applications of electricity had, he said, taken place in the past few years, especially for heating and cooking, and hundreds of electric fires were in use in the city, while for cooking purposes electricity was being increasingly used. In the textile trade the use of electricity had been growing considerably. Already 100,000 spindles were known to be run by electricity and approximately 4,000 looms. Arrangements had also been made for supplying several new sheds. The demand of the textile trade for current was equal to 8,610 kw. The capital expenditure of the department had reached £1,315,000, of which £659,000 had been repaid. Projected developments would bring the capital expenditure up to £2,000,000. There were now 6,429 consumers, 1,000 having been coupled up during the past year. It was proposed to erect a new boiler house at a cost of £300,000. There would be only four boilers in the boiler house, but, being of the water-tube marine type, their steaming capacity would be equivalent to about 35 ordinary Lancashire boilers. A new 12,000 kw. generator had just been installed, and under the authority of the Electricity Commissioners still another would be provided, and then the capacity would be 50,000 kw., instead of the 5,000 for which the premises were originally designed. Bradford was in the Aire and Calder district as defined by the Electricity Commissioners, extending from Goole on the east to Todmorden on the west, and from Barnsley on the south to Harrogate on the north. The super-station for supplying electricity to that district would be put in hand probably during the course of the next two years, and additional supplies required by Bradford would be taken from that station.

Electric Traction.

In order to relieve the overcrowding on the Cardiff tramways, the Council are recommended to purchase six petrol-electric omnibuses.

Walsall Corporation has increased the fares on the local tramway and motor omnibus services.

The Minister of Transport has confirmed the South Shields Corporation Light Railway Order, 1920, authorising the construction of a light railway in the borough and the rural district of South Shields.

A special meeting of Greenock Corporation was held last week to consider the proposal to acquire the local tramways. Though Provost Mitchell made a long speech in support of the purchase, the previous question was carried, and it is probable that the Corporation will not exercise their right until 1928.

On Tuesday the Highways Committee recommended the London County Council to authorise workmen's tramway return tickets being available for the return journey by alternative routes between the traffic points for which the ticket was issued; and that workmen's transfer tickets should be issued for the same journeys as those for which transfer tickets are issued to ordinary passengers.

As from the 15th inst. the powers and duties of the Secretary for Scotland in relation to RAILWAYS, LIGHT RAILWAYS, TRAMWAYS, CANALS, ROADS, HARBOURS, &c., have been transferred to Ministry of Transport. The exempted powers include: the powers and duties of the Secretary of giving sanction to the borrowing of money by Local Authorities; and the powers and duties relating to the assessment of light railways to local rates.

An interesting scheme is being prepared for the construction of an UNDERGROUND RAILWAY from the Strand to Dulwich and the Crystal Palace. At a luncheon given last week by the exhibitors in the Oil Section of the War Exhibition, Mr. H. J. Buckland, general manager of the Crystal Palace, said that the plans were advanced, and the Bill would, he hoped, receive the Royal assent in May or June next. Eleven millions of money would be required, but seven millions had already been ensured. Once the Crystal Palace was brought within 10 minutes' journey of the Bank, it would be of great use as an exhibition centre.

The financial position of the Liverpool Corporation tramways department is, notwithstanding the increased fares, in a very unsatisfactory position. There is now a deficit of £3,694, compared with a profit of £63,000 at the corresponding period last year, and this without making provision for depreciation or reserve, which would require approximately another £140,000. The new claim for an increase in wages of the workers will increase the estimated deficit.

The tramways department proposes to introduce a new type of tramcar, embodying various improvements. On the windows of the lower deck on each side there are illuminated signs in large letters indicating the desrination of the car, with an equally large plate in front and rear. The platforms have been considerably enlarged, with a single staircase instead of the two in use in many of the present cars. Instead of the wooden guard outside the wheels wire netting has been placed.

Institution Notes.

The first meeting of the Graduate section of the North Coast Institution of Engineers and Shipbuilders which has been held since 1916 took place on Nov. 6. We are glad to learn that the section is in a flourishing condition.

The Institute of Costs and Works Accountants has made arrangements to hold the Institute examination on Dec. 6 and 7, in London, Manchester, Birmingham, Glasgow and Sheffield. Forms of application and further particulars may be obtained from the Secretary, 38 Grosvenor-gardens, Victoria, S.W.1.

At last week's meeting of the Cardiff and South Wales Wireless Society, Mr. W. A. Andrews, B.Sc., gave an interestig lecture and demonstration of the two-valve receiver and direction finder manufactured by the British Thomson-Houston Company, and this was followed by a lecture by Mr. E. A. Rudge, B.Sc., A.I.C., on "Some metals and their electrical properties." Mr. W. G. J. Howe has been elected secretary in place of Mr. G. C. Hughes, who resigned.

The Diesel Engine Users' Association has issued in pamphlet form a summary of the information and recommendations in regard to the life of connecting-rod bolts of Diesel and Semi-Diesel engines, and their treatment. The subject was discussed at several meetings of the Association, and it was thought that the summary of the principal points elicited in the course of the discussions should be useful, not only to members of this Association, but to other engineers interested in the care of reciprocating engines.

Among this year's awards of the President and Council of the Royal Society are the following: A Royal Medal to Prof. G. H. Hardy, F.R.S., for his researches in pure mathematics, particularly in the analytic theory of numbers and allied subjects. The Rumford Medal to Lord Rayleigh, F.R.S., for researches into the properties of gases at high vacua; the Davy Medal to Mr. C. T. Heycock, F.R.S., for his work in physical chemistry and more especially on the composition and constitution of alloys; and the Hughes Medal to Prof. O. W. Richardson, F.R.S., for his work in experimental physics and especially thermionics.

The Cecil medal and prize of £10 awarded each year by the Dorset Natural History and Antiquarian Field Club will in 1921 be given for the best Paper on the "Use of Electricity in Reconstruction after the War and its Practical Generation." The competition is open to anyone between the ages of 17 and 35 on May 1, 1921, who was either born in Dorset or resided in the county for not less than one year between May 1, 1919, and May 1, 1921. The last date on which Papers can be received is March 1, 1921, and further particulars can be obtained from Mr. H. Pouncy, Midland Bank Chambers, Dorchester.

In addition to awards already announced for Papers read at meetings, the Council of the Institution of Civil Engineers have made the following awards for Papers published without discussion in the "Proceedings" of Session 1917-18, the issue of which has been delayed by conditions due to the war: A Telford gold medal to Mr. P. L. Pratley, M.Eng. (Montreal); a Crampton prize to Mr. G. M. Clark, M.A. (Johannesburg); Telford premiums to Mr. J. L. Calvard (Hull), and Mr. S. S. D. Robertson, B.Sc. (Hawthorn, Australia). A Paper by Mr. G. H. Duggan (Montreal) was also found to merit the award of a Telford gold medal, but the author, being a member of the Council of the Institution, is ineligible to receive a medal.

At the annual meeting of the National Union of Scientific Workers on Saturday, Prof. L. Bairstow was elected Preisdent for the ensuing year. In the course of his presidential address, the retiring president (Dr. W. Evans) expressed regret that the scientific and technical faculties of our Universities played only a subordinate part in the scheme prepared by the Department of Scientific and Industrial Research for the promotion of research work. He thought a teaching staff engaged in research work were in a more favourable position to discover and develop new processes and methods than those in the laboratories ofresearch associations, or even Government institutions.

At the last meeting of the Birmingham & District Electric Club, a paper was read by Mr. H. C. Young, A.M I.E.E. (member), upon "Some Aspects of Modern Works Management." The Paper was very exhaustive, and dealt with the effects of physical conditions upon labour efficiency. The lecturer showed many graphic records of the effects of hours of work, fatigue, temperature, ventilation, lighting, &c. Mr. Young laid great stress upon the importance of careful selection of works staffs, foremen and charge hands, and showed by records that the personnel of a works staff had a definite bearing upon labour efficiency and upon that bugbear of all employers, "labour turnover." Emphasis was also laid upon the fact that under the new conditions of industry class distinctions tended to disappear, both the commercial and works staff and the workpeople all came from the same social class.

A joint meeting of the Faraday Society and the Sheffield section of the Institute of Metals will be held to-day at the Mappin Hall of the Department of Applied Science of the University of Sheffield at 3 p.m. and 7.30 p.m., Sir Robert Hadfield, Bart., F.R.S., and Prof. C. H. Desch, D.Sc., presiding. Among the Papers to be read are "Electroplating for the Prevention of Corrosion," by Dr. L. Aitchison; "The Use of Colloids in Electrodeposition of Metals" by Mr. W. E. Hughes; and "The Electrodeposition of Cobalt," by Mr. B. Carr. "Electro Silver Plating and Its Technical Development," by Mr. W. R. Barclay; "The Chemical Composition of Old Silver Plating Solutions, with Observations on their Working Properties," by Mr. G. B. Brook and Mr. W. L. Holmes; "A New Maximum Current Density in Commercial Silver Plating," by Mr. F. Mason; and "The Crystalline Structure of Electrodeposited Silver," by Mr. G. B. Brook.

Imperial and Foreign Notes.

Scottsdale (Tasmania) Council propose to adopt public electric lighting.

Ballarat (Victoria) Council wish the scheme for supplying electrical energy generated from the Morwell brown coal to be extended to Ballarat.

Messrs. Christie & Gardiner have presented a report to Mount Barker (South Australia) Council on the proposal to erect electricity works in the district.

Mittagong (N.S.W.) Council recently received an offer from the N.S.W. Works Dept. to supply current from their Port Kemble power house for public and private lighting.

Mr. F. A. McCarty has reported in favour of the construction of electric tramways in Toowoomba. The cost of construction is estimated at £143,752, with £32,500 for power station for traction only.

Melbourne (Victoria) Council recently urged the Premier (Mr. Lawson) to allow coal from the state colliery at Wonthaggi to be supplied to the city, as the electricity department was only receiving each week sufficient for two days' requirements.

Mr. W. Stone, formerly chief electrical engineer to the Victorian Railway Commission, and Mr. O. W. Brain, chief electrical engineer of the N.S.W. Railways Dept., have been appointed members of the valuation board which will advise in connection with the transfer of the Brisbane Tramways to the State Government.

At the recent meeting of the Nundydroog Company, Ltd., Mr. Edgar Taylor stated that about £170,000 would be required for reconstruction purposes and additional machinery. The mine had a length of nearly 6,000 ft.; three permanent circular shafts would be sunk below the 4,000 ft. level and these must be provided with electric winding engines. Electric hoists and electric pumping plant were also required.

It is proposed to form an association of British engineers in Argentine. Particulars are obtainable from Mr. A. C. Kelly, Ferro Carril, Buenos Ayres—Pacific, Calle Florida, 783, Buenos Ayres.

In connection with the proposal to supply hydro-electric power from Norway to Denmark, via Sweden, it is intended to lay a high tension cable from Gothenburg to Frederikshaven, North Jutland, a distance of over 60 miles.

According to the "Manchester Guardian Commercial," the Norte Railway Company has decided to adopt electric traction on the section from Barcelona to Tarrasa. The work will be put in hand at the beginning of next year and will be terminated in 1923. The electrification of the line as far as Saragossa is under consideration.

A group of industrialists in the Department of Concepcion (Province of San Juan, Argentine) are endeavouring to form a company with a capital of $300,000 m/n. to establish electricity supply works. It is proposed to utilise a waterfall on the La Playa canal for the generation of electrical energy.

According to "Elektrizität," a German engineer named Bauschleicher, has succeeded in manufacturing by a simple process artificial coal from peat; it can be manufactured from peat in a wet state, taken direct from the cutting. The new fuel is called "gasol-coal," has a heating capacity of 7,500 units, burns with a bright flame, and is made for use with wood or other fuel.

The waterfalls of St. Jean, near Stechovice, are now being developed for hydro-electric purposes. A dam, 19 metres high, is being built and this will enclose an area 171 metres long, 11½ metres wide and 19 metres deep. The power thus made available will be used for supplying Prague with electrical energy, and it is intended as a beginning to install four turbines each with a capacity of 5,000 h.p.

The Swedish Railway Department have prepared a scheme for the conversion of the Stockholm-Gothenburg railway to electric traction. According to the Commercial Secretary to H.M. Legation, it is to obtain electric energy at various points along the line from the works at Trollhattan and Motala river. Single-phase current at 100,000 volts will be transmitted to the various points and then transformed. An extension will be made to the works at Motala and also a line erected from Lagmansholm to Trollhattan. Step-down transformer stations, for transforming to 16,000 volts, will be constructed at 16 points along the line. The Telegraph Department have decided to do away with the greater portion of the telephone wires which run alongside the railway lines, and propose to substitute cables.

Obituary.

We regret to record the death, on the 11th inst., at 6, Grosvenor-crescent, S.W., of Beatrice Katherine, wife of Sir John Denison-Pender, G.B.E., K.C.M.G., Chairman and Managing Director of the Eastern and Associated Telegraph Companies.

We also regret to record the death in his 82nd year of Mr. Wilson Hartnell, the well-known electrical engineer of Leeds. Mr. Hartnell, was trained as a mechanical engineer, but, in the early days of electric lighting, he carried out many country house installations. He took out patents for steam engine automatic expansion gear and for electric governors. Mr. Hartnell, who was a member of the Institution of Mechanical Engineers, was one of the oldest members of his profession in the West Riding, and was well known as head of the firm of Wilson Hartnell & Company (Ltd.), manufacturers of electrical plant. Notwithstanding his great age, he maintained an active interest in business matters until his death.

Miscellaneous.

Two electrical cranes are being erected by the Harbour Commissioners on the Albert Quay, BELFAST, and two other electric cranes are to be ordered.

Mr. Illingworth, Postmaster-General, announced last week that up to Sept. 30, 168,000 APPLICATIONS FOR TELEPHONE INSTALLATIONS had been received since the Armistice. Of that total, 126,500 installations had been completed, 7,000 were in course of construction, and 34,500 remained to be dealt with.

The new WHITE STAR-DOMINION LINER "PITTSBURGH," which was launched from Harland & Wolff's North Yard, Belfast, on the 11th inst. is a finely modelled passenger vessel of about 16,600 tons. In addition to the main electric generators, which are turbo driven, there are Diesel-driven sets for operating the watertight doors and wireless, and also the light throughout the vessel. A special feature of the electrical installation is that the steering gear and winches are electrically operated.

It is announced that all officers required for duty with the ROYAL CORPS OF SIGNALS (T.F.) will be commissioned direct into the Corps. Candidates should have had an electrical training. Officers who now hold commissions in the Signal Service, R.E., T.F., or who, holding commissions in other branches of the Territorial Force, have been seconded or attached for duty to the Signal Service, R.E., during the war, will have the option of transferring in their substantive rank to the Royal Corps of Signals, provided vacancies exist.

With the approach of Christmas comes the publication of "WINTER'S PIE" to add to the humours of the festive season. The forthcoming issue of this periodical will contain many new features. The whole of the 32 pages of pictures will be presented in four colours, thereby giving great aim of variety to the publication. The literary matter will be up to its usual high standard, and we have no doubt that the sales will appreciably assist the institution for which Mrs. Hugh Spottiswoode works so hard and so successfully.

At the last meeting of EDINBURGH Corporation great interest was aroused by the visit of Alex. Graham Bell, whose work in connection with the development of the telephone is familiar to our readers. The Lord Provost reminded the Council that Mr. Bell was born in Edinburgh, and received his education at the Royal High School and Edinburgh University. In response to the welcome accorded him, Mr. Bell recalled some of his memories of Edinburgh. He said that after having spent the major portion of his life in the United States, and he had been an American citizen for over 50 years, he had decided to pay a farewell visit to his native city.

Coinciding with the two minutes' silence on the anniversary of Armistice Day, A MEMORIAL WAS UNVEILED to the employees of LAURENCE, SCOTT & COMPANY, LTD., Norwich, who lost their lives in the war. The memorial consisted of a massive clock, with a brass tablet bearing the names of the fallen. Mr. R. Laurence, Chairman of the Company in a brief address, recalled that out of a total of 487 employees who joined the colours 33 lost their lives. No less than 76 ex-service men were now employed by the Company.

On the same day a bronze memorial tablet in honour of the 89 men from the SIEMENS WORKS OF THE ENGLISH ELECTRIC COMPANY at Stafford, who fell in the Great War, was dedicated by the Bishop of Lichfield.

Business Items, &c.

Mr. A. HUGH SEABROOK, M.I.E.E., has started in practice as a consulting engineer at 11, Queen Victoria-street, London, E.C. 4. Mr. Seabrook will specialise in fuel economy in connection with heating and power plant, &c.

The Enterprise Manufacturing Company, Ltd., have removed their Glasgow offices to more convenient premises at 47, Oswald-street. Telephone No.: Central 2,526; telegraphic address: "Unopposed, Glasgow."

Mr. E. L. EASTGATE, A.M.I.E.E., engineer at the Melbourne branch of the British General Electric Co., has been appointed manager of the company's business in New Zealand, in succession to Mr. J. H. Ryder, A.M.I.E.E.

The Department of Overseas Trade has received an application from a firm in Winnipeg to be placed in touch with United Kingdom manufacturers of time switches for operating electrical signs and would like to receive quotations, by cable (if possible), for 30 for 30 amp. 250 volts and 50 for 60 amp. 250 volts. Manufacturers interested may obtain the name and address of the firm from 35, Old Queen-street, S.W. 1.

We are informed by the Ampower Company, Earl-street, Westminster, S.W. 1, that their business has been established and is entirely controlled and worked on co-operative lines by ex-service officers and men. The work undertaken by this Company is the installation and repair of electrical apparatus for domestic purposes and for motor cars and they guarantee prompt and good workmanship at strictly competitive prices.

We understand that Mr. H. J. Read, M.I.E.E., who severed his connection with Messrs. Edmundsons' Electricity Corporation in March last, after a service of over 30 years, has joined forces with Mr. H. J. Butcher, A.M.I.E.E., and Mr. W. J. Bransom, A.M.I.E.E., both of whom were on the staff of Messrs. Edmundsons for 30 and 20 years respectively, and with Mr. D. Dunham, B.Sc., recently in the service of the British Thomson-Houston Company. Under the title of Read & Partners, Ltd., they are specialising in electrical installations for country houses, farms, works, &c. They have now established their permanent address at 53, Victoria-street, Westminster, S.W. 1. Telephone: Victoria 8,084. Mr. Jas. Garnett, who was for over 30 years with Messrs. Edmundsons, has also joined the staff of the new firm.

Tenders Invited.

GRIMSBY Corporation invite tenders by Nov. 29 for sub-station and traction converting plant. Specifications from the Borough Electrical Engineer.

PLYMOUTH Corporation invite tenders for h.t. and e.h.t. switchgear and oil-cooled transformers. Specifications from and tenders to the Borough Electrical Engineer by Nov. 30.

The CHESHIRE LINES COMMITTEE require tenders by Nov. 26 for 12 months' supply of stores, including telegraph materials, carbons, signal wire, &c. Specifications from the Stores Superintendent, Warrington.

HALIFAX Housing Committee invite tenders for wiring 366 houses at Holmfields and Boothtown. Particulars from the Borough Engineer, and tenders to the Town Clerk by Nov. 27.

The SLIGO, LEITRIM and NORTHERN COUNTIES RAILWAY COMPANY require tenders by Dec. 1 for 12 months' supply of telegraph materials, castings, oils, &c. Forms of tender from the Secretary, Enniskillen.

PLYMOUTH Corporation want tenders by Nov. 30 for h.t. and e.h.t. switchgear and oil-cooled transformers. Specifications, &c., from the Borough Electrical Engineer.

DARLINGTON Corporation require tenders by Nov. 22 for wiring 238 houses for electric lighting. Specifications from the Borough Surveyor.

THE GREAT NORTH OF SCOTLAND RAILWAY COMPANY require tenders by Dec. 9 for six (or 12) month's supply of stores, including telegraph material, castings, oils, &c. Forms of tender from the Stores Superintendent, 80, Guild-street, Aberdeen.

The date for the receipt by the Crown Agents for the Colonies, on behalf of the Government of the UGANDA PROTECTORATE for a concession of a portion of the Ripon Falls of the Nile for the generation of electric power has been extended from Dec. 20 to Feb. 19.

LEEDS City Council invite tenders for the supply and erection of three-phase switchgear for their generating station. Specifications from the manager of the Electricity Department, Mr. C. Nelson Hefford. Tenders to the Town Clerk, 26, Gt. George-street, Leeds, by December 13.

The TYNE IMPROVEMENT COMMISSION require tenders by Nov. 25 for three (or six) months' supply of stores, including incandescent lamps, arc lamp carbons, rubber and asbestos goods, castings, &c. Forms and tender from the Manager and Secretary, Bewick-street, Newcastle-on-Tyne.

The Directors of the NORTH-EASTERN RAILWAY invite tenders for six or 12 months' supply of telegraph stores, apparatus, wire and line stores, electric wires and cables, electric lighting, sundry fittings, metals, castings, &c. Forms of tender from the Telegraph Superintendent, York, and tenders to the Secretary, by Nov. 25.

CANTERBURY Corporation invite tenders for extra-high-pressure three-phase and medium-pressure d.c. switchgear, and cable connections to the same. Specifications and forms of tender from Messrs. May & Hawes, 36, Victoria-street, Westminster, S.W. Tenders to the Town Clerk, Mr. Henry Fielding, by 4 p.m. Dec. 6.

Tenders have been invited for the conversion of the first zone of the CHILEAN STATE RAILWAYS (from Valparaiso to Santiago) to electric traction. The offers, which are of two classes, will be opened on March 31, 1921. The first class is from those proposing to furnish the electric power, and the second the rolling-stock and equipment.

The CITY ELECTRIC LIGHT COMPANY, BRISBANE, want tenders (by Jan. 20) for a 10,000 kw. turbo-alternator (contract 74), and DUNEDIN (N.Z.) Council require tenders by June 21 for a 3,000 kw. generator, impulse water-wheel, four 2,000 kw. transformers, and steel pipe line. Specification can be seen at the Dept. of Overseas Trade, 35, Old Queen-street, Westminster, S.W. 1.

The Deputy Postmaster-General, Melbourne, requires tenders by Jan. 4 for the supply of switchboards (schedule 1653) and the Deputy Postmaster-General, Brisbane, will receive tenders until Jan. 19 for the supply of testing and telegraph instruments (schedule 517) for the AUSTRALIAN COMMONWEALTH Postmaster-General's Depts. Specification can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The directors of the GREAT WESTERN RAILWAY COMPANY require tenders for the supply of various stores, including telegraph instruments and apparatus, electric wires and cables, telegraph ironwork and tools, metals, rivets, bolts and nuts, &c. Samples and patterns may be seen up to 5 p.m. Nov. 19, and specifications and forms of tender from the Stores Superintendent, Swindon. Tenders, addressed to the Secretary, Mr. A. E. Bolter, Paddington Station, London, W., by Nov. 22.

H.M. Minister at MONTEVIDEO (Sir C. Mallet, C.M.G.) reports that the Management of the Usinas Electricas de Montevideo is inviting tenders by 11 a.m. Jan. 14, 1921, for the construction, delivery and erection of a 10,000 kw. generating plant (steam turbine directly coupled to a 3-phase alternator and exciting dynamo, with accessories, including steam supply pipes, &c.), and a surface condensing plant with air and hot water pumps. The turbine is to be fed with steam at a maximum pressure of 12½ atmospheres and a maximum temperature of 325°C. at the stop valve. The alternator is for a voltage of from 6,000 to 6,600 (50 periods), the power factor being 0·8. Payment of 20 per cent. of the value c.i.f. Montevideo on signing the contract, 50 per cent. against receipt of shipping documents, and balance in two equal instalments. The conditions and specification (Spanish) may be consulted on application to Mr. Holloway, Dept. of Overseas Trade, up to Dec. 4, after which date it may be borrowed by United Kingdom firms.

Personal and Appointments.

The Rt. Hon. Lord Sydenham of Combe has been elected President of the British Empire Producers' Organisation.

Mr. R. H. Stevens, B.Sc., vice-principal of Bury Municipal Technical School, has been appointed Director of Education at Canterbury.

Vice-Admiral Sir Frederick C. T. Tudor, K.C.M.G., C.B., has taken up his duties as President of the Royal Naval College, in succession to Vice-Admiral Sir William C. Pakenham. K.C.B.

M. C. E. Guillaume, Director of the International Weights and Measures office, at Breteuil, has been awarded the Nobel Physics Prize for his treatise on "The anomalies of nickel steel alloys."

Mr. F. J. Harlow, head of the mathematics and physics department of the Sir John Cass Technical Institute, has been appointed principal of the Blackburn Municipal Technical College.

Mr. Robert Geo. Rawkins, the new Mayor of Windsor, is secretary and manager of the Notting Hill Electric Lighting Company, and secretary of the Slough and Datchet Electric Supply Company.

Mr. J. Thompson, the new Mayor of Wolverhampton, is the head of an important local firm of boiler makers, and has been for some time chairman of the Wolverhampton Electricity Committee.

The new Mayor of Stafford (Mr. R. E. Meade) was formerly chief of the Corporation electricity department in that town, and is now in business as a motor engineer, being head of the Gaol Square Motor Company.

Mr. S. W. Gladwell, secretary of the Iron Trade Employers' Association, has been elected president, and Mr. A. F. Harrison (secretary of the City of London Electric Lighting Company) treasurer of the Chartered Institute of Secretaries.

Mr. J. J. Walklate, who is well known in electrical and engineering circles in this country, has been appointed Acting Town Clerk of Auckland, New Zealand. Mr. Walklate, who was associated with the construction of the lines of the Kidderminster and Stourport, South Staffordshire & Potteries Electric Traction Companies, went out to New Zealand some years ago to take over the general management of the Auckland Electric Tramways, Ltd., whose undertaking was recently acquired by the City of Auckland Corporation. Mr. Walklate's duties will embrace, in addition to that of Town Clerk, the general direction and supervision of the affairs and business of the Corporation, with a general authority over the heads of departments subject to the Council's general or special direction. Apparently the Council's idea is a chief executive officer in municipal administration.

Catalogues, Price Lists, &c.

An artistic showcard, which is neatly printed in colours, has been issued by the Carron Company and shows at a glance the advantage of using Carron electric fires. It forms a striking and efficient advertisement of the Company's products.

A pamphlet has been issued by the British Insulated & Helsby Cables, Ltd., of Prescot, Lancs., on aluminium wire, strip and sheet for electrical purposes. It gives the principal physical and mechanical properties of aluminium and also tables of aluminium conductors and of weights and breaking stresses of bare h.d. copper and their equivalent sizes of aluminium wire and strands for aerial lines as used bythe company.

Messrs. J. H. Sankey & Son, Ltd., 74, Cheapside, London, E.C., firebrick manufacturers, &c., have issued a useful table giving MELTING, BOILING AND FREEZING POINTS for various metals, fireclay bricks and refractories, glass, &c. The figures have been carefully compiled, and will be found to be sufficiently approximate for practical purposes. Copies of the sheet, mounted on a card for hanging on the wall, will be supplied by the firm to those interested.

A neat booklet issued by the Galvanising Equipment Company, Ltd., 29a, Portpool-lane, London, E.C.1, gives some of the practical results of rust-proofing by the Galico process. This process does not give a plain zinc deposit, it covers the metal with an alloy which has a far greater resistance to corrosion and forms an absolutely contiguous coating. The surface of the material or goods so coated is always clean and conforms to the base to which it is applied. It is used for treating nails, bolts and screws, chains, electrical conduit, ornamental ironwork, &c. Some excellent illustrations of the treated materials are given in the booklet.

Bankruptcies and Liquidations.

Claims against Johnson Jagger, trading as J. Jagger & Co., electrical engineer and contractor, 28, Northgate, Halifax, are to be sent by Nov. 24 to Mr. A. Gray, 9, Fountain-street, Halifax.

The first meeting of creditors of W. H. S. Ward, electrical engineer, 56, High-street, Acton, will be held on Nov. 23, at 14, Bedford-row, London, W.C.1, and the public exam. on Dec. [illegible] at the Court House, Half Acre, Brentford.

A meeting of the creditors of Messrs. Foote & Milne, Ltd. (in voluntary liquidation), will be held at Anderton's Hotel, Fleet-street, London, E.C., at noon, on the 24th inst. Creditors must send particulars of their claims by Nov. 20 to the liquidator (Mr. R. J. Ward), 10, Serjeants' Inn, Fleet-street, E.C. 4.

The Electro-Chemical Developments, Ltd., is being wound up voluntarily for reconstruction purposes, and the liquidator, Mr. E. A. Ashcroft, 65, London-wall, London, E.C., has been authorised to carry into effect an agreement made between him and the company and the Magnesium Metal Company, Ltd., the Magnesium Chloride Company, Ltd., and the Magnesium Company, Ltd.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1918 Specifications.

151,293 Marconi. Electric accumulators. (5/4/17.)
151,294 Taylor. Transmission of single-phase currents over polyphase mains. (21/6/19.)
151,617 George & Herbert. Electric resistances. (16/4/17.)
151,658 Hedina. Electrical torpedo nets. (6/3/18.)

1919 Specifications.

129,290 Ford. Apparatus for electric step-by-step signalling systems. (3/7/18.)
133,024 Shea. Tools for electric riveting and spot welding. (24/9/18.)
133,290 Piquerez. Electric boiler. (4/10/18.)
138,589 Jaentsch. High-voltage insulators. (6/2/19.)
151,302 White. (International Time Recording Co.) Electrically-operated synchronising clock systems. (20/3/19.)
151,309 Parfitt & Jenkins. System for supplying electricity to an external circuit without receiving energy from external sources. (19/5/19.)
151,335 Murray & Telephone Mfg. Co. Telephones. (18/6/19.)
151,336 Murray & Telephone Mfg. Co. Telephones. (18/6/19.)
151,346 B. T.-H. Co. (G. E. Co.) Amplification of electric currents. (20/6/19.)
151,353 Blades. Electric plug connecting devices. (21/6/19.)
151,357 Adams. Trip mechanism for electric ignition devices for internal-combustion engines. (21/6/19.)
151,370 Breeze & West & Co. Housings and casings for electrical switchgear. (24/6/19)
151,371 Palmer & Telephone Mfg. Co. Telephone transmitters and mouthpieces or the like therefor. (24/6/19.)
151,380 Hall & Hall. Electric switches. (27/6/19.)
151,388 Railing & Nobbs. Electrical cooking apparatus. (4/7/19.)
151,389 Murray, Erskine & Robinson. Radio navigational apparatus. (4/7/19.)
151,435 Munro. Cross-overs of overhead conductors in systems of electric traction. (12/8/19.)
151,446 Automatic Telephone Mfg. Co. & Hudd. Electric relays. (22/8/19.)
151,462 General Electric Co. & Trippe. Thermionic valves, electric incandescent lamps and the like. (12/9/19.)

Means for establishing electrical connection between the contact elements carried by the cap and socket of a thermionic valve or the like, consists in the combination of rigid pins projecting from the base of the cap substantially parallel to its axis, and contact pieces tangentially disposed within the socket and adapted to be engaged frictionlly by said pins when the cap and socket are rotated relatively to one another.

151,465 B. T.-H. Co. (G. E. Co.) Electro-magnetic switches. (17/9/19.)
151,478 Walker & Shanks. Magnetically-operated friction clutches. (4/10/19.)
151,490 Hassler & Metropolitan-Vickers Electrical Co. Brush-holders for dynamo electric machines. (22/10/19.)
151,667 B.T.-H. Co. (G.E. Co.) Insulated electrical conductors. (4/4/19.)
151,680 Houston. Electric batteries. (19/9/19.)
151,682 B.T.-H. Co. (G.E. Co.) Sealing-in machines for electric lamp bulbs. (12/6/19.)

Relates to machines for sealing-in a mount, having an exhaust tube extending therefrom into a bulb, and comprises means for supporting the mount with a portion thereof within the neck of a bulb, and means for directing a flow of air outwardly against the neck of said bulb below the line of seal, said means comprising a support tube having air discharge openings and being adapted to receive the end portion of the exhaust tube, means for supplying air to the support tube to be discharged through said openings, and means for preventing the air from entering the exhaust tube.

APPLICATIONS FOR PATENTS.

May 21, 1920.

14,038 Thompson. (Soc. FranSaise Radio-Electrique.) Means for electric magnetic wave signalling.
14,043 Robinson & Smith. Wireless directional systems.
14,093 Marks. (Langguth & Haar.) Electric heaters for liquids.
14,097 Svenska Radioaktiebolaget. Receiving electrical undamped continuous oscillations, &c. (23/5/19, Sweden.)
14,105 Tyer & Co. & Downes. Electrical apparatus for railway signalling.

May 25, 1920.

14,137 Wall. Amplification of telephone currents.
14.179 Harriman & Wheeler. Insulating fishplates from rails in electric railway track circuits.
14,268 Henley's Telegraph Works Co. Machines for laying up or twining conductors.
14,290 Pilon. Electric systems containing X-ray apparatus. (19/8/15, France.)
14.309 Corsi. Electric heating apparatus. (7/2/19, France.)

May 26, 1920.

14,313 Hearn. Electric soldering irons.
14,318 Automatic Telephone Mfg. Co. Railway signalling systems.
14,321 Kirk. Distributors for h.t. currents.
14,333 Railing & Taylor. Electric conduit fittings.
14,354 Boyle. Regulating speed of electrically-driven rolls on paper making machines.
14,361 Whitehorn. Electric machinery.

May 27, 1920.

14,410 Williamson. Switches.
14,414 Illingworth. Electric cutouts.
14,415 Soutter. Electric kettles, &c.
14,469 Nicholson. Fuses for protection of electrically-heated utensils.
14,500 Pouchain. Accumulators.
14,509 Cummings. Electro-magnets.
14,514 Igranic Electric Co. (Cutler Hammer Mfg. Co.) Controllers for motors.

May 28, 1920.

14.541 Virr. Motor starters, rheostats, &c.
14.542 Carey. Electric switch control mechanism for trucks, &c.
14.565 Horstmann. Switches.
14.571 [illegible]. Electric railway track systems.
14.590 Western Electric Co. Telephone exchange systems. (22/7/18, U.S.)
14.592 Isenthal. Variable condensers.
14,630 Doms. Electric burglar alarms. (11/4/18, Germany.)
14,636 Metropolitan-Vickers Electrical Co. & Walker. Electrical machinery.
14,639 British Lighting & Ignition Co. & Turner. Electric cables and terminals.

May 29, 1920.

14,652 Schuster. Induction meters. (15/8/18, Germany.)
14,669 Colville & Inglis. Electro-magnetically operated plate or bar handling skids.
14.672 Soc. Anon. des Etablissements H. Pilon. Rectification of h.t. alternating currents. (9/4/19, France.)
14.679 Radio Communication Co. & Scott-Taggart. Modulation systems for wireless signalling, &c.
14,680 Radio Communication Co. & Scott-Taggart. Vacuum tube relay devices, &c.
14,[illegible] Chandler. Wireless receiving apparatus.
14,687 Sykes. Terminals for electric conductors.
14,703 Lea. Wireless receiving systems.

May 31, 1920.

14,732 Norrby. Method of generating electrical energy. (24/2/20, Sweden.)
14.741 [illegible] & Chalmers. Sound wave amplifying devices.
14,[illegible] B.T.-H. Co. (G.E. Co.) Meters.

Companies' Reports, &c.

The directors of the Chloride Electrical Storage Company, Ltd., have declared an interim dividend of 5 per cent., tax free.

Altrincham Electric Supply, Ltd., has declared an interim dividend at the rate of 7½ per cent. on the ordinary shares.

The General Electric Company (of America) is offering $27,500,000 of new stock to shareholders at par in the ratio of one new share for each five outstanding on Dec. 8.

The directors of the Ever-Ready Company (Great Britain), Ltd., have declared a dividend at rate of 7 per cent. per annum on both preference and ordinary shares, for the period ended Sept. 30.

The British Bank for Foreign Trade are offering for sale 481,875 £1 shares of Messrs. Siemens Brothers & Company, Ltd. The shares are offered at 22s. each, and the proceeds will be used for extensions in hand and for financing the increasing volume of orders. The firm of Siemens Brothers was established in 1858, and was registered as a limited company in 1880. The dividends paid for each of the years 1917, 1918 and 1919 have been at the rate of 10 per cent., tax free, and an interim dividend at the rate of 10 per cent. has been declared in respect of the six months ended June 30 last. Notwithstanding the increase in the tax on excess profits to 60 per cent., and the imposition of the 5 per cent. Corporation tax, it is anticipated that the dividend for the current year will be maintained at 10 per cent., tax free. The company possess land and buildings at Woolwich covering about 17½ acres, of which the lease expires in 1980, and a factory is rented at Dalston which has been equipped for the manufacture of metallic filament lamps, and has a capacity for an annual output of 2,500,000 lamps. The buildings at Woolwich are of modern construction. During the current year about 3 acres of land adjoining the Woolwich premises on the river side have been purchased, and 5½ acres of land contiguous to the works on the southern side have been leased for 99 years to provide for additions which will have to be made now and in the future to the Woolwich factory. The value of the unexecuted orders in hand exceeds £2,750,000, and in the chief classes of its manufactures, the company is doing an extensive and increasing business.

Viscount St. Davids, who presided over the annual meeting of the Monte Video Telephone Company, Ltd., last week, stated that only two tenders were submitted in response to the invitation of the Post Telegraph and Telephone Department of the Uruguayan Government for a complete underground telephone installation in Monte Video, with exchanges equipped on the central battery system of working. The tenders were by the Monte Video Company and the Western Electric Company. Under the law as it existed at that date it was illegal to consider any tenders unless at least three were submitted, and the two tenders were, therefore, returned unopened. Presumably the law had been altered, as an official announcement was made in September extending the time for receiving tenders to Dec. 18 next, when they would be opened irrespective of the number lodged. He thought that probably only two tenders would be put in—their own and that of the Western Electric Company. The directors were fortunate in being able to discuss matters with Mr. Bayne, a member of their local board, who happened to be in this country, and on his return to Monte Video, being fully acquainted with the directors' views, was prepared to show the Uruguayan Government that in the best interests of the business community of Monte Video the telephone business should be left in their hands. They hoped that a satisfactory concession would be granted to the company that would permit the necessary capital to be raised and the City of Monte Video provided with the most up-to-date telephone system known. After analysing the accounts a final dividend of 5 per cent. (making 8 per cent. for the year) was declared.

At the nineteenth annual general meeting of Drake & Gorham, Ltd., last week the chairman (Mr. B. M. Drake, M.I.E.E.) was able to present a very satisfactory report of the progress made during the past year. The profit (£23,017) was £4,000 above the average for the three years 1917 to 1919, after reserving £1,819 for further depreciation of investments and about £900 for interest on bank overdraft. He said the ill-advised Excess Profits Tax, which penalised any production above that of 1914, still continued, and the sum already paid had necessitated their curtailing trading which would have benefited the country. The transfer of the wholesale department to a separate company has involved a division of the items of goodwill, stock, &c. The shares of the sub-company were taken at par, which was well justified by the return made to the parent company on the investment. Their turnover had increased enormously, and the orders in hand on July 1, 1920, gave every indication of a continued expansion of business. Their value was nearly twice as large as in July, 1919, and no less than eight times the figure for 1914. Had funds been available the expansion might have been still greater.

To handle the business to the best advantage it was essential that further working capital should be provided, and the directors had decided that, in view of the probability of cheaper money in the future, it would be undesirable to saddle the company with preference shares which at present rates would constitute a permanent incubus on the undertaking. They were therefore making an issue of £50,000 seven-year notes bearing interest at 10 per cent. and redeemable at 105. Those best able to judge of the value of the investment—namely, the directors and their friends, the staff and employees, had already bespoken £20,000. Although preference would be given to existing shareholders and the company's clients, anyone interested could apply. Their new head offices were proving a great success, and as they were offered £5,000 premium it was evident that they did not pay too much for the 35 years' lease. The conversion of the building for use as offices, including the introduction of an electric lift from basement to fourth floor, the provision of heating apparatus throughout, and various structural alterations, were necessarily costly. As they had practically paid their rent in advance for 35 years and could employ the money to better advantage in their business, they proposed to raise a 15 years' loan on the lease. They had carried out important work for the Admiralty, including the internal equipment of the "Mystery Ships," one of which was recently launched at Southwick. The large power station at Widnes, with an output of 10,000 kw. and provision for extensions, was now completed, their company being responsible, to Mr. C. P. Sparks' design, for the whole of the work with the exception of the buildings and civil engineering. The installation was carried out under the supervision of Mr. Holbrook Gaskell, chief engineer of the United Alkali Company, who last year became one of their managing directors. They had also contracts in hand for the electrification of mines, cotton mills, and the driving of machinery of various kinds by electric power. Mr. Drake gave a long list of firms for whom work had been carried out. As a result of the steps taken to extend electric service throughout the country, there would be plenty of work available for many years to come for those who knew how to utilise the current to the best advantage. The Country and Town House Department had been busy throughout the year, and many important contracts had been executed. Their Manchester office had again shown excellent results, and the sphere of the Electric Vehicle Department was being extended. The prospects were largely in the hands of their men, and if they would only appreciate that the more work they did for the wages they received the more work there would be for them in the future, all would be well. The difficulty was to induce the saner workmen, who, Mr. Drake believed, constituted a large majority, to assert themselves against the agitators and hot-heads who at present controlled their destiny.

The report and accounts were adopted and a dividend for the year ended June 30, 1920, at the rate of 10 per cent. was declared.

New Companies.

BRENTWOOD DISTRICT ELECTRIC COMPANY, LTD. (171,224).—Reg. Nov. 4, capital £2,000 in £1 shares, to carry on the business indicated by the title. First directors are: A. G. Collis, J. Bradford, D. Cornish and H. E. Wood. Sec.: J. W. Vincent, Reg. office: 53, New Broad-street, E.C. 2.

BRITISH DANUBIAN TRADING CORPORATION, LTD. (171,352).—Private company. Reg. Nov. 11. Capital £100,000 in £1 shares. To enter into an agreement with the British and Hungarian Bank, to open up and promote commercial relationship between the U.K. and Hungary, Austria, Russia, Roumania, Czecho-Slovakia, Jugo-Slavia, Turkey, Bulgaria, Poland or other countries, to carry on business as bankers, financiers, concessionaires, &c. First directors are: Godfrey C. Isaacs, Lt.-Col. Adrian Simpson, C.M.G., Major S. Alley, M.C., Simon de Krauz and Alex. Fleissig. Reg. office: Marconi House, Strand, W.C.

A. L. BROWN & COMPANY, LTD. (171,050.)—Private company. reg. Oct. 28, capital £2,000 in £1 shares, to take over the business of electricians carried on by A. L. Brown and H. F. Mitchell as A. L. Brown & Company. First directors are A. L. Brown and H. F. Mitchell. Reg. office, Millbridge, Frensham, Surrey.

DOUGLAS ENGINEERING COMPANY, LTD. (171,294).—Private company. Reg. Nov. 8. Capital £1,500 in 5s. shares. To carry on the business of electrical, chemical, electro-chemical, mechanical and general engineers, machinists, &c. Solicitor: F. Minton, 33, Bedford-street, Covent Garden, W.C.

IONOID CO., LTD. (171,317).—Private company. Regd. Nov. 9. Capital, £1,000 in £1 shares. To take over the business carried on by W. H. Eccles, 23, Leonard-street, E.C. 2, and to carry on the business of electrical and mechanical engineers, manufacturers of electrical, mechanical or scientific instruments, &c. First directors are: W. H. Eccles, Miss N. F. Paterson, G. V. Twiss and T. A. Henry. Reg. office: 186, Alexandra-road, N.W. 8.

JOHN FURLONG & SONS (1920), LTD. (5,062.)—Private company Reg. in Dublin, Oct. 26, capital £120,000 in £1 shares, to carry on the business of generators and suppliers of electricity. First directors are M. G. Haughton, C. C. Mercier (and secretary), J. P. Goodbody, senr., J. P. Goodbody, junr., and G. E. Goodbody. Reg. office: Lapp's Quay, Cork.

LEWIN & MURRAY (SOWERBY BRIDGE), LTD. (171,301).—Private company. Reg. Nov. 8. Capital £1,000 in £1 shares. To carry on the business of electricians, mechanical and motor engineers, suppliers of electricity, &c. First directors are: A. Lewin and J. T. Murray. Secretary: Florence Murray. Reg. office: Hollins Mill Lane, Sowerby Bridge, Yorks.

OLDHAM & SON, LTD. (171,213.)—Private company. Reg. Nov. 3, capital £30,000 in £1 shares, to carry on the business of mining, mechanical and electrical engineers, manufacturers of and dealers in miners' lamps and colliery requisites, manufacturers and patentees of primary and secondary batteries, &c., and to acquire the business carried on by O. Oldham as "Oldham & Son." First directors are O., G., E. C. and J. Oldham. Secretary (pro tem.): J. J. Hammond. Reg. office: 36, Hyde-road, Denton, near Manchester.

PATENT LAUGHTON DRIVE COMPANY, LTD. (171,194.)—Private company. Reg. Nov. 2, capital £20,000 in £1 shares, to take over the business of an engineer and manufacturer of power transmission, bolt gearing, carried on by H. Laughton, and to carry on the business of electrical, mechanical, motor and general engineers, &c. First directors are J. Shreeves, H. Laughton (managing) and F. C. Brining. Secretary: C. H. Brining. Reg. office: 19, St. James-street, Sheffield.

PERFECTION ELECTRICAL COMPANY, LTD. (171,252).—Private company. Reg. Nov. 5, capital £1,000 in shares, to carry on the business of marine, mechanical, civil, electrical, gas and hydraulic engineers, manufacturers of motors, machinery, plant and tools, &c. Directors are F. W. Martin and H. E. O. Ellis. Reg. office: 1, Emerald-street, W.C. 1.

W. T. RAWCLIFFE, LTD. (170,480).—Private company. Reg. Sept. 27. Capital £10,000 in £1 shares. To acquire and turn to account lands and buildings in the United Kingdom, Canada and elsewhere, and to carry on the business of electricians, mechanical engineers, suppliers of electricity, &c. First directors are: T. S. Jones, E. Jones, W. A. Mortimer, and W. T. Rawcliffe. Reg. office: 3, Greengate, Victoria Bridge, Salford.

SAITAX MF. COMPANY, LTD. (171,071.)—Private company, reg. Oct. 27, capital £3,000 in 2,500 "A" shares of £1 each and 10,000 "B" shares of 1s. each, to carry on the business of electrical, mechanical, water and general engineers, manufacturers of machinery, electrical apparatus, theatrical and general stage effects, &c. First directors are W. Adams and Capt. F. J. H. B. Hutchinson. Reg. office, 106, Albany-street, N.W.

Z ELECTRIC LAMP AND SUPPLIES COMPANY, LTD. (170,924).—Private company. Reg. October 19. Capital, £30,000 in £1 shares. To carry on the business of electricians, electrical and mechanical engineers, &c. First directors are: W. Crawford, J. Scrivener and A. G. Marsh. Secretary, L. W. Ellisdon. Reg. office: 71, Standen-road, Southfields, S.W.

Forty Years Ago.

(The Electrician, November 20, 1880.)

South America.—Cable between Monte Video and Rio Grande do Sul is now repaired.

Mr. Swan's Lamp.—This electric lamp is patented in America. The number of the patent is 233,445.

Menlo Park.—Mr. Edison is busily preparing for further tests of his electric light apparatus at Menlo Park. The new trials will be on a large scale, 7½ miles of street-mains having been laid for the purpose.

Society of Telegraph Engineers.—At the Ordinary Meeting of the Society on November 24, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. J. W. Swan, of Newcastle-on-Tyne, will read a Paper on "A System of Subdividing the Electric Light."

Lighting Underground Railways.— A correspondent of the *Globe* points out with reference to the proposed adoption of the electric light in London railway tunnels that the shadows would put a stop to newspaper reading in the carriages. No doubt they would. What is wanted in the underground railway is the suppression of smoke, not the extinction of gas.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics."—"Flying Clubs and Municipal Aerodromes"; "The Air Postman," by Lieut.-Col. H. S. Holt; "Screw Propellers"; by M. A. S. Riach, F.Ae.S., A.I.N.A.

"The Cabinet Maker."—"The Decoration of Furniture" (continued); "Sale of the Sheldon Tapestries"; and "Electric Lighting of Shop Windows."

"The Chemical Age."—"The Case for Colloidal Fuel", by Lindon W. Bates; and "The Polymerisation of Fatty Oils."

"Farm and Home."—"The Secretaryship of The Royal" (special); "The Control of Farming"; and "Seasonable Notes on Feeding Stuffs."

"The Fruit-Grower."—"Weedkillers and the Public Health"; "Economic Status of Wild Birds"; and "Motor Cultivation," by W. Dennis & Co. (illustrated).

"Gardening Illustrated."—"Apple Wellington"; "Climbing Forms of well-known Roses"; and "Winter Cucumbers."

"Gas World."—"Detailed Analysis of Some Gas Companies' Accounts" "The Changed Conditions of Industry," by Cyril C. Davis; and "Silent Flames," by Hamilton Davies, B.Sc.

"Hardware Trade Journal."—"Electric Steel"; Gas Appliances and Fittings"; and "Electric Lighting of Shop Windows (IV.)."

"Ways and Means."—"The Principles of Proprietorship in Property." by James W. Reid; "Sidelights on Germany," by Courier; and "The Producer," I., by W. G. Soper.

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Arrangements for the Week.

FRIDAY, November 19th (to-day).

Institute of Metals.—Sheffield Local Section.

3 p.m. and *7.30 p.m.*—At the University, Sheffield. Joint Meeting with the Faraday Society. Discussion on "Electro-plating."

Institution of Mechanical Engineers.

6 p.m. At Storey's Gate, London, S.W. Paper on "Sterilisation of Water by Chlorine Gas," by Capt. J. Arthur Stanley, O.B.E.

Institution of Electrical Engineers.—Students' Section.

6.30 p.m. At the City and Guilds (Eng.), College, Exhibition-road, London, S.W. Address on "The Incandescent Electric Lamp from the Inside," by Mr. C. C. Paterson, O.B.E.

Junior Institution of Engineers.

7 p.m. At 39, Victoria-street, London, S.W. Annual General Meeting and discussion on "Economical Transmission of Power," opened by Mr. G. H. Ayres.

West of Scotland Iron and Steel Institute.

7 p.m. At the Royal Technical College, George-street, Glasgow. Paper on "Low Temperature Carbonisation of Fuel," by Major Armstrong.

SATURDAY, November 20th.

Association of Engineering and Shipbuilding Draughtsmen.—York Technical Section.

7.15 p.m. At Priory-street Higher Grade School, York. Paper on "Steel Tubes and Cylinders," by Mr. F. S. Marsh.

MONDAY, November 22nd.

Institute of Aeronautical Engineers.

6.30 p.m. At Royal College of Science, New Building, S. Kensington, London, S.W. Lecture on "The Education Act of 1918," by Mr. S. T. G. Andrews.

Institution of Electrical Engineers—North-Eastern Centre.

7 p.m. At Armstrong College, Newcastle-on-Tyne. Paper on "The Distribution of Electricity," by Mr. W. B. Woodhouse.

Institution of Electrical Engineers.—North Midland Centre.

7.30 p.m. At the Mappin Hall, The University, Sheffield. Joint Meeting with the Sheffield Society of Engineers and Metallurgists. Paper on "Permanent Magnets," by Prof. F. H. Crapper.

TUESDAY, November 23rd.

Institution of Electrical Engineers.—North Western Centre.

7 p.m. At the Engineers' Club, Albert Square, Manchester. Papers on "The Distribution of Electricity," by Mr. W. B. Woodhouse, and "Some Economic Aspects of E. H. T. Distribution by Underground Cables," by Mr. R. O. Kapp.

Institute of Industrial Administration.

7 p.m. At 110, Victoria-street, London, S.W. Discussion on "Staff Selection and Promotion," opened by Mr. E. W. Cousins.

Sheffield Association of Metallurgists and Metallurgical Chemists.

7.30 p.m. At Royal Victoria Hotel, Sheffield. Paper on "Refractories for Electric Furnace Use," by Mr. W. J. Rees.

WEDNESDAY, November 24th.

Institution of Electrical Engineers.—Wireless Section.

6 p.m. At the Institution of Civil Engineers, Gt. George-street, London, S.W. Address by Dr. W. H. Eccles.

Royal Society of Arts.

8 p.m. At John-street, Adelphi, London, W.C. Paper on "Colour Vision and Colour Blindness," by Sir Philip Lloyd-Greame.

Institute of Chemistry.

8 p.m. At University College, Gower-street, London, W.C. Paper on "Some Scientific Aspects of Tanning," by Mr. J. T. Wood.

THURSDAY November 25th.

Institution of Electrical Engineers.

6. p.m. At the Institution of Civil Engineers, Gt. George-street, London, S.W. Papers on "The Distribution of Electricity," by Mr. W. B. Woodhouse, and "Some Economic Aspects of E.H.T. Distribution of Underground Cables," by Mr. R. O. Kapp.

FRIDAY, November 26th.

Institution of Electrical Engineers.—Students' Section.

6.30 p.m. At City and Guilds Technical College, Leonard-street, London, E.C. Paper on "Electricity and the Paper Making Industry," by Mr. A. J. C. Watts.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "Some Experimental Work in Connection with the Injection and Combustion of Fuel in Diesel Engines," by Eng. Commander C. J. Hawkes.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, Westminster, London, S.W. Lecturette on "Reinforced Concrete Coal Bunkers and Silos," by Mr. C. O. Mourant.

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Notes.

An Unwise Suggestion.

THERE is little fresh to report regarding the E.P.E.A. dispute, except that the Provincial Electric Supply Committee of the United Kingdom have asked the Ministry of Transport to convene a meeting of all the associations representing employers in the electricity supply industry to exchange views "on quite neutral grounds and without prejudice" on the recommendations of the Joint Board. It is a little difficult to see what good this will do, and it may badly complicate matters. The employers' side of the Joint Board already includes representatives of these bodies, and as this same Joint Board is backing the E.P.E.A. demands such a conference can only confirm their attitude, in which case it is unnecessary, or disagree with it, when it would close and double bar the door of conciliation and inflict a grave injury on the Whitley Council. We hope that this suggestion will not be pushed and that some other road to a much-to-be-desired peace will be sought.

A Little More Patience.

WE publish in our correspondence columns a letter from Mr. W. ARTHUR JONES, general secretary of the Electrical Power Engineers' Association, in which he criticises our statement that his Association had thrown over the Whitley Council and places the blame for the defection on the employers generally. But surely both sides have disregarded the Whitley Council—the one by rejecting an award agreed upon by a joint body of employers and employed, the other by not exercising more patience in an admittedly difficult situation. As Mr. JONES points out, the Joint Council have been working for months in the E.P.E.A. interests, and are still working, why then stultify their efforts by an action which may well irreparably damage their cause? Let us see just a little more of that Christian-like attitude on which Mr. JONES prides himself. Our information shows that the electricity supply industry as a whole is in sympathy with the E.P.E.A. It would be a great pity if it lost that sympathy by any untoward action.

Higher Electroplating Currents Possible.

THE problems connected with the development of electroplating processes is not a subject which has recently received much consideration from scientific and technical societies. The reason for this is not clear. Either we are to suppose that there is a happy absence of difficulties, which is far from being the case, or that electroplating is of no interest to the general body of electrical engineers. The latter is probably the true explanation, it being presumed without much real basis that a process which is in such general use, and is so commercially successful, must have reached a stage of growth when it has ceased to offer either interest or amusement to the seeker after knowledge. That this is not the case, however, is shown by a Paper read by Mr. FRANK MASON before the joint gathering of the Faraday Society and the Institute of Metals in Sheffield. In the course of a research into certain abnormalities in the ordinary plating bath, Mr. MASON discovered that an alteration in the electrolyte allowed the maximum current that could safely be passed to be increased by 100 per cent. without any deterioration of the quality of the deposit, and with an entire absence of "burning." It is thus possible to get from the same bath double the quantity of work in the same time and with the same labour. At a time when research workers are complaining of the hardness of their lot, we may be permitted to hope that not only the industry, but also the inventors, will reap the rewards of their discovery. But for the present details are mercifully withheld, so that it is a little difficult to prophesy whether this will be the case or not, or whether the invention is quite so epoch-making as at first sight appears.

The Former German Submarine Cables.

THE task of disposing of the former German-owned submarine cables has proved more difficult than was anticipated. Various inaccurate statements regarding the fate of these cables have recently appeared, but we understand that the true position is as follows: As is well known, for some weeks past an International Communications Conference has been sitting at Washington in order to decide the matter. At present Great Britain controls about 5,000 miles, France 9,000 miles, and Japan 1,000 miles of captured cables. So far as the two cables of the Deutsch-Atlantische Telegraphen Gesellschaft, which formerly connected Borkum in Germany with New York (via Horta in the Azores), are concerned, the United

States Government is demanding the same privileges as this country and France, and is insisting upon the former German cables in the Atlantic connecting the United States and Germany being restored to their original position. It will be remembered that these cables were cut by British cruisers during the war, one end of one of them being drawn into Penzance and the other end into Halifax, while the European end of the other was landed at Brest.

Outstanding Problems.

The French delegates to the Conference offered on behalf of their Government to agree to the creation of a trusteeship of the cables in the event of the American claim not being adjusted. The British delegates have, however, decided to fall in with the American views, provided the ownership of the cable continues to be British, and it is possible that France will adopt a similar attitude in regard to the Brest-New York cable, while keeping undisputed control of the Brest–Casablanca–Dakar cable and the Monrovia–Pernambuco cable. There is no immediate prospect of a settlement of the Japanese-American dispute about the ownership of the island of Yap, in the Carolines, and the cables radiating there from towards Shanghai, the Dutch possessions and the island of Guam. It is clear from the prolonged and delicate nature of the negotiations that Governments attach as much importance as ever to direct submarine telegraph communication. Owing to its reliability and secrecy, this means of communication will continue to be employed, notwithstanding the great extension of national and international systems of radio-telegraphy. So important is direct submarine communication between America and Germany considered that the Western Union Telegraph Company has completed arrangements with the German Telegraph Administration for handling cable traffic between Germany and the United States. Plans are also being prepared for laying a new direct cable between the United States and Germany. We therefore hope that these outstanding matters will be speedily settled.

Engineers and Industrial Questions.

Those who complain that the time of engineers is now too much taken up with industrial questions and not enough with engineering may well point to the proceedings at the opening meeting of the 1920-21 session of the Institution of Electrical Engineers last week as giving some ground for their strictures. Technical in character as most of the Presidential Address was one of its most pregnant portions dealt with the causes and solution of the present industrial unrest and all the other speakers referred more or less directly to the same question. Mr. Atkinson, in fact, answered his critics in advance by stating simply that these questions will not be solved by ignoring them, upon the well-known system of not answering inconvenient letters, and in fine phrase pointed out that the most cogent reason for giving this matter attention is that the greatest risk of stoppage of the industrial machine is in the "unlubricated working of the human element." He further contended, as we have often done, that dissatisfaction and monotony are the roots of the trouble, and that increasing education is for the moment an irritant rather than a palliative.

Wanted—A New System.

If this be so, and we agree that it is probably the most fundamental reason, our efforts towards industrial peace had better far be directed not to tinkering with the subject on wages boards, at welfare centres, by systems of payment and by all those other panaceas which promise so much and effect so little, but to a consideration of what means can be taken to make a man's daily task more interesting and productive. If we can do this we shall have gone a long way, even if we admit with Mr. Chamen that our industrial ethics are all wrong and that our main concern should be not with our own welfare, safety and comfort, but with that of our neighbours. It must further be recognised that the mere setting up of ideals, however high, will not bring satisfaction. There is a large element which feeds on and encourages unrest as a sharp weapon useful for winning its own dark battle. Much effort both destructive and constructive, but above all in sympathy with the legitimate desire for betterment, will therefore be necessary before conditions can be permanently improved. But until they are improved they will continue to be a chief concern of engineers.

A Whole Time President.

In comparing the President of the Institution of Electrical Engineers with the holder of the mayoral office in one or other of our cities and towns we have no wish to be derogatory to either party. For while the latter plays some considerable part in local politics and acquires a reflected glory from the traditions of his office, the former, while his glory is less effulgent, plays an even greater part in directing the affairs of a great Institution. There is another point of similarity. The duties of both offices are becoming more and more onerous, requiring the expenditure of an increasing amount of labour and time which, though given voluntarily, is often spared with some difficulty from other equally important matters. The result is that in both cases one of the first qualifications for office is to have plenty to spare of that commodity of which most of us desire a greater supply. This necessarily and unwisely limits the field of choice, and we therefore hope that in the case of the Institution of Electrical Engineers at any rate some compromise will be arrived at whereby even the busiest man can take his share of Presidential responsibility where it is desirable he should do so.

The Musings of an Electro-Cynic.

On another page of this issue we commence publication of a series of articles under the pleasing pseudonym of "Electro-Cynic." Cynicism may be described as a process which introduces too great a percentage of acid into the chemical processes of everyday existence. Nevertheless, acid under certain circumstances has its uses, and though every statement made by the professed cynic need not be taken at its face value, most of them contain a substratum of truth which makes them worth more consideration than they often receive. In the article which we publish in this week's issue the author draws attention to that much-boomed apparatus the electric washer. He points out that not only are the claims made for the sales of this typically American machine obviously exaggerated, but that the machine itself is open to severe criticism in design and employment, while it is not really a domestic electric apparatus at all. Its undoubted faults make it a secret enemy rather than an ally to the development of domestic electricity. The author makes a number of points which we leave to speak for themselves; but he has not mentioned one disadvantage of this machine—that is the noise it makes. This is likely to be a considerable nuisance to neighbours in our congested housing districts, and from this arises the ghost of a domestic tragi-comedy, wherein Mrs. A. knowing that Mrs. B has become possessed of an electric washer, and being especially annoyed that she is not equally fortunate, will take proceedings for nuisance.

Pitfalls of Inventors.

THE action brought by the BRITISH THOMSON-HOUSTON CO., for an injunction to restrain the alleged infringement of their patent No. 10,918 of 1913 dealing with "improvements in incandescent lamps" has been dismissed on appeal. The action illustrates the intricacies of our patent law and exhibits the pitfalls into which an inventor may fall once he begins to patent the results of his work. The patent in question related to gasfilled lamps and the specification contained a claim for "an incandescent electric lamp having a filament of tungsten and of other refractory metal of *large* diameter or cross-section or of concentrated form, and a gas or vapour of low heat conductivity at relatively high pressure, &c." (The italics are ours). It was admitted that the lamp had nearly double the efficiency of the ordinary tungsten filament lamp and that it had a large and increasing sale. Among the defences raised was that the complete specification did not sufficiently describe the nature of the invention. Mr. JUSTICE SARGANT, however, held that, though the patent was not assailable on the ground of proper subject matter, it was bad because the claim was too wide and covered the sole right to apply the principle comprised in the discovery.

Result of Appeal.

THE Company appealed, but the higher Court also held that the word "large" was too ambiguous to define the monopoly claimed. The invention, which was communicated by the General Electric Company of America, was admitted by all the judges to be good subject-matter for a patent and to be beneficial owing to the great economy in lighting that could be effected by its use. We therefore sympathise with the inventor, who has made a valuable discovery only to fail to secure protection because he has not been sufficiently precise in the phraseology used. As we have frequently urged, the moral to be drawn is the necessity for great care in the preparation of patent specifications, more particularly in the claims made.

Difference of Opinion in the United States.

THOSE who consider that judicial decisions on such matters have much the same uncertainty as betting on horses will be supported in their view by the decision reached a few months ago by the Federal Court of Appeal of the State of New York in the General Electric Company v. the Nitro-Tungsten Lamp Company. The original action was for infringement of patent rights on the lines we have just indicated and the District Court of New York found for the plaintiffs. The defence was that the claims made were too indefinite, but the Appeal Court held that it was impossible to define the parts of the lamps in dimensional units or to give exact measurements, because the economic object of the lamp was to diminish the wattage per candle and dimensions must therefore be proportioned to the designed wattage. International patent law would therefore seem to be a matter for the League of Nations, when that amorphous body can find time to deal with it though we do not advise the British Thomson-Houston Company to be in any hurry to bring their claims forward.

Companies and Grants for Research.

A CASE of considerable interest to both engineers and scientific institutions came before the Court last week when the validity of a resolution passed at an extraordinary general meeting of Messrs. BRUNNER, MOND & COMPANY, Ltd., was called in question. By the resolution it was proposed to make a grant of £100,000 to universities and scientific institutions for the advancement of education and research. As is usual on such occasions there was some captious and unenlightened opposition and subsequently a Mr. EVANS opposed the resolution and further distinguished himself by commencing legal proceedings to restrain the directors from acting as they wished. Now it is well known that a company can only perform such things as are authorised by its memorandum and articles of association. It is equally well known the Brunner, Mond & Company are primarily chemical manufacturers, but Clause 3 (s) of their memorandum empowers them to do all such business as may be incidental to the furtherance of this object. The plaintiff's case was that this loophole was not sufficiently large to pass the endowment of general science and that if the expenditure could be made to provide a reservoir of highly-trained men for the company it could also be incurred for education generally—which, of course, would be very horrible.

The Doctrine of Ultra Vires.

THE doctrine of *ultra vires* is a highly technical branch of legal learning and it has been a fruitful source of litigation, but we are glad Mr. JUSTICE EVE took a broad and sensible view of the matter and thus proved that the law is not always an "hass," even if some of BRUNNER, MOND'S shareholders are. In giving judgment, dismissing the action, he pointed out that the question was really whether such an application of the funds was within the Company's power. From the evidence it appeared that the expenditure would be for the benefit both of the community and the company. That seemed to do away with the criticism that the resolution was too general and not confined to a special branch of science. Those universities and institutions to which grants were made would, no doubt, be resorted to in the future by persons of capacity from all parts of the world, who might in some cases act as rivals to the company. But it was a question of degree whether the advantage outweighed the disadvantage, and, on the evidence, his Lordship thought that it did. There was evidence that the company found it difficult to secure the right class of men for the proper conduct of its business as chemical manufacturers and he thought the provision of the fund would bring into existence an efficient body of men from which recruits could be drawn. We welcome not only the decision, but the reasons for it and we hope that other companies, engineering as well as chemical, will follow the good example set by Messrs. BRUNNER, MOND & COMPANY. It would, however, be advisable to see that their constitution is sufficiently wide to enable them to do so or they will find some parsimonious or litigious shareholder raising objections. This is important at a time when much more in this way is, we hope, going to be done by electrical manufacturers.

The Moral of It.

There are several kinds of Presidential Addresses. There is, first, the kind that differs very little from the Papers which it is customary to read before the society to which it is delivered. It deals with some particular phase of the work upon which the occupant of the chair is particularly engaged and is only exempted from the discussion, that would otherwise take place on it, by custom and by the fact that those present are prevented by diffidence or ignorance from indulging in impromptu criticism. The silence thus imposed is generally made doubly sure by not issuing the address to members in advance. Such a presidential address has not a very high place in the scheme of things.

Then there is the presidential address which deals in a more or less general way with progress in the particular branch of science or industry with which the speaker is most familiar. Such an address also has its uses, especially as a work of reference if it is accompanied by sufficiently copious footnotes; but it is also exempted from formal—or, what is more important on such occasions, from informal—discussion by the fact that it deals with self-evident truths, which neither invite nor admit of controversy.

THE ADDRESS OF THE ONLOOKER.

The third kind of address deals with progress in science or industry, or in both as a whole. It is necessarily composed by a worker in one or other of the numerous small plots in these extensive fields; but the composer is one who has not permitted the mental myopia which is a concomitant of the specialisation of the present day to cloud his outlook on the movements which are going on outside his own sphere, or to their importance on both past developments and future progress, whether it be in a particular section of the field or in the field as a whole.

It is into this third class, which is the most useful of them all, that Mr. LLEWELYN ATKINSON'S presidential address delivered to the Institution of Electrical Engineers last week falls. It is, of course, by the custom we have already noted, exempt from formal discussion, but when once the magnetic field caused by the attractiveness of its subject-matter and the charm of its delivery have died away, it will be widely and critically discussed in an informal way, and will be a work of reference for many a long day. We can think of no better use to which it can be put.

THE RECORD OF A JUBILEE.

As will be seen by the abstract which we publish on another page of this issue, an abstract much shorter than we could wish it to be, Mr. ATKINSON starts from the old familiar point of the present position of the Institution, describes the increases in the range of its activities during the fifty years that it has been in existence, and deals shortly with the technical, financial and administrative problems with which it is now faced. As he shows, the Institution has not only grown taller as the years have gone on, but it has also broadened out, and, to change the metaphor, for the present, after a massed attack that has carried a very important line of trenches, it must undergo a period of recuperation before it can safely undertake any further attempts at a development which is really necessary for its well being.

Then, by a species of electrically-operated time-machine, with 1871, the date of the founding of the Society of Telegraph Engineers as a starting point, we are taken successively over the developments that have been effected in the various fields of electrical, scientific and engineering knowledge. The value of such an exposition must depend on the expositor. It might be worthless, but true, or packed so full of meat that it would be difficult to digest, being accompanied by none of that pepsin which makes assimilation easy. It might be lively and untrue, on lines which, though popular in modern biography, are hardly suited to the pronouncements of a President of a learned body. In fact, as regards historical detail, it is both true and lively—qualities no doubt derived from the character of the speaker, but more from the circumstance that he has lived most of the history about which he is writing. Such a man is the best kind of historian if he can avoid the fault of failing to see the wood for the trees. In Mr. ATKINSON'S case, his comments, too, are not without their value, though whether they will receive general subscription is rather doubtful. It is a little early to say. It is true that the onlooker sees most of the game, but he does not always best understand the game's difficulties. That is what has sometimes happened to Mr. ATKINSON. Still, even in such cases, he represents a point of view which it is useful to have even if it only gives rise to criticism.

THE FUTURE OF THE ELECTRICAL INDUSTRY.

So much for the past. When we come to the future, Mr. ATKINSON is upon surer ground. Speculations about new methods of power generation, of radio-communication, of electric vision and of the application of electricity to agriculture, are worth every consideration at the present time so long as they are well reasoned, sane and broad in their outlook. The point of view from which all these problems are regarded is in itself important, and Mr. ATKINSON possesses the useful quality in these troublous times of being able to look at old problems from new points of view. That way solution lies.

SCIENTIFIC METHODS IN INDUSTRY.

The past and future having been discussed, in the concluding portion of the address we return to the present (the most important period for all of us) with a stirring plea for the application of scientific methods to commerce and industry. What is required in both, says Mr. ATKINSON, is organised knowledge, so that what has been done in the past may be taken advantage of in the future, instead of innumerable fresh starts having to be made, as is the natural result of present methods of working. Many of the troubles of electrical industry can be solved by the formation of associations representing the separate branches which, by damping the oscillations caused by attacks on or from competitors, will enable the whole body to devote itself to the overcoming of external competition, to the cultivation of overseas trade, to the development of improved processes and to an enjoyment of the benefits arising from an increased application of scientific knowledge. Along with this must go the education of the public to an appreciation of the benefits that will follow from the employment of electrical apparatus by, as Mr. ATKINSON truly says, the creation of a vacuum into which goods will naturally flow, instead of having to be pushed, as is necessary with our present-day policy.

A NON-VICIOUS CIRCLE.

A great deal has recently been heard about the vicious circle. But a circle is not predestined to viciousness, and the circular tour which Mr. ATKINSON has so ably conducted for the benefit of members of the Institution of Electrical Engineers is one of which, owing to its educational possibilities, most electrical engineers stand in real need. The giants in the past did well for the electrical industry, but now, as Mr. ATKINSON said, there are so many giants that great stature is of no account, but with that increased stature goes increased responsibility, and the future, therefore, expects even more from electrical engineering than has been given in the past. One of the quaint philosophers in "Alice in Wonderland" says that every story has a purpose, but that purpose may be implied as well as explicit. We take it that Mr. ATKINSON'S implied purpose is, to paraphrase Bacon, that the time has now come when the debt which each man owes to his profession should be paid in full with interest by electrical engineers.

The Cost of Electric Traction.

The great question upon what system the railways of this country are to be electrified having presumably been settled by the report of the Ministry of Transport Committee, there remains the still greater question whether it will pay to carry out the conversion from steam to electric working. The answer, of course, depends on two things: The expectation of saving money on operating expenses by making the change, and the possibility that electrification, while costing just as much as steam working and predicating also an increased capital account, will bring in more revenue than the present methods of working and thus increase the margin between receipts and expenditure. In attempting an answer to this question, too much reliance must not be placed on estimates. They are misleading, and the only really safe basis must be actual operating results. Unfortunately, such published results are very meagre and we remember only three Papers dealing with British railway practice in which anything like full information has been given in a form suitable for use by railway engineers.

The Liverpool-Southport Electrification.

The first of these was Mr. (now Sir John) Aspinall's Presidential Address to the Institution of Mechanical Engineers, which was published and criticised in The Electrician for April 30th, 1909. It will be remembered that Sir John dealt with the electrification of the Liverpool-Southport section of the Lancashire and Yorkshire railway and took as his text the dictum that electrification had been adopted "not to save, but to make money." Nevertheless, it was found that there was a considerable saving in coal consumption per ton-mile, and that other economies are a corollary to the improved methods of traffic working which are possible when electrification is introduced. Dr. Steinmetz, speaking recently, put this fuel saving as high as 60 per cent., and pointed out that there was an auxiliary economy possible in only having to transport the coal to a few places on the line instead of to numerous coal dumps and stores. Mr. Armstrong, in a Paper to which we refer below, gave similar figures, and there seems no reason why British and American practice should differ much in this respect.

Mr. Roger Smith's Presidential Address.

In Mr. Roger T. Smith's Presidential Address to the Institution of Electrical Engineers, with which we dealt in our issue of November 21st, 1919, it was pointed out that the cost of a steam locomotive was 2s. per passenger train mile, and about 4s. 8d. per goods train mile. Electrification would give corresponding figures, if the cost of energy and the amount necessarily payable on account of interest did not together exceed 1s. 2d. in the case of the passenger locomotive, and 3s. in the case of the goods locomotive; or, put in another way, if the weight of the passenger train did not exceed 175 tons and of the goods train 1,000 tons. Taking present practice as a standard therefore, it appears that the electric working of main line passenger traffic would hardly be a paying proposition, while the electric operation of goods traffic would be quite remunerative if the cost of energy did not exceed 0·5d. per unit. Experience has, however, shown that with electrification the traffic does not remain constant but increases at a rate that some systems in this country have found almost embarrassing. It is therefore fair to draw the conclusion from both these pronouncements that electrification is not likely to cause any actual saving, but that it will certainly bring an increased revenue, which properly employed comes to the same thing. This is a point which is not new, but as it is often disregarded in discussions on this question, nothing will be lost by once more pressing it home.

Electric v. Steam Locomotives.

There is, however, another side to the picture. Dealing with the related question of locomotive performance Mr. A. H. Armstrong, in a Paper read recently at a joint meeting of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, compares the performances of the Mikado and Mallet types of steam locomotive with the electric locomotive, and concludes that the last can deal with heavier loads more expeditiously and efficiently and with a lower labour cost than either of the other two types. The electric locomotive is, in fact, especially useful in relieving congestion on single track sections and should permit of the tonnage capacity of such sections being increased by fully 50 per cent., while its greater braking possibilities makes the carrying of traffic on the down grades very much safer. Its maintenance costs are about 15 cents per mile, compared with 60 cents for the steam locomotive.

These figures from American practice therefore tend to show that there is a direct saving to be gained by the adoption of electric traction. The economies of electrification do not, however, end here. For it is obvious that though an actual saving over the older methods of working may not be in all cases obtainable, yet there must be in all cases where electrical working is used methods of operation which give the best financial results. It is here that these engineers who have already had experience with electrified railways might help us, if they would.

Operating Data from the United States.

We, therefore, welcome some operating data concerning the electrified section of the Chicago, Milwaukee & St. Paul Railway which have recently been published in a Paper read by Mr. R. Beeukes before the American Institute of Electrical Engineers. It will be remembered that the system is operated by high-tension direct current at a pressure of 3,000 volts, and that the section in question, which is 440 miles long, contains some very severe gradients, passing as it does over the Rocky Mountains. The section is divided into two to which energy is supplied at 100,000 volts under two separate contracts. Each of these contracts provides for a minimum payment on the basis of a 60 per cent. load factor and when this is exceeded each unit consumed is paid for at the rate of 0·536 cents. To ensure the maximum economical working, however, the demand is controlled by a "dispatcher" whose duty it is to prevent the power demand exceeding a certain amount. This he does by lowering the voltage and thus decreasing the speed of the trains. Such an arrangement has also the effect of increasing both the time taken to carry goods and the engine driver's wages, so that it cannot be pushed too far. And in practice it is found that a great deal can be done by arranging the running of trains over the section on a time basis, and that the time the limiting action is in operation does not in most months exceed 10 per cent., and is sometimes as low as 2 per cent. Consumption readings are regularly taken on each locomotive and it is found that about 66 per cent. of the energy delivered to the system is usefully employed, while the average consumption per gross ton mile train taken over a year's working is 34·8 units at the high-tension 'bus-bars and 23·8 units at the locomotive. The average load factor is 57·3 per cent. and the cost per unit per gross ton mile is 22·5 cents. These figures apply to one division alone, though those on the other are very similar. The cost per unit delivered to the locomotives is 1·1 cents.

As regard maintenance some figures recently published for the working of the St. Clair Tunnel on the Grand Trunk system show that the average cost of maintenance was 4·5 cents. per locomotive mile up to 1915 and 7·05 cents. for the last five years. Moreover, the locomotives were available for more than 90 per cent. of their life.

These figures, though interesting and given in a form which we should like to have for electric railways in this country, are hardly comparable with anything our railway engineers are likely to obtain. We are more concerned with suburban traffic than mountain divisions, and with the railway companies generating their own power the question of demand limitation ceases to have so great an importance. Nevertheless, a detailed analysis of the costs of operation would be both interesting and useful. We hope some public-spirited railway will supply them without delay.

Mr. Llewelyn B. Atkinson on Electrical Science and Industry.

Past Progress and Future Developments.

It is not generally realised that the main work of the President of the Institution of Electrical Engineers lies in something else than writing his address. For his year of office he is, as it were, the chairman and managing director of this great Institution, and what with the ordinary meetings, the meetings of the local centres, and of the committees and joint committees on various subjects, it is becoming nearly a whole-time job. Unless these tendencies can be modified, few members will feel able to undertake the office of President, because they are unable or unwilling to devote the time and administrative effort necessary to the office.

The Jubilee of the Institution.

The year 1921 will be the jubilee of the Institution of Electrical Engineers, as the Society of Telegraph Engineers was founded on May 17, 1871, the first general meeting being held on February 28, 1872, when the President, Dr. William Siemens, delivered an address dealing principally with the objects of the society, and made clear that he at least regarded it as a specialists' society, and thought of the Institution of Civil Engineers as the Institution of Engineers. Substantially the Society, and subsequently the Institution, retained that point of view for the first 35 years of their joint existence, but by a process of evolution the Institution of Electrical Engineers has now reached a position where it claims to represent science and an industry based on that science. It is the first of the great institutions to have been forced by the circumstances of its industry into such a position, and this function of its activities has to a considerable extent been brought about by the fact that electrical engineering is largely concerned with public services.

The Present Position of the Institution.

The increased sympathy existing between the Institution of Electrical Engineers and all classes in the industry may be traced to the time when definitely or implicitly this great difference between it and the older institutions was recognised, and its work was adapted to the needs of the electrical industry. The great extension of the activities of the Institution and its twelve territorial centres and sub-centres, whilst it has raised it to the position of the most active engineering force in the country, has created its own special problems, notably that of finance. The meetings, of which 105 in all took place during the last session, in themselves involve considerable expense. In addition, the cost of printing the "Proceedings" has increased from £2,000 in 1914 to £6,000 in 1920, and a point may soon be reached comparable to that of the old London Electrical Society, which was submerged in the cost of printing its own proceedings. It is therefore evident that some editing of the discussions and proceedings will have to be put into force if the present number of Papers is to be published. A reduction in the number of Papers is to be avoided if possible, as it would mean a number of Papers on electrical subjects being taken elsewhere in order that they might be published.

The fact that members have to grasp in this connection is that this Institution is giving more to its members than any other has ever attempted, and that comparisons of the cost of working of it and the necessary subscriptions thereto with those of other similar bodies have no common basis. In 1917 Mr. C. H. Wordingham dealt very exhaustively with some possible further activities of the Institution. Some of these have been inaugurated and others are waiting until the building is regained. For the immediate future the great advances in the Institution's activities render a period of digestion necessary before any further radical changes are made. The question of registration was very fully discussed last year, and when the time comes again to deal with this principle the members will be invited to take a hand in settling it. It will, however, be a *sine qua non* that this great Institution takes in any such scheme the position to which it is entitled. One of the results of the war was the stripping of the colleges of their students, and the result will be that in a certain number of years there will be a dearth of men coming forward with the necessary qualifications for full membership of the Institution.

The Electrical Progress of the Half Century.

In 1873, the second year of the life of the Society of Telegraph Engineers, the first edition of Clark Maxwell's "Treatise on Electricity" appeared. The treatise was the starting point of modern electrical theory, and it is unfortunate that its subdivision into two volumes was not made, because many engineers have never studied Maxwell's work owing to their having been dissuaded from doing so by the formidable nature of its analytical parts, whilst the principles might have been clearly understood with only a general knowledge of the mathematical methods adopted. At the time of this book's publication there was absolutely no knowledge of what actually constituted the electric current, but the work on electrical discharges in rarefied gases of Spottiswoode, De la Rue, Gordon and Crookes, and later of Lenard and Röntgen, terminated in 1896 with the discovery of the electron, and the part it plays in the phenomena of the electric current. Many writers, notably Oliver Heaviside, followed up what Maxwell had commenced, and the results predicted received their full proofs with the experimental work of Hertz, leaving us with the unsolved problem with which electrical science is doubtless called upon to deal—the nature of the atom.

Electronic Theory.

Tied up with this lies the complete solution of the problem of temporary and permanent magnetism. Investigations which have been made in connection with the electron have led to a revision of our ideas on some questions of mechanics. Following the investigations of Sir J. J. Thomson, published in 1881, on the quasi-inertia of a moving electric charge, we cannot regard the electron as having a fixed inertia mass. It cannot move without setting up movements in the ether involving the storage of energy therein, and the amount of those movements depends on the acceleration and also on the velocity of the electron. The inertia mass of the electron, therefore, is in part or wholly an expression of a rate of storing energy in the ether. Experimental investigation seems to show that the whole mass of an electron may be thus accounted for, and it is clear that at least some part, if not the whole, of the inertia mass of all matter arises from the energy effect of the ether disturbances which take place when matter is accelerated, and these disturbances being transmitted with a finite velocity, the inertia mass of all matter in whole or in part depends on the velocity with which it is moving. It is quite clear, therefore, that we as engineers have to accept considerable changes in the views on which the scientific training of most of us was often based, and the theory of relativity enunciated by Einstein adds to the truth of this dictum.

Whilst, however, it is necessary that engineers should prepare their minds for great changes in their conceptions of these matters, this need give rise to no misgivings about the ordinary results of mechanics and physics as applied to engineering. We may say that a complete expression for the mass or the energy of matter involves a series of terms dealing with their velocities and accelerations. Such a series involves terms some of which only become of importance for velocities comparable with the velocity of light, and others, which are more moderate velocities, produce disturbances not comparable with the terms that are of importance to us within the limits of ordinary experiments.

Generation of Electric Current.

The simultaneous publication in 1867 by Werner von Siemens and Sir Charles Wheatstone of their inventions of the shunt and series self-exciting direct-current dynamos, and the invention by Gramme in 1870 of the closed-coil armature, gave a fresh impetus to the practical construction of what at that time was considered to be large machines. The year 1873 saw the invention of the drum armature winding, and in 1885 Drs. John and Edward Hopkinson gave a complete solution of the determination of the magnetic flux in the single complete magnetic circuit of a dynamo. The necessity for a robust tramway motor led to the adoption of the slotted armature, the sparking due to which was eliminated by the help of the carbon brush, which since 1900 has excluded all other types. Commutating poles, which had been used as early as 1885, returned in 1905 and are in general use to-day. In 1883 Gaullard and Gibbs produced the first transformer, and the possibility thus opened up of distribution at high pressure, and the use at a lower pressure led to a renewed interest in alternating-current generators. In 1882 Dr. John Hopkinson showed that alternators could be run in parallel, and this was experimentally demonstrated by Prof. Grylls Adams in 1884. The year 1886 saw the invention of Tesla's 2-phase alternating current motor, and 1890 the invention of the 3-phase motor of Dobrowolski, while the first demonstration of power transmission at high pressure occurred in 1891 in the Lauffen-Frankfort installation.

Problems of Generation.

The improvements in high-speed steam engines and their adaptation to the direct driving of electric generators has been largely accomplished by electrical engineers and members of this Institution. Two types in particular have contributed to this progress that associated with the name of Willans and the steam turbine first introduced by Parsons in 1884. The progress of late years in the generation of electricity has been in the direction of enlarging the units, thus increasing the efficiency and diminishing the amount of attendance necessary. It appears probable that we have now reached the present economical limit of size and that the immediate problem of electrical generation to-day lies in the direction of more complete utilisation of fuel by selective distillation, with the recovery of useful products, and in the use of gas and coke in the boiler furnaces, or by complete conversion of the coke into gas for use under gas engines.

It is probable that the future gas turbine will work on a cycle of combustion at constant pressure, with adiabatic expansion through nozzles, giving the gas the necessary velocity for a turbine wheel, the constant pressure for combustion being obtained by pumping the air and gas to the turbine through regenerators heated by waste heat. The inherent advantages of such a cycle for large units are so great that sooner or later the difficulties of the compression part of the cycle will be overcome. Efforts are also being made to give wider ranges of temperature in the working fluid in heat engines by the use of mercury vapour, and improvements in condensers are being made to maintain higher vacua economically.

There still remains the possibility of some completely new process which will eliminate the heat engine and dynamo and substitute some other method of producing the electron stream that we call the electric current. In this connection the possibilities suggested by what is called the photo-electric effect cannot be overlooked. When light of certain wave lengths falls on a metal, the metal becomes positively charged, electrons being liberated. As far as we know the energy which liberated electrons possess is greater than that supplied by the light wave if the energy of the wave is uniformly distributed. Photo-electric cells capable of generating small currents have been produced, but the whole subject is as yet awaiting further research.

Central Station Supply and Transmission.

After the demonstration at Frankfort in 1891 electrical transmission of large amounts of power over long distances was only a question of gradually improving technique. This country, by lack of water power and by the smallness of the distances involved, does not lend itself to striking examples of such transmission. On the other hand, the density of the population and the universal demand for light and power has led to the development and distribution of power on a large scale. The history of this development has been largely influenced by the Electric Lighting Act of 1882, and what has been effected has been done in spite of and not by the help of legislation. Political misunderstandings bound up a technical instrument for annihilating space within the narrow space limitations of the municipal and urban boundary until war, the universal solvent, roused even politicians to the fallacy of this policy, and now we have under the newly-appointed Commissioners to begin again, the problem to be solved being what is to be scrapped and what is worth preserving out of the medley of generating stations in existence. How are they best to be linked up and what is to be added to the new and who is to initiate and finance the new. Forty years we have worked in the wrong direction, and the task is indeed a most formidable one. Considerable progress is being made in the organisation of areas for linking up, but who is to control the policy? Every element of jealous humanity is there, and much diplomacy and much good will and some force will be necessary for the solution. The third stage, the provision of new and additional generating stations, is that which will give rise to the greatest engineering and technical interest and discussion.

The Scientific and Directional Staff.

The discussions and uncertainties surrounding the future programme of electrical generation and distribution are having a very serious psychological effect on the engineering and directional staff of the supply industry. The position of these staffs, especially in the small undertakings, has never been very happy. Men of considerable engineering ability have had to contend with environment in which local and labour politics form a dominating feature. The result has been in many cases a condition of semi-apathy. This has been greatly aggravated in the last year or two by the belief that all the smaller stations were to be swallowed up, with the result that there has been a general loss of interest in the work. The appointment of the Electricity Commission, while it has been loyally accepted, has also led to an attitude of mind whereby the Commissioners are regarded as the *deus ex machina* who will solve all problems and dissolve all troubles. The realisation that generation will cease and distribution only remain and that salesmanship rather than engineering skill will be the predominating feature, is naturally not very agreeable to engineers whose work and pride has been in engineering. And the fact must be faced that one reason why large generating stations will be more economical than the smaller one is the decrease in the amount of skilled superintendence that will be necessary. This class of occupation will diminish, and compensation must be found in the increasing use of electric current and the diversion of the engineer's function to new openings, the designing of equipment for new operations and stimulating consumption and distribution.

Cables for Power and Lighting.

In 1871 the gutta-percha and rubber insulated cables were widely used for telegraphic purposes, and naturally the same sort of cables were adopted when electric light and power appeared. In 1885 came the early bitumen insulated cables which suffered like gutta-percha covering from softening and decentralisation of the conductor with heat. Systems employing bare conductors at one time were quite extensively used, and in 1890 Ferranti produced the paper insulated high pressure main in connection with the Deptford station. Before, however, any considerable length of this conductor had been made oil-impregnated paper-covered stranded conductor cable with lead covering was developed and a definite and permanent type established. To-day it may be said that the vulcanised rubber insulated cable holds the field for internal work, and that for underground mains working at low and medium pressure vulcanised bitumen cable or the paper insulated lead-covered cables are the general practice, while for higher pressures lead-covered paper-insulated cables are used exclusively.

Whilst the type of cables enumerated have by a process of elimination become standardised, it must not be supposed that they have not developed, and future progress seems to lie in the direction of the improvement of the material in two directions, either in discovering papers of a different chemical composition, or in the discovery of a new method of applying felted fibrous materials. As it is, the constant improvement of quality of the paper in the sense of elimination of weak spots is taking place. The dielectric strength of paper as used for cables is 500 volts per mil, but the dielectric strength is only operated in cables at, say, 50 volts per mil, the wide margin being necessary to cover the inequalities of the material and the irregular and unexpected rises of pressure to which they are subjected. The great fall in the price of rubber may have a permanent bearing on the future types of high pressure cables.

Telegraphy by Land and Sea.

At the foundation of the Institution the electrical telegraph was well-established, as in 1853 the principles of duplex working had been invented, and in 1877 the diplex which had already been theoretically foreshadowed came into use, thus forming the quadruplex system. These methods generally meet requirements, though on certain lines the traffic is heavy enough to justify special methods. For this purpose two broad principles have been worked on, those typified by the Wheatstone system where several operators prepare messages which are sent over the line by an automatic sender and are received by an automatic printer of some kind, and those systems where the hand sending remains, and the line is given in turn to several operators, the receiving station being coupled in synchronism, all operators having a line for some part of the time taken to give one signal by hand. This is called multiplex telegraphy. The Committee appointed by the Postmaster-General in 1914 to consider this question came to the definite conclusion that for this country the multiplex system was superior to the automatic. The special apparatus mentioned in the report working the duplex with quadruple sending and receiving sets at each end despatched from 40 to 50 telegrams per hour per operator, thus making 160 to 200 messages each way per hour. One such apparatus dealt with two-thirds of the whole Manchester-London traffic, and very few circuits would keep one apparatus occupied. Hence we may certainly say that even for crowded traffic, inventions are ahead of requirements. Probably the most needed apparatus to-day is a cheap and simple transmitter worked from a typewriter keyboard, and a cheap and simple printing receiver to replace the hand-operated sender instrument for smaller offices, for the reason that there is a remarkable supply of people able to use typewriters, and the printing receiver obviates clerks skilled in reading Morse code.

The speed of signalling at telegraphic frequencies has been greatly increased by the use of the thermionic valve tube as a repeater. In submarine telegraphy heavier conductors, improved methods of working, the use of inductance shunts, and the employment of other sensitive relays has brought this speed up to 300 letters per minute under duplex conditions of working, and permit of Morse printing instruments being used, while the thermionic amplifying valve is producing a further increase due to the possibility of operating it with smaller current than any other relay.

Progress in Telephony.

At the date of the foundation of the Institution telephony did not exist, but in 1862 Reis had invented an instrument, though there is no evidence that it was ever used by him for transmitting speech. In 1877 Graham Bell gave an account of his researches and inventions to the Institution. Bell's receiver and transmitter has varied very little for the past 20 years, though the operations of both have been very carefully studied and improved. In 1882 the suggestion by Jacob of using two complete metallic circuits as the metallic circuit for a further telephone, the so-called "phantom" working, and the researches of Heaviside published in 1887, showing the conditions giving rise to attenuation and distortion of telephonic transmission and indicating that distributed capacity and induction in certain proportions would minimise both, combined with Pupin's analytical and experimental establishment in 1899 of the conditions necessary to embody these ideas practically and their first application in 1902 marked notable advances.

The problems awaiting solution in telephony include more research into the nature and production of vocal sounds, so as to lead to some method of production and measurement which will enable accurate tests to be made of telephone transmitters and instruments for this purpose, independent of human estimation. The subject of multiplex telephony is also one of the coming problems.

In addition there are questions of financial and administrative, rather than technical interest. Comparisons are often made as to the number of telephones per head of population in this and other countries, but probably if we had a comparison of the messages per telephone or even the total number of messages per head of population a different story would be told. In most businesses the cost of an individual service becomes less as the number of services increases. In the case of a telephone exchange the operating costs of each connection increases as the total number of connections increases, for the simple reason that each individual can and does make more calls. It is for this reason that comparisons of the annual cost of the telephone is quite fallacious unless the number of calls is referred to, and why any system of flat rate charging is inequitable. The problem for telephonists therefore becomes technically one of keeping all main and junction lines working fully, this being a question of the proper distribution of centres and sub-centres, together with a proper system of charging so that every user pays for what his service costs. In this connection the system whereby the Post Office records the charges and renders an account at intervals is most unsatisfactory, and sooner or later some method of rapidly opening a call as registerable must be put in operation.

Wireless Signalling.

When the Institution was formed the idea was in many minds of signalling without any actual wires, but the results of experiments were not very encouraging until after 1876, when the invention of the telephone provided a means of picking up exceedingly small currents. In 1880 Prof. John Trowbridge commenced a series of experiments on wireless methods by conduction through earth, and these were developed on a much larger scale by Preece. From 1887 to 1889 Hertz published the results of his investigations, and many experiments were carried out during the years 1892 to 1896, culminating in the adaptation and improvements of Marconi, and his discovery of the vertical earth antenna, so producing a workable apparatus. From this point improvements have been largely in detail, and include the discovery by Duddell in 1900 of the electric arc method of producing oscillations which has been developed by Poulsen and others. The greatest discovery, was, however, to come. Long ago Edison observed that an incandescent filament allowed a current to pass between it and an independent electrode in a lamp valve, and in 1913 Dr. J. A. Fleming discovered that a current would only pass in one direction. The apparatus was, in fact, at once a rectifier and a sensitive detector of small electric disturbances. It was improved by Lee de Forest adding a grid placed between the hot cathode and cold anode. This when connected to a separate circuit, the variations of whose potential, even if small, produced great variations in the electron stream, opened the way to a most remarkable series of results that the history of electric science has to offer. By suitably ringing the changes we have in this apparatus a wireless receiver and detector and an exceedingly sensitive relay, a current magnifier and a generator of oscillations. In fact, the thermionic valve is finding application in almost every branch of electricity.

With the apparatus thus provided producing continued wave trains, means of receiving, rectifying and amplifying the received wave train, a steady flow of energy which could be received as a uni-directional current operating a magnetic telephone or as an alternating current operating an electro-dynamic telephone, it only remains to vary the intensity of the wave train by voice modulation in order to accomplish wireless telephony.

The future of wireless signalling is hardly to be estimated. The immediate future will probably see all other methods of generating oscillations give way to the thermionic tube method. In detail it does not differ from the arc method, but the advantage of steadiness of temperature and resistance lies with the tube. Already demonstrations with tubes up to 20 kw. capacity have been given. The recent development of automatic transmission by high speed senders with perforated tapes and reception with telephones and dictaphone recorders holds out singular promise. First, as to secrecy and secondly as to transmission at speeds only limited by the capabilities of the transmitting and receiving machines. Now that wireless transmission has achieved success in a high degree attention must be paid to design. Loss in reception and dielectric loss in present antenna construction are very large compared with the radiated energy, and nearly the same results hold good at the receiving end. Here then is a field either for much greater radiation or for the same radiation with a much lower input of energy.

Problems Needing Study and Solution.—Electricity in Agriculture.

The position of the problem of electricity in agriculture is not one reflecting great credit on our science. Results have been confused and contradictory, and certainly have not reached any degree of scientific certainty. The effect of past history on a particular piece of land is astonishing. Definite differences in soil occur even in the same field, while the application of a roller at the right time over part of the field may easily add 20 per cent. to the crop of that part. Where tests have been made on treated and untreated seeds there may be a difference in time of sowing one or the other. Where electrification tests have been made there may be a slight difference in the tillage due to poles and wires and hence it is only in the case of tests by really reliable experts who understand the effects of small causes that results of any value can be obtained, and it is just here that tests by reliable experts have so far shown the least effect of the electrical methods. It would seem that careful plot and plant laboratory experiments offer the greatest opportunities for obtaining the cause of the effects that have been observed. The representative committee appointed during the war to consider this question under the chairmanship of Sir John Snell in their interim report, pointed out that with currents of the order of 10×10^{-9} amperes, the effects on the plants were injurious, while with currents to the order of $0{\cdot}3 \times 10^{-9}$ amperes, in the case of young plants at least, the growth was accelerated. This committee is still sitting, and it is believed that some rather more encouraging solutions than indicated by the first report have been arrived at. The problem is certainly one which the industry should study. One of the difficulties at the outset is that few horticulturists or agriculturists understand electrical phenomena, and few electrical engineers understand the scientific basis of horticulture or agriculture, but whilst there is always an air of mystery about the discussions of electroculture the questions to be answered are simple: Does any system of electrification promise to increase the quantities or the availability of any of the primary food necessities of the plant or to augment the rate or the total absorption of the plant foods and if so, at what cost? It may be said at once that the presence of a highly charged conductor with a discharge system cannot augment the quantities of any of the food materials necessary in the soil, except the nitrogen. It is conceivable, but improbable, that it will increase the rate of solution of the natural soil elements.

What are the possibilities? Direct stimulation of growth processes, increase of transpiration of water, decrease of evaporation from the soil, production of nitrates, ionization of nitrogen or carbonic acid and sterilisation of the soil. Of these, the first three are purely electrical and their actions would occur in the region immediately under the wires. But as the effect has been shown not to occur in this manner it can be said that the result is not strictly electrical, but is due to something produced in the neighbourhood of the wires which is heavier than air, but can be diverted by the prevailing wind. The fact that chemical active ions and compounds are produced which move with the wind points to these being the cause of the observed results. Remarkable results also follow increased sterilisation of the soil, and recent researches have shown that one of the most powerful sterilising agents is oxide of nitrogen. This then seems to give a possible solution of the effect of electrical discharges on plants, and the different effects of strong and weak discharges may be that the former produce products other than the sterilising nitrogen, while the latter produce the sterilising nitrogen only.

Problems of Electric Vision.

One of the problems which await solution by electrical engineers is that of electric vision. The broad principles have long been understood and successful results with transmission of photo copies have been obtained with the apparatus of Korn and Thorne Baker. But to make the picture so transmitted immediately and constantly visible requires something else. Either the whole operation must take place and be repeated sufficiently often for the image to impress the retina continuously or the image must fall on a phosphorescent luminous surface. For the first of these methods 75,000 impulses per second would be required, compared with the 800 of telephonic frequency. Wire transmission can therefore hardly be considered for the purpose, and the action of selenium is too slow; wireless transmission methods however, remain.

Research requires to elucidate two questions: Some action of light which acts instantaneously and enables a current variation to be set up; some massless method of illuminating or darkening a surface which can be varied by an electric current. For the first the photo-electric effect might be used, and for the second a vacuum tube with a beam of cathode rays diverted by the current from or on to a phosphorescent point after the manner of the Braun cathode tube oscillograph suggests itself.

The Changing Basis of Productive Industry.

It may be thought that the devotion of any attention to such a subject as industry is outside the range of an Institution like ours. But while we pride ourselves on the engineering efficiency of our great generating stations and on the safeguards for avoiding breakdown, the greatest risk of stoppage is the unlubricated working of the human element. Of what avail is it to continue to perfect the machinery of material civilisation if, in the end, that civilisation is wrecked because of the dissatisfaction of the people for whose satisfaction the perfecting is assumed to proceed?

The basis of the present social and industrial unrest may be shortly said to be the monotony of machine production or operation at high pressure, combined with enough education partially to awaken the reason, but insufficient to appreciate the beauty and triumph of what is happening. The organisers of entertainments of various kinds find an ever-growing multitude of supporters because they provide something to think about besides the mechanical routine of work. If then lack of interest in work under modern methods, lies at the basis of industrial unrest efforts to allay this unrest must contain some element which will overcome this obstacle. Sooner or later we have got to place part of the direct responsibility of management and production in the hands of the operatives, and to do this we must find a basis where the capital required is paid for at a fixed rate, and the whole product beyond is divided between the management and the operative producers. To work on such lines utilises individual skill and enthusiasm, and removes the objection that surplus production benefits someone other than the producer.

Application of Scientific Methods in Industry.

It is a matter of common knowledge that British industry has been for the most part controlled by men without scientific or engineering training. The broad characteristics which go to make a successful commercial man are in fact generally incompatible with the mental attitude of a scientific worker, but if some scientific training were universal in our educational system there would be an understanding by the industrial leaders of the power of the scientific method which would lead then to surround themselves and maintain contact with men of specialised training. Why should every industrial or commercial operation be a new experiment go over ground which has already been covered? Yet this is the situation in many commercial operations.

The solution of this lies in Associations representing the separate branches of the industry. These enable an industry to devote itself to the overcoming of external competition, to the cultivation of overseas trade, to the development of improved processes, all with the benefit of increased application of scientific knowledge. Twenty years ago when the Cable Makers Association was founded, its founders saw these effects in a dim way. But since then the Association movement has spread and has saved the British industry from eclipse.

In no direction is association more needed than in the relation of industry to the public. We have always worked with a plenum or pressure pushing our wares, but now we are beginning to see it is cheaper to create a vacuum into which the goods will flow. In other words, educate the public, enlighten the immense possible market, in fact, work to create a universal demand for electric current. This is the function of the British Electrical Development Association.

These cases of associated effort are examples of the more scientific methods of conducting business, which, whilst utilising individual effort in every direction, nevertheless by organised method use the resources of accumulated knowledge to take the place of wasteful unorganised effort.

The Industrial Outlook in the Electrical Industry.

Since 1871 the manufacturing side of the electrical industry has not prospered as it should have done due to the localised condition of electricity supply resulting in each generating station embodying the special ideas of the designing engineers. This discouraged the placing of contracts for the whole supply undertaking in the hands of one firm and prevented a proper entrance into the foreign market where the opposite conditions prevailed. It also meant senseless competition in the home market which kept the industry in a state of poverty. The danger of such a process was realised as early as 1889 by the cable makers, an industry where it was always possible to obtain some margin of profit at almost any level of price by a sacrifice of quality. Thus alongside a machinery and accessories manufacture in a deplorable financial condition we have seen a cable manufacture dominating the world market and generally in a satisfactory financial position.

There has, however, been recently a movement of integration to enable complete contracts to be undertaken in any part of the world. The close of the era of constructing small plants will permit standardisation, while the increasing size of units will limit the number of newcomers into the industry. The experience of the mass production of standard designs will tend to specialisation, thus eliminating competition and decreasing cost. The general outlook, therefore, appears to indicate a time of great activity for electrical manufacturers with a more satisfactory financial result than in the past.

Relation of Members to the Institution.

Though the age of our great scientific workers, when a few great men stood out from the rest has apparently gone, it is really the number of great workers to-day that leads us to suppose there are none. This Institution contains within its membership men capable of dealing with any scientific problem and it is the privilege of the Institution to be the centre of their work. It should be more and more used for that purpose. The Council has in the past been freely criticised, but while criticism is good constructive suggestion is better. It should be the conviction of every member that the Institution exists to fill his needs and that where the Institution cannot speak with one voice because of its conflicting interests, it should use its power to obtain the best possible hearing for those interests individually to expound their views. The Institution exists for its members, but its members owe it something. Three hundred years ago Bacon wrote: "I hold every man a debtor to his profession, for the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereto."

A New Relay for Heavy Currents.

At a recent meeting of the Physical Society of London a Paper on "A New Relay for Heavy Currents" was read by Dr. Guy Barr. The action of the relay described depends on the fact that no one can be maintained between mercury electrodes in hydrogen. One lead is brought to mercury contained in a vertical tube within a solenoid. An iron rod, at the upper end of which is a glass cup, flouts in the mercury. The cup also contains mercury, and the other lead is connected to an iron rod which dips into this. When no current flows in the solenoid, the rim of the cup is about 1 cm. above the level of the main body of mercury. When the relay current (about 0·03 amp.) is running the iron rod is sacked down until the rim of the cup is submerged by about 0.5 cm. The space above the mercury contains hydrogen. The relay can be used to break quite large currents (20 amps.) without much spark.

In the course of the discussion it was elicted that the working pressure of the apparatus was 100 volts and that part of an iron float in one limb of the tube and contains all the mercury and prevents the break taking place between mercury surfaces as it was important it should. There was little disturbance of the mercury, but the amount of heat losses are uncertain.

Large Electrically-Operated Blast Furnace Chargers.

A number of unique features have been embodied in the design of some recently installed blast furnace chargers, which render them of special interest to the steel works engineer. These chargers, which are electrically equipped with semi-automatic features, are the largest of their type at present working in this country. They consist of two equipments which are identical in every respect, and provision has been made for a third furnace and charger to be added at a later date. The chargers are designed for drop bucket charging, each bucket having a capacity of 8 tons of ore and limestone, or 4 tons of coke. They are capable of charging a furnace with 100 tons of raw material per hour. Their maximum speed on the incline is 6 ft. per second.

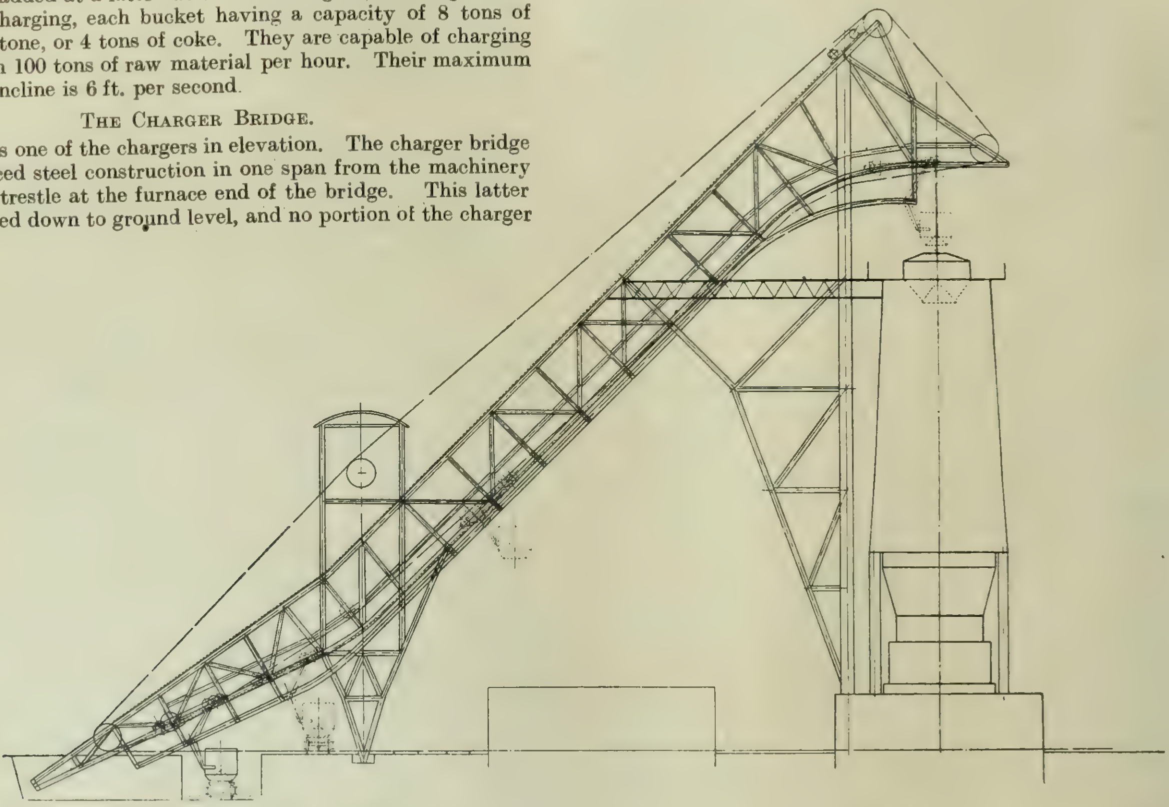

Fig. 1.—General Arrangement of 10-ton Drop Bottom Bucket Charger.
Showing in elevation the carriage track and the balance weight track, at Messrs. Baldwin's, Ltd., Port Talbot Iron Works.

The Charger Bridge.

Fig. 1 shows one of the chargers in elevation. The charger bridge is of the latticed steel construction in one span from the machinery trestle to the trestle at the furnace end of the bridge. This latter trestle is carried down to ground level, and no portion of the charger is supported on the furnace casing. The lower extension of the charger bridge to the bunkers and coke road is built as a cantilever from the machinery trestle. The total length of track on the hoist bridge is approximately 202 ft., and the highest point on the charger at the furnace is 160 ft. above ground level. The machinery trestle is extended over the charger bridge to carry the machinery house and hoisting mechanism. The charger bridge is provided with the necessary tracks for the travelling bogie inside the girders and for the travelling balance-weight on the top of the girders. The ore buckets are lifted, hoisted, discharged and returned empty into the scale cars on the low level line, whilst the coke skips are similarly dealt with from the higher level line.

The travelling carriage, or bogie, from which the bucket is suspended, is of special design possessing several patented features. It carries the hook which engages the bucket stem head, and also contains the mechanism for lifting the bucket clear of the car table. The hook and stem head are so formed that engagement and disengagement are automatically accomplished as the hook creeps past the centre line of the car. As the bucket hook is passing that point, the mechanism in the car causes the hook to rise slightly when engaging, or to drop slightly when disengaging and, as the automatic control gear of the hoisting motor ensures creeping speed at this point, the bucket is lifted from, or deposited on, the car without shock and with absolute certainty at both ore and coke levels.

As shown in Fig. 1, the carriage with its suspended bucket is more or less balanced during hoisting and lowering, by means of a counter weight mounted on the second carriage. This is arranged to run on a track built above the track on which the bucket carriage runs. The track of the former is on a constant gradient, but that of the latter alters in incline near the foot, for the purpose of clearing and accommodating the two car lines at their different levels.

The bucket carriage track is rounded off at the top until it becomes nearly horizontal as it approaches the furnace top. When the bucket carriage reaches this horizontal track its speed is automatically brought down to a dead slow, and finally it comes to a stop directly over the furnace. At this point in the sequence of operations, the forward motion of the hoisting rope is continued and the bucket is deposited on the furnace top; its bottom then drops and the contents are discharged into the bell.

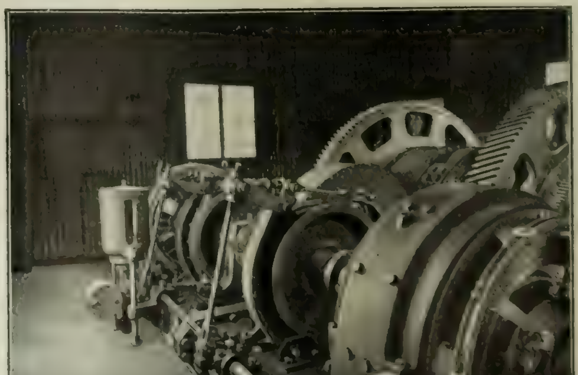

Fig. 2. 150 b.h.p. Stand-by Motor for 10-ton Bottom Bucket Charger.
Showing solenoid-operated and separate hand-operated brake gear

The Prevention of Swaying.

An ingenious mechanical device is employed to prevent the bucket swaying during the hoisting and lowering processes, due to either wind or to the rapid acceleration and retardation necessitated by the increased speed of working of the charger. This consists of a clutch, or steadying arm, attached to the carriage, which pushes the bucket slightly forward, so that it hangs slightly out of the vertical while travelling up the charger bridge. Swaying of the bucket is thus prevented by the force of gravity up to the moment of its being lowered into the furnace, when it is, through the withdrawal of the clutch pressure, allowed to assume its natural vertical hanging position without swinging. A considerable saving of time and gain in accuracy of operation is thus effected over the ordinary Pöhlig type of hoist.

Electric Control Arrangements.

Each charger is electrically controlled from the cabin on the ground level at the foot of the machinery trestle of the charger, the driver having an uninterrupted view of the hook when hitching on a bucket at both the coke and ore levels. Each of the driver's cabins contains control gear for one charger. An ammeter and voltmeter are also fitted, the former being useful for determining the load carried. A depth indicator, fitted with an over travel limit switch, is provided, and shows the exact position of the carriage at any time. The chargers have been designed for the following duty, and to the data given :—

Gradient on carriage track	25 degs. and 45 degs.
Gradient on balance weight track... ...	45 degs.
Ore charge	8 tons.
Coke charge	4 tons.
Empty bucket	4 tons.
Carriage	9½ tons.
Balance weight	15½ tons.
Maximum speed	6 ft. per sec.
Pause on furnace	5 sec.
Changing time	50 sec.
Drum diameter	6 ft.
Rope diameter	1·273 in.
Maximum rope coiled for ore	211 ft.
Maximum rope coiled for coke	184 ft.

The semi-automatic features of the equipment are, of course, embodied in the electrical gear, which is thus of particular interest.

Converter Equipment.

The converter equipment of the two charges consists of three Ward-Leonard motor generator sets (*see* Fig. 3), one being used as a standby set. Each comprises one 120 h.p., 3-phase, 50 ∼ 3,000 volts., 720 revs. per min. squirrel cage induction motor mounted on the same bed and driving one 95 kw., 500-volt generator and one 3·5 kw. exciter. The rope drum on each charger is driven through double reduction, double helical gear by a 150-h.p. 500 revs. per min. motor, a second 150-b. h.p. motor being fitted in each case as a standby (*see* Fig. 2). Both motors on each charger are fitted with jaw clutches so that the spare motor can be used for driving the charger at short notice.

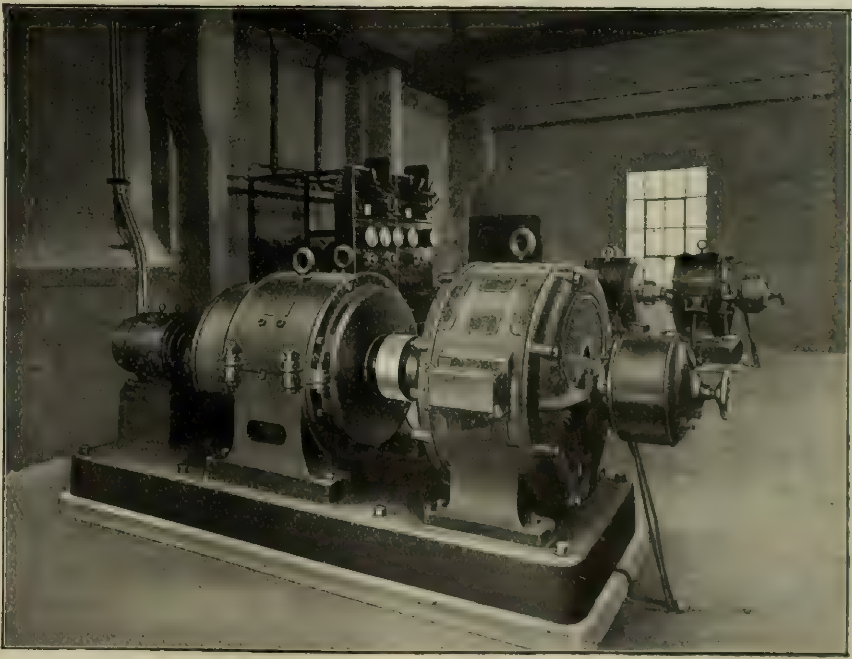

Fig. 3.—Motor-generator House.

Showing 95 kw., 500-volt motor-generator sets (semi-automatic Ward-Leonard system), with 3.5 kw. exciters, supplied by Metropolitan-Vickers for 10-ton drop bottom bucket chargers.

Duplicate Ward-Leonard controllers (*see* Fig. 5) are also fitted to each equipment, and a change from one to the other can be made in a few minutes. The switchgear is provided with change-over switches, so that the spare motor-generator set can be changed over to either charger motor. The stand-by motor or controller for each charger can be put into service when required, also, by means of change-over switches. The question of spares is always a most important one in blast furnace practice, and the consulting engineers decided that, with such large furnace outputs as in this instance, it would pay to provide complete duplicate driving units, so as to obviate entirely the risk of a shut down. With the arrangement above described, an exchange of drive and control can be made each week, each day or at any time, with the utmost convenience, so as to ensure that all plant is kept in thorough working order, and the stand-by plant prevented from becoming defective through disuse and want of attention.

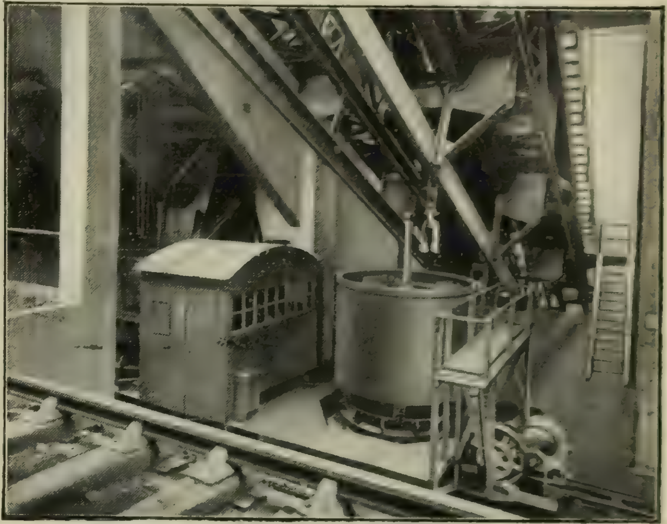

Fig. 4.—The Scale Car for 10-ton Drop Bottom Bucket Charger.

Showing hook and clutch about to pick up the ore bucket.

Control Equipment.

The motor control is on the Ward-Leonard principle, and, as the control during speed changing is automatic, the controllers are therefore placed for convenience in the winder house beside the motor. The governing of the rate of acceleration and retardation depends on the movement of the controller face-plate, and is controlled by cam wheels and two sets of cams, the wheels being driven from the drum shaft through a suitable reduction gear. A special feature of the switching arrangement is the toothed quadrant which drives the pinion mounted on the shaft carrying the rheostat arm of the controller. This is rigidly attached to a two-roller rocker arm mounted on the cam gearcase. The wedge-shaped cams, as they revolve with the wheel, control the angle through which the rheostat can be turned by the operator on starting up until full speed is reached. Similarly, the rheostat is cam controlled during the retarding period. For instance, in starting up without bucket from ore level, for the purpose of picking up a coke bucket at the higher level, the operator presses his lever to start, but he finds that, due to the cam profile, the movement of lever permitted is only such as will give up to two-thirds full speed between the two levels. At a point midway the lever will commence to be pushed back automatically until the hoisting speed is a "creep" as the hook engages with the loaded ore bucket. From this point, pressure on the lever will give gradual acceleration up to full speed. Again, when a certain point on the bend of track, near the top is reached, the retarding cam brings the lever and controller back gradually until the speed is reduced to a slow "creep," and the carriage comes to rest gently against the buffers. At this point, further pressure on the lever permits the lowering of the bucket as the retarding cam has a slight depression to correspond with the required speed. Ultimately, when the bottom of bucket is lowered to its full limit, the lever will be at the "off" position, as the rocker arm roller will have reached the stopping heel on the retarding cam.

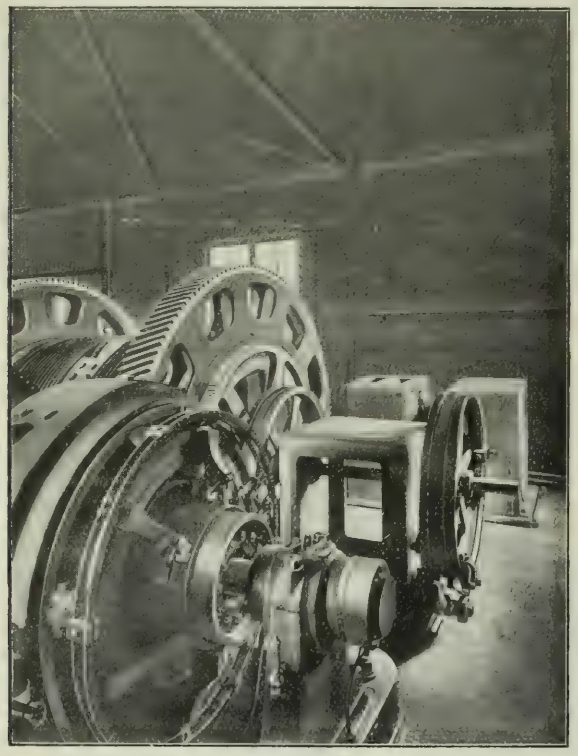

Fig. 5.—Duplicate Ward-Leonard Controllers.
Semi-automatic system, for bucket chargers, at Messrs. Baldwin's, Ltd., Port Talbot Iron Works.

As mentioned above, hoisting takes place from two levels, and it is therefore necessary to have two distinct cam wheels and sets of cams (*see* Fig. 5) in order that the control on each of the ore and coke cycle of operations may be appropriately governed. Only one of the cam wheels is driven at any one time, and the drive is taken through a two-way sliding jaw type clutch, which is changed over for ore or coke journeys by means of a lever in operator's cabin.

Braking Arrangements.

The braking arrangements are clearly shown in Fig. 2.

It will be observed that a separate hand-operated brake is fitted in addition to the solenoid-operated brake; but the former is designed for use only under special conditions, and is not used in everyday working of the charger. It should be noted that the solenoid operated brake is capable of being lifted into the "off" position by hand through the rod shown, and the hand-operated brake is operated by a hollow rod or tube, through which the first named rod passes. The control hand levers for these brakes are mounted in line with the starting lever in the driver's cabin.

In connection with this work it is interesting to note that the evolution of the blast furnace hoist from the top and bottom hand barrow type to the drop-bottom bucket incline type of charger has been steady. In existing works, where hand charging is retained, it is chiefly because of the great difficulties which would be encountered in the planning of an installation of inclined chargers, which would not interfere drastically with the existing lay-out of the works. There is now, however, a tendency further to develop the vertical-horizontal blast furnace charger, a type of hoist which, owing to the necessary supporting piers being vertical and of small horizontal section lends itself to easy installation in practically any works where the position of most of the existing accessories in connection with the furnaces must be retained.

The two chargers just described have been installed at the Port Talbot Iron Works of Messrs. Baldwins, Ltd., by Messrs. Head, Wrightson & Company, Ltd., Thornaby-on-Tees, the electrical equipment being designed and carried out by the Metropolitan-Vickers Electrical Company, Ltd., Manchester. It should be mentioned that the motors are direct current and that the electrical equipments of the cars were also supplied by the Metropolitan-Vickers Company. Mr David E. Roberts, of Cardiff, acted as consulting engineer for the installation.

A Proof of the Formula for Determining the Self-Induction of a Coil Using the $\sqrt{-1}$ Function.

By H. F. TREWMAN, M.A.

In order to refresh the memory of those readers who are not familiar with the method it might be well to briefly describe it. The coil of unknown self induction L is first balanced by a Wheatstone Bridge against the known resistances a, b, and d. This gives the value of its resistance x. A condenser K and additional resistance r are then connected as shown in Fig. 1, and an alternating P.D. is established across BC by means of a buzzer. The galvanometer between D and E is replaced by a telephone receiver. K and r are adjusted until no sounds are heard in the telephone receiver, *i.e.*, no current flows through it. The self-induction L is then given by the formula

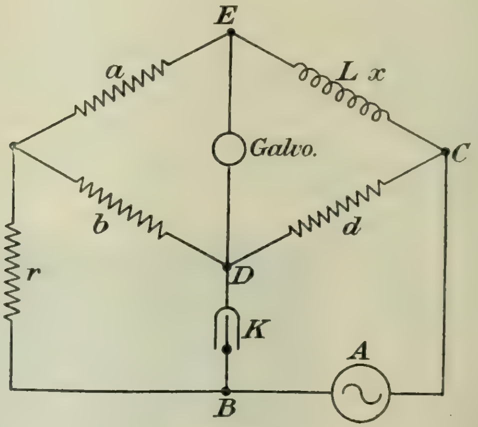

Fig. 1.

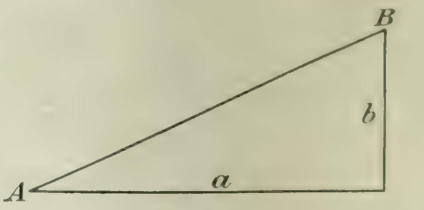

Fig. 2.

$$L = K\{(d+x)r+bx\}.$$

Proof.

It is well known that the imaginary quantity $\sqrt{-1}$, written as i, turns a vector through 90° in a clockwise direction.

Thus, in Fig. 2, the vector AB is equal to $a+ib$.

Any alternating current is therefore given in value and direction by such an expression. Suppose the currents in Fig. 1 to be as follows:—

$$a+ia^1 \text{ in } r.$$
$$\gamma+i\gamma^1 \text{ in } b.$$
$$(a-\gamma)+i(a^1-\gamma^1) \text{ in } a,\ L,\ x.$$
$$\delta+i\delta^1 \text{ in } K.$$
$$(\delta+\gamma)+i(\delta^1+\gamma^1) \text{ in } d,$$

where $a, a^1, \gamma, \gamma^1, \delta, \delta^1$ are constants.

The potential drop across K must equal that down r and b.

Therefore $$(a+ia^1)r+(\gamma+i\gamma^1)b=(\delta+i\delta^1)\times\left(-\frac{i}{K\omega}\right).$$

Equating real and imaginary parts,

$$ar+\gamma b=\frac{\delta^1}{K\omega}, \text{ or } K\omega(ar+\gamma b)=\delta^1, \quad . \quad . \quad . \quad (1)$$

and $$a^1r+\gamma^1b=-\frac{\delta}{K\omega}, \text{ or } K\omega(a^1r+\gamma^1b)=-\delta. \quad . \quad . \quad . \quad (2)$$

Also, since there is no current through the telephones, the potential drop through $L\,x$ must equal that through d.

$$\therefore \quad \{(a-\gamma)+i(a^1-\gamma^1)\}\{x+iL\omega\}=\{(\delta+\gamma)+i(\delta^1+\gamma^1)\}d.$$

Again equating real and imaginary parts,

$$(a-\gamma)x-(a^1-\gamma^1)L\omega=(\delta+\gamma)d, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

and $$(a^1-\gamma^1)x-(\delta^1+\gamma^1)\,d=-(a-\gamma)L\omega. \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Further, the potential drop down a must equal that down b.

Therefore $$(\gamma+i\gamma^1)b=\{(a-\gamma)+i(a^1-\gamma^1)\}a$$
$$=\{(a-\gamma)+i(a^1-\gamma^1)\}\frac{bx}{d}$$

since $$ad=bx.$$

Equating real and imaginary parts,

$$d\gamma=(a-\gamma)x$$

and $$d\gamma^1=(a^1-\gamma^1)x$$

Therefore $$\frac{a-\gamma}{\gamma}=\frac{d}{x} \text{ or } a=\frac{d+x}{x}\gamma. \quad . \quad . \quad . \quad . \quad . \quad (5)$$

and $$\frac{a^1-\gamma^1}{\gamma^1}=\frac{d}{x} \text{ or } a^1=\frac{d+x}{x}\gamma^1. \quad . \quad . \quad . \quad . \quad . \quad (6)$$

From equations (1) and (4) we have

$$\frac{K(ar+\gamma b)}{L(a-\gamma)}=\frac{-\delta^1}{(a^1-\gamma^1)x-(\delta^1+\gamma^1)d}$$

whence, substituting for a, $a-\gamma$ and $a^1-\gamma^1$,

$$\delta K\left[\left(\frac{d+x}{x}\right)r+b\right]=L\frac{-\delta^1 d\gamma}{x\{d\gamma^1-d\delta^1-d\gamma^1\}}$$

Therefore $$L=K\{(d+x)r+bx\}.$$

The Institution of Electrical Engineers.

Of the members attending the first meeting of the new session of the Institution of Electrical Engineers on Thursday, November 18th, the wisest were those who left the attractions of the tea room and entrance hall for the lecture theatre some minutes before six o'clock. For by the time the members of the Council, headed by Mr. ROGER T. SMITH, entered the room it was uncomfortably crowded, all the seats being occupied and a number of those present having to find places in upright positions against the walls and in the gangways. What would the L.C.C. say to this overcrowding.

The proceedings opened with the passing of a resolution of regret at the death of Prof. John Perry, and the procedure of asking the members to rise before the resolution was read out was followed with good results. At least it prevents the unseemly scuffling of feet and consequent disturbance which is so often present on such occasions.

The premiums and scholarships awarded for last session's work, which have already been announced in THE ELECTRICIAN, were then presented, and as is now too usual there was an almost entire lack of personal appreciation by those to whom awards had been given. Only four out of some 20 odd attended. We realise that it may be impossible for a proportion of those to whom awards are given to travel long distances from the provinces just for this occasion, but that so large a proportion should be absent throws an unnecessary slight on the honours which the Institution has in its power to give.

Mr. ROGER T. SMITH then inducted the President-Elect, Mr. Llewelyn B. Atkinson, into the chair. In so doing he spoke clearly and to the point, on what must always be a rather difficult subject. The best thing he said lay in the assurance he gave not only of his own loyal co-operation, but that of the whole of the Council and of the members of the Institution in Mr. Atkinson's new work. It is not always realised what an invidious position the immediate past-President holds and how much credit is due to him in rendering smooth the operation of the Institution machine.

The customary vote of thanks to the retiring president was then moved by Sir JOHN SNELL, who humorously remarked that the almost volcanic energy of Mr. Roger Smith's immediate predecessor, Mr. Wordingham, must have filled his successor's mind with dismay. Mr. Smith had the further disadvantage of being obliged to undertake his duties when suffering from the effects of a very serious surgical operation. He made the point, which was afterwards reiterated by the President, that it was now for the good of the Institution to have a period of comparative calm and consolidation after all that had gone before. Nevertheless, Mr. Smith's year had been one of great anxiety, and what with coal questions and problems of industrial disputes, he had been called upon to give the Institution unremitting labour and attention. He paid an unusual and graceful tribute to Mrs. Roger T. Smith for the way in which she had ably assisted her husband in carrying out his duties.

This motion was seconded by Mr. J. S. HIGHFIELD, who, speaking rather quietly, said that the Institution had acquired added weight during the last few years in a sense of discipline, dignity and efficiency. No man had done more to contribute to these qualities than the retiring President.

Mr. ROGER T. SMITH, in reply, also laid stress on the point that the work of the President was becoming almost overwhelming in quantity, and added that if it were not each year that the President received from the Institution a Council much more closely representing the varied interests of the body and of the industry it would hardly be possible to carry on.

Mr. LLEWELYN ATKINSON then took the chair and proceeded to the delivery of his Presidential Address, an abstract of which will be found on another page of this issue. In spite of the discomfort in which most of the members were placed owing to the crowded state of the room he was listened to with great interest, interspersed as is, however, very usual on these occasions with a great deal of unnecessary coughing. Why cannot coughers stay at home? The necessary element of humour was contributed to the proceedings by the "fusing of an electric wire" which apparently objected to the pressure of a chair occupied by one of the members of the Council. These occurrences are always happening at electrical gatherings. It looks like bad stage management!

Col. CROMPTON, who proposed a vote of thanks to the President, is an electrical pioneer who seems to grow younger as the time goes on. At any rate, he has lost none of his vitality and his remarks were listened to with great appreciation. He particularly emphasised the point that the real solution of the present industrial unrest was to give the worker greater interest in his work.

Mr. CHAMEN, in seconding the vote of thanks, was more doleful. He considered the solution of industrial unrest was not so simple as the President made out. Very sinister influences were at work and deliberate attempts were being made to wreck the whole world. Becoming more altruistic in tone he said that much of our commerce was founded on a fundamentally wrong basis. We had all been brought up to think that the only way in which a commercial success could be obtained was by buying at the very lowest and selling at the highest price. We had also been taught that self-preservation was the main thing, and the view that everyone was firstly concerned with the welfare, safety and comfort not only of himself but of his neighbour had never been tried at all. After this short flight into the higher idealism the resolution was carried with acclamation.

The PRESIDENT, in reply, took the safe ground that if anyone disagreed with anything in his address they were probably right and he was wrong. He admitted that some of his opinions had been put up as Aunt Sallies in order to start a discussion. It is a great pity that this is not more done. The meeting then adjourned after two hours' solid hard work.

Mr. J. E. Sayers on Electricity Generation.*

We are still almost entirely dependent on steam for the conversion of heat into action. Steam is a heat carrier which takes toll of at least 60 per cent. of the heat consigned to it. The present average thermal efficiency of steam operated generating stations in the Kingdom may be taken as about 8 per cent. In modern stations 13 to 15 per cent. may be expected, and in a super-station possibly 20 per cent. But even this result leaves an absolute loss of 80 per cent. Present views on the question of electricity generation and coal economy include the popular view (involving exaggerated expectations), and the official view as roughly indicated in the recommendations of the Coal Conservation Sub-Committee. Thirdly, there is the view of the gas engineer, which is in effect that the carbonisation of coal should be in the hands of the gas industry, and the thermal products, gas and coke, distributed to the community, or used for the generation of electricity.

Referring to Sir Dugald Clerk's chief contentions in regard to the greater thermal efficiency of gas for heating,† and the respective fields of gas and electricity for lighting and power supply, while gas has distinct advantages for the heating of large masses of water, it cannot compete with small portable electrical apparatus of convenience such as kettles, hot plates, irons, &c. Similarly thermal considerations have relatively little bearing on the choice of electricity or gas for lighting, while again in power work there are other considerations, notably the convenience and flexibility of the electric drive, and the saving in transmission losses in shafting, belts, &c. It is not unusual in a factory to find less than half the brake-horse-power accounted for by tools and machines operated, owing to such losses. Of the 60,000,000 tons of coal used in factories in this country a large portion is used very wastefully, with a return of perhaps only 1 or 2 per cent. of the potential heat. If electricity were available at reasonable rates it might save much of this wasteful expenditure of coal.

Back Pressure Systems of Generation.

The suggestion has also been made that electricity should be generated by non-condensing steam movers and the exhaust steam used either as steam or hot water, or both, to provide domestic and public heating or hot water services. This proposal appears at first sight attractive, and Mr. A. E. Edwards has calculated that over 49 per cent. of the potential heat of the fuel consumed might be made available. Such "back pressure" systems for combined power and heat production show remarkable general efficiency, as well as high thermal efficiency in cases where there is a fairly constant load. But a typical local electricity supply station is the worst possible partner for such a combination; the great part of its output is required only for a small part of the day, whereas domestic heat is required from early morning to late at night. Such a station would, for the greater part of the time, operate as a central heating plant. Moreover the system of distribution of heat would present great difficulties, and would probably be impracticable on account of the cost involved. In any case the economic radius of distribution must be small. On the other hand, in special circumstances, *e.g.*, in chemical works, breweries, dye-works, and sugar refineries, such systems are remarkably efficient and there are in operation even to-day heat and power installations which produce electricity at less than ½d. a unit. Other cases of power generation which should not be interfered with are small colliery power houses where steam is raised with washery residues of very small marketable value.

Broadly speaking, the solution of the problem of making the best use of our coal lies in its scientific reduction in up-to-date gas works, and combined gas and electricity stations for the whole of the heating lighting and power services of the country. The production of gas and coke should be variable. It should be possible at all centres to gasify coke, and steam-raising plant should be designed to consume coke and gas indiscriminately. No restrictions should be put on the use of gas for power purposes, as one of the greatest factors in coal economy would be the advent of the gas turbine for power production.

The Production of Steam by Electricity.‡

By E. C. CONSTAM-BULL.

The steam boiler heated by means of the electric current is now developed to an appreciable extent, especially in countries such as Switzerland, where hydro-electric energy is abundant and coal is scarce. The production of the heat at the time it is used, the small importance of the losses during the stand-still periods, and the ease of regulation, all add to the main advantage of the economy effected in coal, and favour the expansion of the use of this type of boiler. Heating apparatus of this type may be used for heating liquids, for producing steam, for producing hot air, for heating buildings, &c. Sometimes it consists of large boilers, in which electric radiators are placed, the mass of the water permitting a considerable heat storage. On the other hand, the quantity of water may be very limited, and the rate of steam production adjusted to the demand of the moment.

Description of the "Revel" Boiler.

The "Revel" boiler, constructed by the Escher Wyss and Oerlikon Companies, belongs to the latter type, and is thus an electric geyser. In comparison with an ordinary steam boiler, the space taken up is very small, and its water capacity very limited, in spite of its large steam raising capacity. As shown in Fig. 1, the feed water is supplied to the lower part a, and the steam outlet is through a central tube b to the valve v. The water is heated and evaporated by means of an alternating current, either single-phase or three-phase, which is passed through the liquid. Direct current cannot be used, as it decomposes the water. Current is led by one or two electrodes c, which pass through the cover, in which are fixed steam-tight insulating bushes. An ammeter indicates the value of the current. The water level is indicated by the gauge d, and the two lower valves e and f permit the removal of scale and sediment, and of the automatic regulation of the water circulation respectively. The feed pump is driven by a small electric motor.

The boiler being empty, the pressure may be switched on, but the circuit is broken, and it is only when, the water being supplied steadily, the surface of the water reaches the tips of the electrodes, that current flows, and a certain quantity of steam is at once produced. The current and the rate of evaporation increase as the water rises and covers more of the electrodes, and the boiler is under pressure after ten minutes. As soon as the normal working pressure is exceeded, the valve f, which is adjusted for this pressure, opens and returns some of the water to the feed tank, so that the water level is maintained constant. The rate of evaporation is dependent upon the water level. If steam is taken off constantly, the pressure remains steady; if the load increases, the pressure tends to fail, and the net supply of water increases so that the level rises, a greater portion of the electrodes is immersed, the rate of evaporation is increased and the working pressure re-established. The normal pressure cannot appreciably be exceeded, owing to the action of the valve f. If the stop valve v is shut, the water only just reaches the tips of the electrodes, and only a very limited evaporation takes place, sufficing to compensate for the heat losses in the apparatus.

Automatic Regulation.

The regulation of the current and of the evaporation is thus automatic, so that the boiler adjusts its output almost instantaneously to suit the load. The main switch has only to be operated at starting and stopping, and the accidental failure of the feed water cannot result in an explosion, so that the Revel boiler does not need a permanent attendant, but simply the small amount of attention necessary to its upkeep.

Some Test Results.

A boiler 250 cm. high by 60 cm. outside diameter, supplied with current at 500 volts, gives 550 kg. of steam at a pressure of 15 kg. per square centimetre. The evaporation may be taken as 1·3 kg. per kilowatt-hour supplied to the boiler the moisture present in the steam is only about 3 per cent. The following figures relate to a test carried out on an installation designed to consume 200 kw. :—

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* Abstract of an Address delivered to the Scottish Centre of the Institution of Electrical Engineers on November 9th.

† See The Electrician, Vol. LXXXIV., p. 688.

‡ Abstract of an article in "Le Genie Civil."

Duration of test	2·5 hours.
Mean pressure....................................	219 volts.
Mean current	384 amperes.
Energy consumption	367 kw.-hour total.
Energy consumption per hour	146·7 kw.-hours.
. . . . . .	
Mean effective steam pressure	6·42 atmos.
Mean feed temperature	10°C.
Mean outlet temperature (at *f*, Fig. 1)......	14°C.
Gross mass of water evaporated	461 kg. total.
Gross mass of water evaporated per hour	184·2 kg.
Gross mass of water evaporated, per kw.-h.	1·256 kkg.
Evaporation from water at 0 deg. to steam at 100 deg. per kilowatt-hour	1·284 kg.
Percentage of moisture in steam	2·93 per cent.

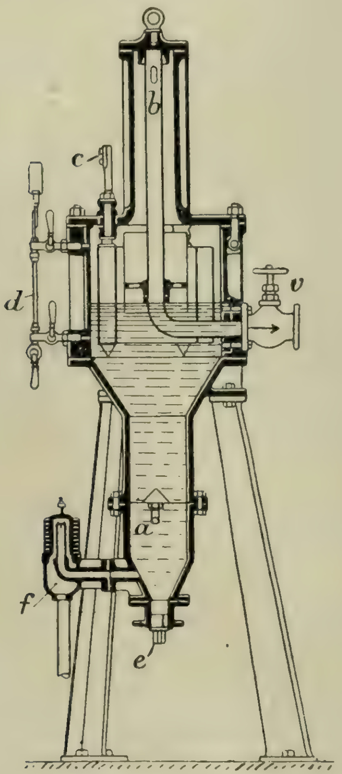


Fig. 1.—Vertical Section of a Revel Electric Boiler.

The total quantity of feed water was 771·5 kg., of which 461 kg. was converted into steam, and 310·5 kg. was evacuated by the regulating valve, this latter quantity of water being heated from 10 deg. to 14 deg. From these figures the thermal efficiency can be calculated, and allowing for the heat used in increasing the temperature of the water evacuated by the regulating valve, the efficiency works out to 95·7 per cent. The losses are thus only 4·3 per cent. These figures may even be improved, since the apparatus was working at only about 75 per cent. of its designed output. The steam storage only varied very slightly during the test, and the flow of steam was practically steady. The percentage of moisture present is very small, but increases a little if the load is very great or if it is irregular.

Revel boilers are already installed in more than 300 cases, in all types of factories, both for isolated use and for use in conjunction with existing coal-fired boilers. Occasionally they are provided with heat accumulators in the form of large sheet steel vessels containing water, which is heated by the surplus steam produced at any moment. In one case the storage capacity provided is no less than 4 million calories. The accumulators in this case consist of two well-lagged horizontal drums 10·5 metres long by 2 metres diameter. These are supplied at night with the steam from a Revel boiler, working at 15 kg./sq. cm. The boiler receives current from a 350 kw. three-phase alternator driven by a water turbine. During the day the turbine is used for power purposes, and the Revel boiler is stopped, the accumulators furnishing steam to the spinning mill.

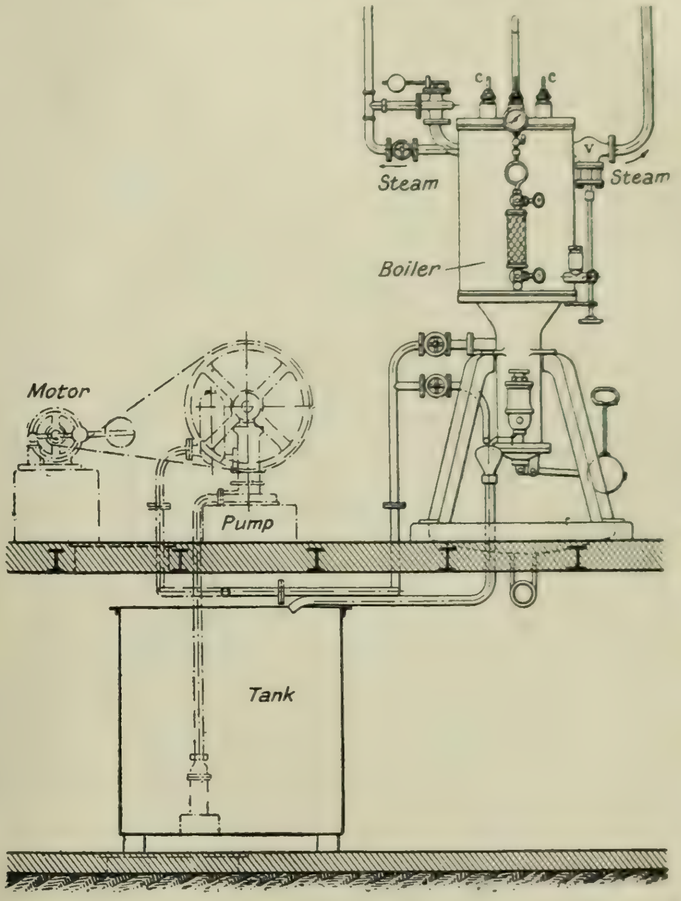


Fig. 2.—Elevation of a Revel Boiler Installation.

Progress in Electroplating.

A general discussion on "Electroplating" was held on Friday last in the Mappin Hall of the University of Sheffield under the auspices of the Faraday Society and the Sheffield Section of the Institute of Metals, meetings taking place both in the afternoon and the evening.

At the afternoon meeting Dr. L. **Aitchison** dealt with "Electroplating for the Prevention of Corrosion," and pointed out that the advantages of electro-deposited coatings compared with those obtained by such processes as hot galvanising are: (1) The more regulated weight—0·00075 in. of zinc will provide a very satisfactory coating under aircraft conditions. (2) Superior appearance (by no means a small item in the nickelplating of bicycle and motor parts). And (3) the avoidance of changes in the heat treatment or cold-worked properties of the steel. Since many plated parts are bent after the deposition, a bend test is required. Zinc and nickel are the most important metals for the plating of steel.

In the course of the discussion Mr. S. **Field** considered that pure zinc was essential and much more resistant than less-pure samples.

Mr. **Field** then read a Paper on the "Electrolytic Refining of Zinc," in which he remarked that a current efficiency up to 93 per cent. could be obtained at the commencement of the electrolysis of a zinc-sulphate solution containing 10 per cent. free acid. Temperatures up to 40-45°C. were reached in the end cells, and the finished zinc contained 0·02 per cent. each of cadmium and lead and a trace of copper and iron. About 3,000 kwh. were consumed per ton of zinc. The merest traces of cobalt and nickle reduce the efficiency enormously and increase the energy consumption to over 4,000 kwh. per ton.

Electro-Deposition and Aeronautical Engineering.

Capt. W. A. **Thain**, of the A.I.D., read a Paper on "Some Applications of Electro-deposition in Aeronautical Engineering," in which he dealt with the electro-deposition of copper on steel parts which are not to be carburised in case-hardening. The parts which are not to be coated are covered with varnish and dried. The article is first immersed for three to five minutes in the following solution: 8 oz. copper cyanide to 1 gallon of water at 16°C. After washing in water the chief copper deposit is obtained in a bath with 34 oz. copper sulphate and 5 oz. sulphuric acid to 1 gallon of water. A suitable thickness of deposit is 0·004 in. An account was also given of the copper-plating of aluminium aero-engine cylinders to increase the thermal conductivity. A deposit 0·003 in. thick is obtained with very low-current densities in 60-80 hours. The third section of the Paper dealt with the building up of the copper water-jacket of the Beardmore aero-engine cylinder by electrolytic deposition. The walls, 1·7 mm. thick, are tested under pressure of 30 lb. per square inch. This represents a more or less new and very important step in electrolytic processes in engineering practice.

Mr. **Byron Carr**, who dealt with the "Electro-Deposition of Cobalt," showed that extremely good, hard deposits, which were remarkably resistant to atmospheric corrosion, could be obtained, provided that they were not too thick, in which latter case they peeled off the cathode. The bath was used at 34°C., and contained 4½ lb. of cobalt sulphate, 5 oz. of boric acid and 2½ oz. of sodium chloride per gallon. Current densities as high as 150 amperes per square foot could be used with a 2-minute immersion, or 3-4 minutes with 70 amperes per square foot. Cobalt was being used for facing stereos.

Mr. S. **Field** read a second paper on "The Electro-deposition of Gold-silver Alloys." As the temperature rises less gold and more silver are deposited with the same current density. The percentage of gold in the deposit is increased by the presence of free KCN up to 200 per cent. Green gold contains 77 per cent. gold and 23 per cent. silver. These deposits, as Prof. **Desch** pointed out, are solid solutions, and Mr. **Smith** mentioned that in America attempts have been made to deposit artificial dentures of gold-silver and copper electrolytically.

The Work of Brunner.

The evening session was opened by Mr. R. **Barclay**, who gave an excellent summary of the work of Brunner, which is hardly known at all in this country. Summarising his own experience, the following solution and conditions for the electro-deposition of silver were given: 3 oz. silver per gallon, equivalent to 5½ oz. $KA_g{\cdot}CN_2$; free cyanide, 3½ troy oz. Potassium salts such as hydrate, carbonate, chloride and cyanate are advantageous within the limits found in practice. The working temperature should be between 17 and 23°C. and the current density 2¾-3 amperes per square foot. Mr. **Barclay** subsequently criticised the Papers by Mr. **Brook** and Mr. **Mason**, urging that while agreeing with their conclusions, their results were not new, having been previously obtained by himself and by Brunner.

The Paper by Mr. F. **Mason** created considerable interest and discussion. From a bath containing 26·14 gms. of silver per litre 47·25 gms. KCN and 165 gms. potassium carbonate smooth adherent deposits were obtained with a current density as high as 8 amperes per square foot. This increased output from the vat can only be used if adequate opportunities of preparing and finishing the articles are available. The process has been in commercial use for over six months.

Two Papers by Mr. G. B. **Brook** and Mr. **Holmes** dealt with the properties of old silverplating solutions and the crystalline structure of the deposit. The advantage of the old solution appeared to be due to 8-16 per cent. potassium carbonate, which increased the conductivity. The silver content of a large number of solutions examined varied from just over 1 to nearly 4 oz. per gallon, and the free cyanide from below 50 to 400 per cent. In the second Paper excessively large crystals, one with high current density, were considered to be the cause of red marks on silver-plated articles when finished. Mr. **Byron Carr** criticised the conclusion very severely, and showed that it was, at any rate, quite insufficient.

The Electric Washer.

Is it a Toy or a Triumph?

By "ELECTROCYNIC."

Not very long ago I read in an American paper that the electric washing machine sales for last year had amounted to 100,000,000 dollars. To the best of my recollection this figure referred to United States business only, but it may have included exports. Now the average price of an electric washer in America is something like 100 dollars; so that we are asked to assume that in the year 1919 at least one million washers of American manufacture were sold. With all due respect to the enterprise of the American manufacturer, and the unwavering truthfulness of the American press, I think their passion for round figures has, on this occasion, blinded them to the significance of the eight cyphers which impart an impressive rotundity to the number mentioned above.

We are to suppose that a million cultured American homes are equipped with electric washing machines; that every Monday morning a million American housewives confide their cherished linen to the abluent frenzy of these much-advertised contrivances. However, I am not really concerned to dispute the value of washing machine sales on the other side of the Atlantic; and I have only referred to the matter because, in a measure, it accounts for what follows, in the sense that the figures, ludicrous though they be, compelled me to ponder the utility of these machines and to wonder whether, in fact, the electric washer is a labour-saving triumph or merely a toy which is enjoying an artificial and evanescent popularity.

Washer or Washout?

I am informed that most of the work (certainly, if measured by time) in connection with clothes washing lies, not in rubbing or otherwise maltreating the clothes, but in lighting fires, boiling water; filling, emptying and carrying tubs; hanging the things up to dry; taking them down again; ironing them; airing them and putting them away. The electric washer does not carry out any of these processes, for the simple reason that they cannot be done otherwise than by hand. They probably occupy at least 70 per cent. of the total time spent in washing.

The only thing the washing machine does by itself is to provide a mechanical substitute for the corrugated board which the ordinary washerwoman uses for the purpose of removing particularly obstinate stains. With human help it also wrings the clothes, and sometimes, I am given to understand, the fingers of its kind assistant.

As an electrical man I am naturally averse from criticising any class of electrical apparatus. Certainly such an action would have rather a disloyal appearance. However, I do not think this point arises in the present discussion, because the electric washer is not very electrical after all. The relatively inexpensive motor is the only electrical item in the majority, if not in all, washers. Essentially, it is *not* an electrical device, and probably most washers cannot even claim the honour of being made by electrical firms. You might almost as well call an electrically-driven linotype an electric machine, or, horrible thought, a gas burner fitted with dry-cell ignition.

With easy conscience and uplifted heart I can, therefore, proceed to demolish the American-made superstition regarding the economic advantages of electric washing. Perhaps I ought to say that I have never owned or used one of these machines, and have a very vague acquaintance with their mechanical details. Some, I believe, are extraordinarily fine examples of design and workmanship, and I am quite ready to admit that, within their limits, they function in a highly efficient and satisfactory manner.

An Unprofitable Investment.

The trouble is that their limits of usefulness are so narrow that the amount of work accomplished must always be ridiculously disproportionate to the first cost and maintenance charges. This, of course, does not matter to those fortunate persons who can afford to pay £60 for six pennyworth of work. If one could buy an electric washer for £5, it might be a profitable investment. As, however, the average price in England is somewhere in the neighbourhood of £60, it is difficult to see wherein the economic advantage of electric washing lies. In a small family (no man with a large family could possibly afford to buy one) a washer might save an hour's work every week, at a yearly expense (including interest on investment, cost of current, repairs and lubrication) of about £10. After all, the objection (in England) to washing in the home is not the labour, because one can hire a charwoman to do the work for 1s. an hour, but the long drawn-out mess and muddle which are involved, especially in wet weather when the clothes cannot be hung outside. That is why many people are willing to risk the carelessness and cupidity of the average laundry. So far as I can see the electric washing machine is not likely to abolish either the charwoman or the laundry.

Incongruous Qualities.

That so many washing machines have been sold in the United States is evidence of the startling ability of American advertising men, if not of the intelligence of the American housewife. She is apparently persuaded to buy a washing machine for the most amazing and irrelevant reasons. A big feature of one machine is that it "works like a rocking chair." A homely touch that—well calculated to appeal to the deepest instincts of every American mother who has poised herself and child on one of these insecure articles of furniture. This same machine is also advertised as having a "beautifully lacquered surface," which to me seems rather incongruous; although, of course, the owners may be in the habit of keeping their clothes washing apparatus in the drawing room in the company of exquisitely lacquered bureaux and screens. Another machine is unusually accomplished, since, in addition to "dashing the clothes from side to side in a surfy wave-like swirl of suds," the interesting process of diosmosis takes place, and "sudsy" water is forced, by way of a number of jets, "thoroughly through the fabric." "Thoroughly through" is good, and the clothes should be too "utterly utter" for anything after such treatment.

An "Engaging" Habit.

The question of safety is not disregarded in this machine, and the wringer is provided with a "Real Safety Release." It is consoling to know that if one's fingers get caught in the wringer (a fairly frequent occurrence, apparently) they can be released, if the victim is quick and has a disengaged extremity, before the feet are reduced to pulp. Of course, a device for the prevention of such unfortunate happenings would be better still, but I suppose we cannot have everything.

Then there is the washer that washes and dries *without* a wringer. The advertisement I have seen does not give any information as to how the drying is accomplished. Perhaps, as in a famous "electric" ironer, one has to light gas jets, or, on the other hand, the clothes may be dried by pressure after the container has been drained. I should like to think that it is done by electrical means, in which case I should feel inclined to encourage the use of this washer, not because it does more work, but simply because it uses more electricity than the others.

If I had £60 to spare, which I haven't, I would spend it on improving and extending the existing sink and copper arrangements, with a view to cutting out as much as possible of the labour of tub-carrying and fire lighting. The sin of spending such a sum of money on a device which, at the best, can only assist in performing one function out of the many involved, and that by no means the most laborious, is aggravated by the fact, already noted, that the electric washing machine has little claim to be called electric. If the money were likely to find its way into the pockets of electrical men, mine amongst others, the offence would be considerably less heinous.

Hence these Lines.

In the absence of such financial inducement to condone the washing machine superstition, and since I am quite determined to make something out of the business, the only thing that remains is to make journalistic capital out of my opinions. These, I must confess, are not shared by any of my acquaintances, either electrical or non-electrical. The reason for this singular attitude I have reserved until the end. As a matter of fact my wife wants a washing machine. It is useless for me to tell her that an electric washer is neither worth its cost nor its keep. She would think I was just saying it to save my pocket. If, however, the Editor will be good enough to print this little diatribe, I can show it to my wife and thus destroy her longing for the unattainable; for she has a touching faith in the printed word.

Books Received.

[Copies of the undermentioned works can be had from The Electrician Office on receipt of published price, plus postage.]

"Useful Hints for Motorists," by V. W. Page (London: Henry Frowde, Hodder & Stoughton). Pp. 163. 5s. net.

"Testing of Motive-Power Engines," by R. Royds, M.Sc. (London: Longmans, Green & Co.). Pp. xii + 392. 2nd Ed. 21s. net.

"Science German Course," by G. W. Paget Moffatt, M.A. (London: University Tutorial Press). 3rd Ed. Pp. xii + 270. 5s.

"Telegraphy." By T. E. Herbert, A.M.I.E.E. (London: Sir Isaac Pitman & Sons, Ltd.). 4th Ed. Pp. xx + 1019. 18s. net.

Reviews.

Telephony Without Wires. By Philip R. Coursey, B.Sc., A.M.I.E.E. (London: Wireless Press, Ltd.) Pp. [illegible] + 414. Price 15s. net.

The subject of wireless telephony is one which has always held a fascination for both technical men and the general public. It is, however, only in the last five years that any material advance in the development of this science has been made. Even now, the layman has no clear idea of what has been, and is being, accomplished. The time is ripe for the dissemination of more information, and on the technical side this has been accomplished by Philip R. Coursey in his book "Telephony Without Wires."

The volume, as its name implies, covers not only radio telephony but also the transmission of speech by earth conduction systems, capacity and induction effects, and the methods of utilising light and heat waves. The inclusion of these methods of communication is a distinctive feature of the book, since such particulars are not to be found elsewhere in a single volume. Having discussed the earlier attempts to communicate speech without wires, the author passes on to the use of "spark" oscillation generators. A very good descriptive account is given of various forms of quenched spark-gaps and the Marconi multi-disc discharger. Multiphase spark transmitters also receive attention. Chapter X. brings us to a useful account of the arc as used for the generation of oscillations. The use of multiple arcs is described, and various arc circuits are considered. Still only discussing the production of continuous waves, the author next describes the use of the thermionic valve as an oscillator. A brief history of the valve is given and also some simple circuits. The subject, however, does not receive the attention it deserves, and no details are given of actual valve continuous wave transmitters of either low or high power. This is a very marked defect in the book. The very extensive use which is nowadays made of the valve as a transmitter, especially in aircraft wireless telephone sets, gives this form of generator very considerable importance, and many readers, no doubt, will be disappointed at the scant attention given to the subject.

Chapter XIV. brings us to the use of alternators and frequency raisers. The Alexanderson and Goldschmidt alternators are described, but not in very great detail. No description is given of the Telefunken alternator. The subject of frequency raisers is very ably treated and numerous methods are illustrated. The modulation of the transmitted energy is next considered. Different positions are given in which a microphone may be connected in order to modulate the energy to be radiated. The next chapter deals with variable resistance and other microphones. The list includes one or two which are of no practical value, although descriptions are passed on from text-book to text-book. The "clearness of articulation" invariably claimed is frequently scarcely human. This chapter, however, is very complete and valuable as a historical record.

Chapter XVIII. deals with special microphonic control systems. This aspect of wireless telephony is by far the most important. It is the search for an effective method of modulation which is and always has been the chief problem in wireless telephony. Consequently, the reader will be especially interested in the various modern methods of modulation described. Four systems using the thermionic valve are discussed. The latest system given is four years old, and more might have been written on this subject with advantage. The next chapter is rather an unusual one and deals with the efficiency of various types of transmitters. It is a valuable criticism of modern continuous wave generators.

Chapters XXI. and XXII. deal with the reception of wireless speech. The ordinary forms of detector are described, and a brief account is given of the thermionic valve detector. On page 321 the author states that the rectified current in the plate circuit of a valve is proportional to the voltage applied to the grid, whereas it is actually proportional to the square of the voltage. The author also explains the action of the three-electrode valve as a detector by stating that when the grid is negative the plate current is decreased; when the grid is made positive the plate current is likewise decreased, since the grid by absorbing electrons deflects some of the plate current to the grid. This is far from being a typical form of rectification. It will only happen when the valve is operated at the extreme saturation point, and then only when the grid potential variations are large. Strangely enough, hardly any mention is made of the detector action obtained through the non-linear characteristics of the plate or grid current curves. In discussing amplifiers, the author describes the Brown relay and one or two valve amplifiers. The next chapter deals with interference prevention. Four methods are described, namely the balanced aerial system, the use of balanced detectors, the valve limiter and Pupin and Armstrong's device.

At the end of the text is a brief chronological résumé of the most important results obtained in wireless telephony. Then follows an exceptionally useful list of references to original Papers and articles. The book is rather unusual in this respect. Mr. Coursey gives us a bibliography of great value, and he is to be complimented on increasing the usefulness of his book in this way. It would be well if his example were followed to a greater extent than is customary at present.

The book is the first real British attempt to describe the developments of wireless telephony, and the author has given us a volume which none of us can afford to be without as a book of reference. One cannot help, however, feeling regret that more attention was not given to more recent advances. For example, there is no reference to modern methods of simultaneous transmission and reception, an exceedingly important problem. Nor is there any account of the methods devised for the transmission of speech without the aid of a carrier wave. The inclusion of the recent work done by the Western Electric Company (U.S.A.), the General Electric Company (U.S.A.) and Lee de Forest would have considerably enhanced the value of the book. It must be stated, however, in all fairness to the author, that the book was evidently in the printer's hands about 15 months before it was published. The latest date up to which information is given is March, 1919, and the author at the time of actually writing the book, was obviously affected by the restraint made compulsory by the war.

John Scott-Taggart.

A Text Book of Electrical Engineering. Translated from the German of Dr. Adolf Thomälen by G. W. O. Howe, D.Sc., M.I.E.E. (London: Edward Arnold.) 5th Ed. Pp. xi.+482. 28s. net.

As electrical practice develops it becomes increasingly difficult for authors of textbooks to justify so comprehensive a title as "A Textbook of Electrical Engineering." This book was written for second and third-year students of the Central Technical College in order "to bridge the gap between the elementary textbooks and the specialised works on various branches of electrical engineering." The intention is wholly admirable; but the book can hardly be said to provide the desired bridge in that it undoubtedly specialises on dynamo machinery. A better and surer guide to students and teachers would have been provided had it been described as a textbook dealing with the fundamental principles of the construction and performance of dynamo machinery for both direct and alternating currents.

As such it is excellent, and can be recommended with confidence. And if Prof. Howe will provide an additional volume dealing in a similar manner with the fundamental principles of power distribution, instruments and testing, switchgear, traction, lighting and heating, we shall be prepared to admit the validity of the wider claim quoted from his preface.

This new edition differs from its predecessors in two main respects. Firstly, the symbols have been modified to bring them into agreement with the recommendations of the International Electrotechnical Commission; and, secondly, a number of minor alterations have been made, descriptions of obsolete types of machines have been deleted, whilst descriptions of the differential booster and of the automatic voltage regulation of alternators have been added. The sections dealing with the single-phase commutator motors have been modified and extended.

Whatever views may be held as to the merits or demerits of the system of symbols which the Commission recommended, it will be generally agreed that the symbols used in our leading textbooks should be reasonably uniform, so that we may be able to pass from one book to another without unnecessary labour. We therefore appreciate this change and trust that future editions of other electrical textbooks will show the same movement towards standardisation—assuring publishers and authors that the greater flexibility and interchangeability thus attained would increase rather than decrease sales.

There are 22 chapters in this edition, nine of which deal with direct-current and 13 with alternate-current machinery. The general treatment is mathematical rather than physical, though the mathematics employed does not go beyond the elements of higher mathematics. The book is essentially and intentionally written for the use of thoroughly well-grounded students, and cannot be read by anyone "who runs."

Nevertheless, we could have wished for more physical treatment—for the provision of fuller physical conceptions as to "why the wheels go round."

It may be argued that all such conceptions should be given in the more elementary stages, but that is hardly possible in the case of alternate-current machinery. Dr. Thomälen, in his preface to the first German edition, did express his desire "to lead the student to enter mentally into the various phenomena and to give him a physical conception of the underlying principles," but the spirit of Faraday is not very strongly evident.

However, a book must be judged by the degree with which it fulfils its object, and, as we have said, it is an excellent work for students of the type of the second and third year at a technical college such as the Central Technical College. Further, every student of electrical engineering, however lowly his status, should so order his general education that he should be able to read it with profit.

J. Paley Yorke.

Correspondence.

ACTION OF THE E.P.E.A.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I have read with interest your comments in the current issue of The Electrician re the crisis in the electrical-supply industry, but am somewhat at a loss to understand the concluding sentence of your remarks. You state that the E.P.E.A., in throwing over the Whitley Council and deciding on direct action, have taken a step which it will find hard to justify to the public and the industry in general. Surely in this dispute it is the bulk of the employers who have thrown over the Whitley Council, and it is they who will find it hard to justify their conduct?

In an earlier paragraph you pointed out that the reason the award had not been honoured, was because the employers believed that the E.P.E.A. were either unwilling or too weak to push matters to extremes. Is it suggested that the E.P.E.A. should have negotiated an agreement to forego that agreement because the employers are prepared to trade on our loyalty to the industry? The statement is also incorrect as to fact. Both sides of the National Joint Board have done their utmost for the past six months to obtain compliance with our Schedule, but with very small success, and the action of the E.P.E.A. now provides the National Joint Board with the weapon which past negotiations have proved to be necessary.

The extension of time given by the E.P.E.A. provides the National Joint Board with an opportunity for a final effort to secure compliance with their award. It is, therefore, incorrect to say that the E.P.E.A. have thrown over their Whitley Council, which is the National Joint Board. It would be more correct to say that we, having decided to adopt a Christian-like attitude by turning the other cheek when we have been smitten by those who should have been our friends, are now with characteristic thoroughness doing our duty to our neighbour by teaching the defaulting employers such a lesson as will convince them that, after all, honesty is the best policy.—I am, &c.,

London, Nov. 23, 1920.
W. Arthur Jones, General Secretary,
Electrical Power Engineers' Association.

[We comment on this letter in our "Editorial Notes."—Ed. *E.*]

INSTITUTION OF ELECTRICAL ENGINEERS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: With regard to the proposed increased Institution subscription, I shall only be expressing the views of many members when I suggest that, if the subscription be raised, the Council should be prepared, when we return to our Embankment building, to give us additional facilities.

I write as one who has had years' experience as a London member, and three years' experience as a country member, where I felt the lack of any benefits, even those enjoyed by London members. At present, in our Institution, no facilities are given for using the Reference Library, except during the day, when few can avail themselves of it. In my opinion, if the library could be open in the evenings, and if a room could be available for social intercourse (with light refreshments, which could be charged for) this would be an inducement to an increase in membership.

I feel sure that many would vote for the proposed increase under some such conditions as these who otherwise will vote against the proposal on December 2nd.—I am, &c.,

Wimbledon, Nov. 15. J. M. G. Rees.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I should like to express my agreement with the opinions of Mr. R. A. Sheldon contained in his letter published in your issue of the 12th inst. I shall not be able to attend the London meeting, nor do I know anyone who is going to the meeting to oppose the resolution. I am therefore debarred from casting a vote.

If the Council desire to ascertain the opinion of all the members, then they have adopted a singularly unfortunate means of so doing; but if they desire at all cost to pass the resolution, then there are obvious advantages in the method selected. I trust that many others will support Mr. Sheldon's protest.—I am, &c.,

Manchester, Nov. 14. William B. Simpson, A.M.I.E.E.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I am sure there are a large number of members, and a larger number still of associate members, who are in entire agreement with Mr. Sheldon's protest against the method adopted by the Council for obtaining proxy votes for the meeting on December 2nd.

It herefore suggest you would be doing a service to a large section of your readers by publishing an appeal to some London member who is prepared to go to the meeting and vote against the proposed increases, to come forward in the columns of the technical press and signify his willingness to accept proxy papers for that purpose.

In this way provincial members who do not happen to number among their acquaintances anyone who is able to attend the meeting would at least have some chance of recording their votes against the measure if desirous of doing so.—I am, &c., Fair Play—Manchester.

[As will be seen from our last week's issue, Mr. F. W. Purse, engineer and manager West Ham Corporation's electricity department, is willing to undertake this task.—Ed. *E.*]

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I should be grateful if you would kindly allow me to acknowledge receipt of the many letters and proxy papers, relating to the proposed increased subscription, which have been sent to me. Although I cannot reply to each individually, I have made careful note of all the points raised, which I shall find helpful in connection with the matter.

I would urge upon the members—particularly the provincial ones—if they are opposed to the new subscriptions to send their proxy papers to me as soon as possible; otherwise, the members present at the meeting, together with the Council's proxy vote, may carry the proposals.—I am, &c.,

Stratford, E., Nov. 22, 1920. Fredk. W. Purse.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: There appears to have been very few criticisms raised against the proposed increase of subscriptions, but it is only natural that amongst the 8,000 members of the Institution some dissentient voices should make themselves heard. The broad view of the situation should be taken that as two successive Councils representing the membership have unanimously decided that the Institution needs this increase of income, and as the members' own personal experience in regard to general expenditure must convince them that pre-war subscriptions will not meet post-war outgoings, they should firmly support the action of their representatives and trustees. Whether they intend at present to attend the meeting or not, they should send in their proxies to the Secretary of the Institution, so that the resolutions may be passed by an overwhelming vote. Otherwise, as such meetings are more likely to be attended by the opposing minority than by the assenting majority, it might be made to appear that there is a cleavage in the ranks of the members which I am sure does not exist.—I am, &c.,

London, Nov. 23. G. W. Partridge, M.Inst.C.E.

PULVERISED COAL AND COLLOIDAL OIL.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Power station engineers in Great Britain will have read with interest the reviews upon the lecture given by Mr. Lindon Bates at the recent meeting of the Society of Petroleum Technologists. Doubtless they have also noticed an account of the use of pulverised coal at the 200,000-kw. power station at Milwaukee, U.S.A., given in the "Manchester Guardian" by Mr. S. L. Pearce, Chief Engineer to the Manchester Electricity Committee, upon his return from America.

It cannot be claimed that for incorporation in any of the super-power station schemes now under consideration in Great Britain colloidal oil will receive serious consideration. Were there an abundance of liquid fuel for this or any other industrial purpose the admixture of 30 or 40 per cent. of pulverised coal would permit of the use of an ideal fuel for boiler firing, thereby saving approximately an equal quantity of the more costly liquid fuel. Supplies and prices ruling to-day do not offer much opportunity of adopting either straight oil or colloidal oil, outside marine applications, on any extensive scale.

The question of pulverised coal is quite a different matter. We have our coalfields and are, therefore, certain of supplies, and it is the duty of all heavy users of coal to investigate and adopt any method of saving 20, 30, or even 50 per cent. of the coal now burnt, providing such method or system is a proved success. The burning of coal in pulverised form under water-tube boilers can be accepted under strict guarantee as to results, for it is the "ABC" application of the many uses now responsible for the burning of nearly 20,000,000 tons of coal per annum in this manner in America alone. When burning pulverised coal, conditions in the boiler-house are approximately analagous to oil firing, any grade of coal can be used, boilers carry "oil firing" overloads, there are no banking losses, and dust or smoke nuisance in the neighbourhood is unknown.

If this has been accepted for a 200,000-kw. station as against mechanical stokers after complete trials extending over a period of two years, should we not have sufficient courage to emulate our colleague in America, Mr. John Anderson, Chief Engineer of Power Plant at Milwaukee, and hasten the day when such a great economy in coal can be effected at our own power stations?—I am, &c.,

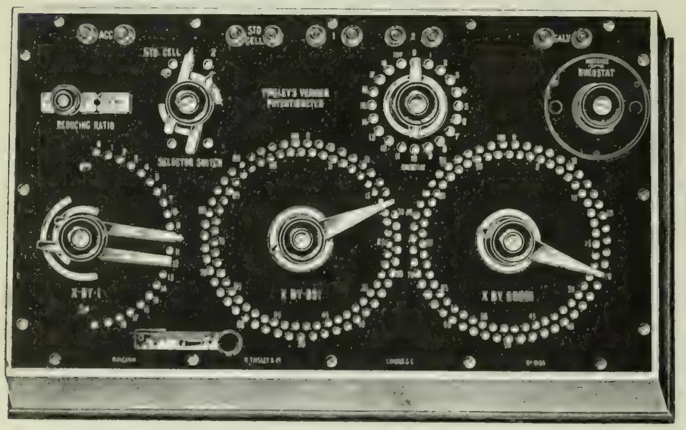
London, Nov. 24. L. C. Harvey.

Tinsley's Vernier Potentiometer.

Messrs. Tinsley & Company have recently designed an improved form of universal potentiometer to meet the demand for a long-range potentiometer without a slide wire. We illustrate this instrument herewith. The normal range of this potentiometer (with reducing ratio plug in the X by 1 hole) is from one hundred-thousandth of a volt (0·00001) to 1·90100 volts. The lower range (with reducing ratio plug in the X by 1 hole) is from 1 microvolt to 0·190100 volts. The principle adopted in order to obtain this long range is that of the "Thomson-Varley" slide or vernier. It will thus be seen that on the normal range it is very suitable for all the usual potentiometer measurements, such as the comparison of resistances, currents and voltages, and using the reducing shunt, it is equally suitable for thermo-electric and similar low E.M.F. measurements.

The main dial (X by 0·1 volt) of the instrument consists of 20 coils of 10 ohms each, and when used normally the voltage drop on each coil is 0·1 volt. Owing to the vernier coils (second dial) always shunting two coils, the effective range, however, is only 19 by 0·1 volts, or 1·9 volts for the total reading on this dial. The vernier dial (X by 0·001 volt) consists of 100 coils of 0·2 ohms each coil, total 20 ohms. This dial always shunts two coils of the main dial, so that intermediate readings of the main dial sections can be obtained on the vernier dial down to 0·001 volt. The fine adjustment dial (X by 0·00001 volt) is a series of 100 equal resistances placed in *series with the main dial*. The value of these resistances being 0·001 ohm each coil and 0·1 ohm in total. As the current through the potentiometer is 0·01 ampere or 10 milliamperes, the voltage drop is 0·01 by 0·001, or one hundred thousandth of a volt for each stud.

It will be noticed that the studs are staggered on the large dials, to prevent cramping and improve the insulation, and that the illustration shows *even numbers* on the *outer* ring and *odd numbers* on the *inner*. This tends to avoid confusion in reading. The principle of keeping to a definite standard current through the potentiometer is adhered to, as this has many advantages, and the 0·01 ampere (10 milliamperes) is still retained as standard. This value does not polarise the accumulator too quickly or throttle the sensitiveness of the D'Arsonval galvanometer by making the resistance of the potentiometer too high.



View of Tinsley's Vernier Potentiometer.

As regards the accessories, the rheostat with 20 studs is for the approximate adjustment of the standard current. The enclosed rheostat is for the exact adjustment of the standard current, and is very carefully made with a double spiral of wire on an ebonite cylinder. The selector switch is a three-way double-pole switch, one pair of poles being allotted to the cadmium cell terminals, and two pairs of terminals are allotted to the other two circuits marked 1 and 2, the positive terminal being on the right in all cases. The reducing ratio is an arrangement of a two-way plug switch, by means of which the current in the working coils of the potentiometer can be reduced to one-tenth of its normal value of 0·01 ampere, or to 1 milliampere. This reduces the voltage drop on the measuring dials to one-tenth of its engraved value. In other words, the working range of the potentiometer then lies between 0·190100 volts and 1 microvolt. This two-way shunting arrangement is accomplished by putting in series a resistance $\frac{9}{10}$ the value of the resistance of the working portion of the potentiometer and shunting this portion by a resistance of $\frac{1}{9}$ of its value, thus reducing the current through the working coils to one-tenth, or 0·001 ampere; at the same time it keeps the current from the accumulator at its normal value, so that its rate of polarisation is constant. As this is done by one plug only, the time from setting the standard cell to the instant of use is reduced to a minimum.

The Institute of Physics.

We understand that the Institute of Physics has now been incorporated and has begun to carry out its work. It will be remembered that the objects of the Institute are to secure the recognition of the professional status of the physicist, and to co-ordinate the work of all the Societies interested in physical science or its applications. This co-ordination has already been secured by the participation of five of these societies, namely:—The Physical Society of London, the Optical Society, the Faraday Society, the Royal Microscopical Society, and the Röntgen Society. The Institute thus promises to become a powerful unit in connection with any wider scheme of federation of scientific societies.

The first list of members includes the names of over 200 fellows. Sir J. J. Thomson, O.M., the retiring President of the Royal Society, has accepted the invitation of the Board to become the first and at present the only Honorary Fellow.

It is a tribute to the status already acquired by the newly-formed Institute that its diploma is now being required from applicants for Government and other important positions requiring knowledge of physics, and thanks in great part to the Institute the physicist is now becoming recognised as a member of a specific profession.

The first President of the Institute is Sir Richard Glazebrook, K.C.B., F.R.S., who will preside at the first statutory meeting of the Institute, which will be held early in the New Year.

Particulars with regard to the qualifications required for the different grades of membership can be obtained on application to the Secretary, 10, Essex-street, London, W.C. 2. Fellows elected before May 1, 1921, will have the privilege of being styled Founder Fellows.

Mr. S. L. Pearce on his American Visit.

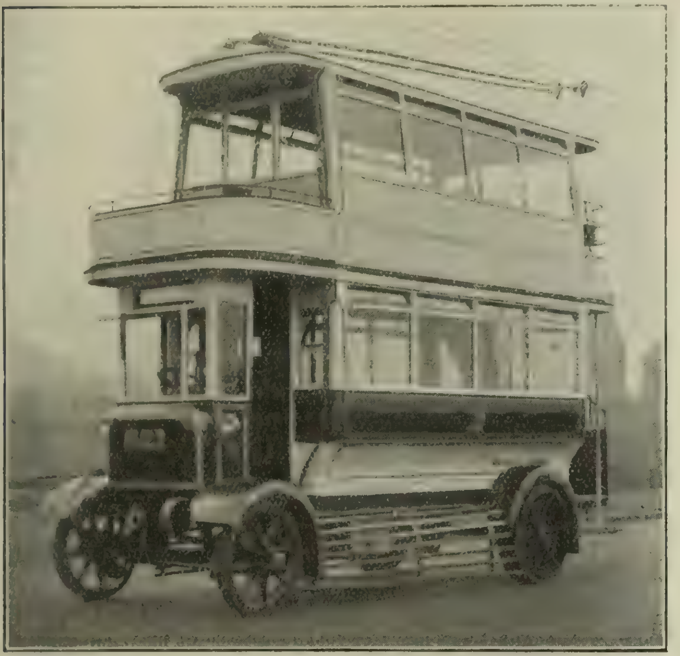
In an interview with a representative of the "Manchester Guardian," speaking on his recent visit to America, Mr. S. L. Pearce, Chief Electrical Engineer, of Manchester, said that whilst he had come across many interesting features that could be embodied in the Barton scheme he saw nothing to induce him to make any fundamental alterations. The extraordinary large generating units now being employed in America had not been a complete success, and there was a tendency to go a little more slowly and to build sets of a more moderate capacity. The explanation of the difficulty that had been experienced was given as inability to obtain proper material during the war period. "No faults in design are admitted," added Mr. Pearce, "but I would not be prepared to accept that."

In America, he mentioned, engineers were much keener than in this country to secure the last ounce of power from coal, and the reason it would seem that pulverised fuel will be the boiler fuel of the future would certainly have to be considered in connection with the electricity supply in Manchester. "Another matter which interested me," said Mr. Pearce, "was the public steam heating systems they have in a good many American cities, particularly in New York and Detroit. We have done a little bit of warehouse and office block heating in Dickinson-street with exhaust steam, and have tried to make it a by-product supply from the power station. They started in exactly the same way in the States, but found out, as we found out, that it is next to impossible to run supplies of electricity and steam together, because the loads are not coincident with the times of demand. In America they now have independent steam stations owned and controlled in some cases by the electrical companies, and there is no reason why something of this sort should not also be done in Manchester."

Interconnection of electricity undertakings, he points out, is being adopted more and more in America, though American experience cannot be directly applied over here as the conditions are so different. A striking example of these schemes is to be found in the Ohio district, where something like 500,000 kw. are interconnected. The outstanding scheme, however, was the interconnection of the whole of the electrical undertakings on the Atlantic seaboard from Maine to Washington, an area 400 miles long, and from 150 to 200 miles wide. "The thing that struck me," said Mr. Pearce "was that it apparently paid certain undertakings to shut down their own plant and buy power from stations 80 or 90 miles away."

The Bradford Trolley 'Bus.

An interesting type of electric vehicle has recently been put on the road by the Bradford Tramways Committee. It derives its interest from its design and the way in which it is being used, and from the fact that it has been entirely constructed in the works of the Tramways Department at Thornbury. As our illustration shows, in outward appearance it is very much like that of a motor bus with the addition of a roof and two trolley arms. The vehicle is rubber-tyred, and is fitted with well sprung seats fixed in the charabanc fashion. The covered-in top deck gives it a good load factor, and its sphere of usefulness is much increased from the fact that it has been designed to run both on trackless trolley routes and on the tram lines. In the latter case the negative trolley is disconnected, and contact with the permanent way is effected by fixing an iron shoe to the front part of the car. This shoe fits the curved part of the rail of the permanent way, and is connected by a short rod to the steering axle. It thus serves to steer the car automatically and to provide the necessary earth contact. We are informed that while the working expenses of this new type of car may be slightly more than the ordinary tramcar, against this must be placed the enormous saving in the cost of track, which amounts in Bradford to something like £50,000 per mile.



THE BRADFORD TROLLEY 'BUS.

Parliamentary Intelligence.

BRITISH MAGNETOS.

In the House of Commons last week, Mr. MACQUISTEN asked the President of the Board of Trade whether he was aware that there were 14,000 magneto workers in Great Britain who were specially trained during the war to make magnetos for aeroplanes and other Government purposes; that a Committee of the Board of Trade had decided that the making of magnetos was a key industry; that, owing to the exchange, German magnetos were being dumped at a figure below the cost of material to the British manufacturer; that in consequence one-half of 7,000 of the employees were out of work and the rest on half time; and that, over and above the handicap of the exchange, the German Bosch manufacturer was selling below cost, as he did prior to the war, to exterminate the British trader? In view of these facts, would he cause prohibition of such imports until trade and exchanges were normal and so cherish a key industry?

In reply, Sir P. LLOYD-GREAME said he could not state the actual number of magneto workers trained during the war, nor the proportion of these who were out of work or on half time. The industry was undoubtedly depressed, and that depression was partly due to German magnetos being offered at low prices. He had no reason to believe that they were being sold below the selling price in Germany. There was no power at present to prohibit the importation of magnetos, but the Government had undertaken to introduce legislation dealing with key industries at the beginning of next session.

Mr. Campbell Swinton on Wireless Progress.

In the course of an address which he delivered to the Royal Society of Arts on November 17, Mr. A. A. CAMPBELL SWINTON, F.R.S., Chairman of the Society, said that wireless telegraphy and telephony shared with aerial navigation the merit of being among the most useful and startling of the practical applications of science.

The address was illustrated by experiments and the lecturer began by receiving the usual nightly wireless message from the Admiralty Station at Horsea, near Portsmouth. A temporary aerial on the roof of the building was used and a Creed receiver recorded the Morse signals by punching holes in a tape. This tape was afterwards put into the Creed printing telegraph instrument, and a portion of the message printed in Roman letters was exhibited on the screen. The signals were also made audible by means of a loud speaking telephone appliance fixed on the lecture table. It was stated that this was the first occasion on which wireless messages printed in ordinary type had been publicly exhibited. At a subsequent stage of the proceedings a message was received from General Ferrie, of the Eiffel Tower Wireless Station and head of the French Military Wireless Service. This was also converted by the Creed printer into Roman type and was shown on the screen.

A demonstration of wireless telephony by speaking, whistling and gramophone performances from a near-by station was successfully given in the lecture room. Mr. Campbell Swinton in conclusion suggested that before long it would be possible to reproduce wirelessly transmitted speech with sufficient distinctness to allow of verbal communications being no longer confined to single halls. Thus individual speakers would be able to address an unlimited number of audiences simultaneously, and at election times we might see great party leaders speaking to hundreds or thousands of separate meetings distributed over the whole country. For such apparatus different political parties would have to be allotted different wave lengths, so as to avoid the babel of opposing declamations which would otherwise result.

British Made Fractional H.P. Motors.

The increasing demand for labour-saving appliances, not only throughout the world, is stimulating inquiries for fractional H.P. electric motors. In these circumstances it is to the national interest that British rather than foreign manufacturers should cope with the increasing demand for these appliances. We are therefore interested to learn that Messrs. SCHOLEY & COMPANY have for some time past been developing the design and construction of small compact high speed motors for every domestic and commercial use. Their aim is the construction of small motors with at least as great a reliability factor as larger motors which generally receive some measure of skilled attention.

In general construction the Scholey fractional H.P. motors follow in miniature the lines of the best modern electrical practice. They are manufactured, moreover, in the interests of portability and price, to run at a very high speed and, in addition, are capable of working off the comparatively high voltages obtained on lighting circuits. With the two pole construction used, these speeds give a high frequency of magnetic reversals in the armature and necessitate careful lamination and the use of the best iron; they also involve the necessity for exceedingly accurate balancing of the rotating parts. Very great attention has therefore been given to the balancing of the armature laminations when assembled on the shaft, while a special divided winding is used which avoids the bunching up of the end windings commonly occurring with hand-wound armatures, and, finally, the complete armature with its accessories is balanced on knife edges.

The armature cores are built up of thin laminations of high grade electric alloy steel, carefully stamped and ground to size. With a high rate of revolutions some trouble might be expected at the commutators, but Messrs. Scholey & Company have now succeeded in producing sound commutators which keep smooth, it is claimed, and true up to the highest speeds which may be called for. Great attention has been paid to the commutator connections to eliminate the danger of open circuits occurring at these points. The segments are of hard drawn copper, insulated entirely with pure mica and carefully tightened under heat to withstand high speeds. High speed graphite brushes only are employed in these motors. The armature laminations are assembled in position on the armature spindle by presses, which force them over a short tapered portion of the spindle on to the main seating. Being originally stamped slightly smaller than the shaft they are held firmly in position by this process. After assembly, the core plates are ground on the periphery to ensure concentricity and balance. The field magnet laminations are assembled on a jig and held together by four tubular rivets.

The armature spindle is hardened and ground and runs in self-aligning radial ball bearings—the armature and two bearings forming a complete unit which can be easily withdrawn by simply removing the cover screws—and an ample supply of grease is provided in a cup at both bearings enabling the motor to run for long periods without attention. The motor case of the smaller types consists of an aluminium casting carried on a foot base of the same material adapted for fastening to any convenient support. The motors are made in sizes of from 1-50th h.p., of the series wound "Universal" type, have an exceedingly high efficiency, are self-cooling and, although rated for continuous operation at a given speed and B.H., will nevertheless carry a heavy overload for short periods.

Geneva Wireless Station.

Many thousands of words are being sent out daily from the temporary Marconi Station at Geneva for the special use of journalists attending the Conference of the League of Nations, and over 10,000 words were handled on the 15th inst. within a few hours of the close of the first sitting of the Conference. Naturally, the Marconi Company is gratified with this excellent performance by a station which was completed only a few hours before the opening for commercial traffic. Sixteen days ago the equipment, including a 200 ft. steel tower (dismantled) weighing many tons, had not arrived at Geneva, so that the temporary plant was erected at lightning speed. Rapid automatic transmission is being employed, the train of clear-cut signals, which cannot be understood aurally without special apparatus, being received at the British station at Witham, Essex, on rapidly revolving phonograph records. From Witham the signals are re-transmitted by Creed high-speed gear to London. This is said to be the first occasion upon which the newspaper world has had at its disposal a channel of rapid communication in which Press messages have priority over ordinary commercial traffic.

The station, which was erected in agreement with the Swiss Federal Government, is a 6 kw. continuous wave valve one, and the service commenced on the day the Conference opened. In addition to the primary service to the Witham station, communication has now been effected with Csepel (Hungary), Nauen (Germany), Centocelle (Italy) and Barcelona (Spain). The transmitting apparatus comprises one Marconi standard 6 kw. continuous wave valve telegraph set of the coupled circuit type, fitted with 6 "power" and 4 "rectifying" valves. The power is taken from the Geneva Supply Company and supplied to a 30 B.H.P. 500 volt two-phase motor, which drives by belt a 23 kw. 100 volt direct-current dynamo. An emergency power plant is provided, consisting of one 18 kw. 110 volts direct-current Austin oil-engine generator. Each power set is provided with a slate panel switchboard. One 6 k.w. motor alternator is installed, taking supply from the 110-volt direct-current circuit, giving a single-phase supply at 500 volts 300 cycles. The voltage is raised to 7,500 by a step-up transformer, at which pressure it is fed to the valve transmitter panel. The signalling circuit comprises special high-speed keys operated by a Wheatstone transmitter, the tape for which is "punched" on a Gell keyboard type perforator. The aerial is of the umbrella cage type with six radial members, supported by a single lattice steel self-supporting tower 200 ft. high, each radial member being carried out to a 50 ft. pole at a distance of 300 ft. from the central tower. The earth system consists of the usual galvanised iron plates and earth wires buried in the ground. Five miles from the transmitting station is a separate receiving station erected so as to permit of duplex working. This station is provided with a special aerial constructed on the latest directional principles, and is connected to the transmitting station by landline.

The receiving station at Witham, near Chelmsford, is equipped with the latest type of directional aerial and, in addition to up-to-date valve receivers, is provided with dictaphone apparatus for the reception of high-speed messages. For transmitting the necessary acknowledgments, service messages, &c., a 15 kw. valve transmitter at the Marconi Works, Chelmsford, is operated direct from the receiving station at Witham by landline connection. Witham is also in direct landline communication with the Marconi Company's London Offices to which the messages are finally transmitted by high-speed automatic apparatus. Many thousands of words are daily handled by this service.

Standard Steam Turbines.

The British Engineering Standards Association, 28, Victoria-street S.W.1, has issued the standard specification for steam turbines for electrical plant. This specification (No. 132) includes clauses dealing with the following items: rating, margin of capacity of steam turbine, output of condensing steam turbines when working non-condensing, maximum speed, governing characteristics, synchronising limits, emergency cut-off speed, minimum steam consumption per kilowatt hour, definition of average steam consumption, statement of steam consumption, load at which steam consumption is guaranteed, tolerance, measurement of steam pressure, measurement of temperature of the steam exhaust pressure, limits of bearing temperature, hydraulic test for parts exposed to boiler pressure and critical speed of shaft. An Appendix dealing with the method of measuring the temperature of the steam, and illustrations showing the correct method of measuring the pressure at the exhaust opening, have also been included. The class of materials to be employed are not dealt with. The Sub-Committee responsible for drafting this Specification, which is published at 1s. 2d., is under the Chairmanship of Captain H. Riall Sankey, C.B., C.B.E., R.E.

Commercial Topics.

The Export Credits Scheme.

The Department of Overseas Trade notifies that this scheme, which affords assistance in the development of British trade with Central and S.-Eastern Europe, has been revised. As originally framed, advances were made by the Department only up to 80 per cent. of the cost of the goods, including freight and insurance and commission paid to the Exports Credit Department, such advances being without recourse against the exporter. The Department is now authorised to advance in approved cases up to 100 per cent., retaining recourse against the exporter in respect of 20 per cent. Credits may be granted up to a maximum period of three years. Copies of the revised conditions may be obtained from the Export Credits Department, 73, Basinghall-street, E.C.2.

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Electrical Supplies Required in Fiji.

The Imperial Trade Correspondent at Suva, Colony of Fiji, recently wrote to say that since the electric light was installed by the Municipal Council at Suva he has had several enquiries regarding lighting and cooking apparatus, and he suggests that if he were supplied with illustrated catalogues, stating prices, business would doubtless follow. Some lighting and cooking apparatus of United States manufacture is already being used in the colony. Details of the plant installed by the Municipal Council in Suva are not yet available to the Department of Overseas Trade. Catalogues should be addressed to The Acting Receiver-General, The Treasury, Suva, Colony of Fiji.

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Anglo-Chinese Trade.

Progress is being made with the development of the organisation of the Anglo-Chinese Trade Corporation, which is being formed for the purpose of extending British trade in China and the Far East. Three firms have guaranteed to find the greater part of the initial sum of £120,000. One of the main purposes will be to delegate the powers and privileges enjoyed under its charter to subsidiary or associate industrial undertakings, and it will also act as an intelligence bureau and exploration agency with the object of furnishing information or influencing Chinese capital and generally of acting as a liason, when necessary, between firms operating under the charter on the one hand and the Legation and Chinese Government Departments on the other.

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The London-Australia Exchange Position.

The Federation of British Industries has addressed an important communication to the High Commissioner for Australia (the Right Hon. A. Fisher) on the trade difficulties caused by the serious position of the London Australia Exchange. It is suggested that the present critical state of affairs can be remedied by:—

(1) The Commonwealth Government removing the prohibition on the export of gold from Australia to Great Britain, and thus enabling the Banks in Australia to export the gold necessary to meet immediate credit needs; (2) by the Commonwealth Government placing at the disposal of the Australian banks in London the considerable sums which it is understood the Australian Government has at its disposal in this country, and which it is withholding from its normal function of financing trade between Great Britain and Australia.

Further, the Federation state that they feel that the present state of affairs has been caused by the action of Governments in entering into commercial transactions. These transactions, although they may have been fully warranted at the time when they were entered into, have now created a serious trade crisis, and it is not unfair to ask that all possible steps should be taken to end it. The present position is a good illustration of the evils of trading by Government departments, and of the difficulties caused by trade control, &c. It is most undesirable that difficulties which are capable of adjustment should be allowed to impede trade within the Empire at a time when trade with many foreign countries is practically impossible owing to exchange difficulties.

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A Substitute for Excess Profits Duty.

In the current issue of the *Manchester Guardian Commercial* Sir Charles Mandelberg suggests substituting for the present Excess Profits Duty a flat rate tax on the net profits of all concerns, after providing for a fixed percentage on capital employed, with the proviso that reserves and undistributed profits should be treated as "capital employed," and that remuneration for management, depreciation, &c., should be deducted before arriving at the net profits. Taking into account the present difficulty of obtaining new capital he suggests eight per cent. as a datum line above which the surplus profits tax should be charged.

Sir Charles claims for this tax that it is based on the sound principle that every form of capital has a right to a return before it is taxed for surplus profits. At the same time it must be admitted that heavy taxation is a necessity to meet our war commitments and the arrangement suggested does not seem to us to give the necessary inventive to earn anything above the datum line. It forms, in fact, a kind of control the malevolent operations of which we are sufficiently familiar with. A better suggestion appears to us to be the "first fruits" tax suggested by *Ways and Means* some months ago. This tax takes the form of a 100 per cent. tax upon profits made in excess of those of the previous year. This tax would be an incentive to increase the standard of the company and as the State would always take the first year's profits on any improvements, large sums of money would accrue to the Exchequer. Such an arrangement would therefore tend to encourage rather than retard progress.

Electricity Supply.

Sir Chas. Starmer has been re-elected chairman of the Darlington Electricity Committee.

Mr. P. J. Wemyss, of Mullingar, has purchased the Portarlington Electric Light Supply works.

Southend Corporation has authorised extensions of the electric supply cables at a cost of about £3,500.

Sanction to a loan of £52,900 for extensions of the electric supply undertaking has been secured by Peterborough Corporation.

Shrewsbury Corporation has been authorised to increase the maximum charge for electricity from 8d. to 9d. per unit.

The Carrickmacross Urban Council has agreed to pay the local lighting company 1s. per unit for the supply of electricity for public lighting.

Littleborough (Lancs.) Urban Council has applied for sanction to borrow £16,000 for providing high tension cables to local mills together with transformers and switchgear.

The Lord Mayor of Cardiff has been requested to convene a conference, at an early date, of representatives of all electric supply undertakings in South Wales and Monmouthshire in order to consider the formation of a Joint Electricity Authority for the area.

In connection with the scheme of the North Wales Power & Traction Company for the erection of hydro-electric works at Maentwrg, the company has secured the option of purchasing 16 farms at Trawsfynydd, Merioneth, for the construction of a dam which will be four miles long by three miles broad.

Representatives of the N. E. Lancashire group of the Mid-Lancashire Electricity Undertakings held a conference at Burnley on the 18th inst. preparatory to a conference with the Electricity Commissioners in London on the 1st prox. It is reported that the delegates are unwilling to undertake any financial responsibility for the working of a group of districts in Mid-Lancashire.

In a statement issued by Mr. L. Raul, chairman of the Dublin Electricity Supply Committee, he complains that the recent request to electricity consumers to reduce their consumption met with feeble response. Coal supply will not be normal for weeks and between 4 p.m. and 6 p.m. shop display lights and general lighting and power loads should be reduced. The choice now lies between a substantial reduction voluntarily or compulsorily, or in ultimate cessation of supply.

The accounts of King's Lynn electricity department for the year ended March 31 show revenue £15,749, gross profit £4,259, compared with £4,871 in previous year, and net profit £1,219 (£1,924), working expenses were 2·65d. (2·15d.) per unit sold, and total costs, including capital charges, &c,. 3·84 (3·16d.). Maximum supply demanded was 586 kw. (495 kw.) and load factor 15·32 (17·05) per cent. Units generated were 861,617 (808,126) and sold 786,201 (738,562).

Sunderland Corporation recently adopted the National Joint Board scale of salaries applicable to the technical staff of its electricity department, the approximate additional cost being £1,262 per annum. The Council has, however, rejected a recommendation to adopt the new schedule of rates of pay and conditions of employment for workmen. Objection was made to the grant of an annual holiday with pay to certain men, in regard to whom an arbitration is pending on this question.

At an important conference of representatives of electric supply authorities in the West Midlands area, which was held at Birmingham on Monday, it was unanimously resolved that all electric supply authorities in the area be strongly urged to accept in their entirety the conditions of employment and schedule of salaries for technical engineers issued by the National Joint Board, subject to the further consideration of anomalies arising out of the application of the schedule of salaries and the conditions of employment. Thirteen authorities were represented and Alderman Bird, of Birmingham, presided.

The revenue of the Maidstone Electricity Department for the year ended March 31 was £43,935 (compared with £31,341 in 1918-19); costs were £32,263 (£23,801), leaving gross profit £11,672 (£7,540). After payment of capital charges, the net profit was £1,486 (against a deficit of £177). Units sold were 4,600,879 (3,877,930); maximum load was 2,108 kw. (1,643 kw.), and load factor 31·24 (33·6) per cent. The engineer (Mr. E. E. Hoadley) reports that the lighting demand is only 9 per cent. of the total output. The power demand is ever increasing, and the heating and cooking load also shows an appreciable increase.

There is an increasing demand for the introduction of electricity supply into Crieff. A successful electrical exhibition was recently held in the town, and a canvass of residents was most encouraging. One canvasser reports that in his district it was not a case of trying to convince the people of the advantages which would accrue from the introduction of electricity, but of being asked how soon the scheme could be put into operation. The matter will be considered by the Council at an early date, but it is suggested that a supplementary report should be obtained from the Engineer on the question of water power.

The accounts of the Accrington Electricity Department for the year ended March 31 show revenue £54,084, compared with £43,097 in previous year and working and general expenditure £43,369 (£33,422), leaving gross profit £10,715 (£9,675), or £11,004 including dividend on investment. Interest and sinking fund required £11,586 (£11,230), and the net result was a deficit of £582 (£1,266). Working expenses were 1·55d. (1·15d.) per unit, and total costs, including capital charges, 1·96d. (1·54d.). The total maximum demand was 3,380 kw. (3,200 kw.), and the load factor 22·65 (24·8) per cent. Units delivered to feeders were 7,531,873, and sold 6,705,274 (6,948,390).

The accounts of Eastbourne Electricity Department for the year ended March 31 show revenue £50,833 (compared with £35,012 in previous year), working expenses were £29,101 (£22,442) and gross profit was £21,732 (£12,569). Capital charges were £15,976 (£17,060), and the net result was a profit of £5,755 (against a deficit of £4,490). Cost per unit was 2·88d. (2·66d.), and redemption of capital required 0·75d. (1·08d.) and interest 0·43d. (0·45d.). Units generated were 3,263,055 (2,757,130) and sold 2,521,437 (2,167,297). Maximum load was 1,652 kw. (1,349 kw.) and load factor 22·51 (18·34) per cent. Motors taking energy have increased from 321 to 360, and the total horse-power of motors connected is 1,270, exclusive of 70 h.p. used at the electricity works.

The accounts of Halifax Tramways Department for the year ended March 31, show revenue £189,186, compared with £149,827 in the previous year, and working expenses were £162,892 (against £111,725). Interest, sinking fund and income tax required, £24,817 (£27,303) and net profit was £1,476 (£10,767). Total revenue per car mile was 21·46d. (19·43d.) and working expenses were 18·48d. (14·49d.) including power. Passengers carried were 26,295,770 (24,516,973) and car miles run 2,115,734 (1,850,513). The revenue from motor omnibuses was £4,382 (£3,503)=19·94d. (16·48d.) per mile, and expenditure was £5,938 (£3,444)=27·02d. (16·20d.) per mile, the deficit being £1,556, compared with a surplus of £59.

The accounts of the Stepney (London) electricity undertaking for the year ended March 31 show revenue £205,155, compared with £175,834 in previous year, and working and general expenses £139,421 (£110,154), leaving gross profit £65,734 (£65,680). After adding miscellaneous income, and providing for interest, repayment of loans, &c., the net profit was £23,376 (£22,245). Average income per unit was 1·708d. (1·647d.), and costs were 1·141d. (1·017d.), exclusive and 1·510d. (1·437d.) inclusive of capital charges. Units generated were 30,836,840 (28,811,770) and purchased in bulk 3,537,916 (2,087,262), while units sold were 28,323,075 (25,383,085). Total maximum demand was 12,200 kw. (10,800 kw.). The income from the provision and maintenance of motors was more than double that of the previous year, and the profit on this branch was over £1,200.

Portsmouth Corporation have decided to adopt electric power at the Eastney pumping station in connection with the new drainage scheme. It was originally proposed to use suction gas, but in view of projected electric supply extensions the claims of electric power were considered by the consulting engineer, Mr. G. Midgley Taylor. The Electric Lighting Committee undertook to lay a main to give a supply of 600 h.p., provided the Drainage Committee would guarantee to pay a sum of not less than £2,000 per annum for five years, the energy to be charged for at ordinary power rates. In his report Mr. Midgley Taylor stated that the saving of electricity over suction gas was only about 5 per cent., but as the capital cost of the electrical plant was much less than that of the suction-gas plant (about £30,000), he was of opinion that the adoption of electric power would prove of great advantage.

The accounts of Bury (Lancs.) electricity department for the year ended March 31 show revenue £76,452 (compared with £53,226 in previous year), and working expenses £57,386 (£38,874), leaving gross profit £19,065. Interest on loans required £7,516 (£7,018), sinking fund £9,173 (£9,317), and the net profit was £2,377 (compared with a deficit of £1,983). £1,000 has been devoted to relief of rates, and the remainder of the net profit placed to reserve. Maximum supply demanded was 5,875 kw. (5,017 kw.), and load factor was 29·8 (30·4) per cent. Units generated were 17,036,613 and sold 15,367,885 (13,388,384). During the year 114 consumers were connected, making a total of 1,218, with the equivalent of 319,503. 8 c.p. lamps. The increase of motors connected was 43, equal to 291 h.p., the total connected being 1,107, equal to 9,306 h.p. Average price of fuel was 29s. 2d. (21s. 11d.) per ton.

Business Items, &c.

The Alliance Trading Company, Ltd., has removed to Oxford House, 15, John-street, London, E.C.3.

The offices of Messrs. E. G. Acheson, Ltd., have been removed to 40, Wood-street, Westminster, S.W. 1. Telegrams, Oildag Vic London: Telephone, Victoria 9848.

The Northern Electric Supplies Company, of 23, Bank-street, Bradford, ask us to announce that they have no connection with any firm of contractors in Bradford or any other firm trading under a similar name.

The partnership between Arthur Saunders, Fredk. Garner and Fred Mothersdill, electrical and mechanical engineers, &c., 249, Regent-road, Salford, has been dissolved. Debts by Mr. Garner and Mr. Mothersdill, who continue at the same address under the present style of Saunders, Garner & Mothersdill.

In the alphabetical entry of the London Electric Firm in the last edition of our "Electrical Trades' Directory" we regret that we inserted in error an address at Holborn (London), in addition to the Croydon address. We are asked to state that all communications for the Firm should be sent to them at Brighton-road, Croydon.

The partnership between Herbert Thompson, Andrew Ducat & Charles Almer White, trading as Almer White & Company, electrical and general engineers, Shard Mews, Hill-street, Peckham, London, S.E., has been dissolved so far as concerns Mr. White. Debts by Mr. Ducat and Mr. Thompson, who continue the business under the style of Ducat & Thompson.

Electric Traction.

Owing to the greasy state of the rails a Halifax tramcar got out of control on Tuesday evening and collided with a motor lorry. A woman who was passing was struck by the car and killed, and two or three passengers were also injured.

The new convener of the Glasgow Tramways Committee (Bailie M'Whirr) and the general manager (Mr. Jas. Dalrymple) conducted the members, many of whom are newly elected, through the various offices and depots of the department on the 17th inst. The Ministry of Transport has authorised the suspension of workmen's fares until Feb. 15, 1923.

In the Report of the proceedings of the Minister of Transport under the Tramways Act, 1870, it is stated that only two Provisional Orders were granted in the current session, viz., (1) the Gravesend, Rosherville and Northfleet Tramways (Amendment) Order, authorising increased maximum fares; and (2) the Warrington Corporation Order, authorising the construction of two short extensions of tramways, estimated to cost £7,689. The Bill to confirm the orders was unopposed and received the Royal Assent on Aug. 4.

The total revenue of Newport (Mon.) Tramways Department for the year ended March 31 was £108,892, compared with £81,608 in 1918-19; working expenses were £85,862 (£64,718), leaving gross profit £21,030 (£16,890). Interest, sinking fund, &c., required £10,413 (£11,224) and net profit was £10,617 (£5,666). Average total revenue per car-mile was 23·482d. (19·27d.), and working expenses were 18·86d. (15·28d.). Passengers carried were 16,126,871 (14,751,105), and car-miles run 1,092,423 (1,016,469).

Mr. F. C. Wilson has been re-elected Chairman of the Liverpool Tramways, Electric Power & Lighting Committee. In returning thanks, Mr. Wilson stated that the financial position of their undertakings required serious attention, as the cost of labour had increased 260 and materials 370 per cent., while revenue had only increased 104 per cent. It was likely that tramway fares would have to be again increased. It was anticipated that the new generating sets that were being installed at Lister Drive station would be brought into use during next year. The demand for electricity was steadily increasing and in the near future their plant would be fully loaded.

The Highways Committee of the London County Council recommend that 125 new electric tramcars be purchased at an estimated cost of £548,000. The first batch of 50 cars will cost approximately £4,305 each and the remaining 75 about £4,326 each. The pre-war cost of a similar type, based on orders placed in 1910, was £883. It is anticipated that the first car will be delivered in 42 weeks. It is also proposed to extend the central car repair depot at Woolwich, for which £185,000 will be required in the current financial year. The total cost of the depot, so far as it has been provided for by estimates, including those now under consideration, is about £468,800. Including the additional amounts required for plant, machinery, &c., and for an extension of the depot for use as a store, the total estimates amount to about £585,600, of which about £380,000 remains to be expended. The expenditure on capital account for tramways during the next two years will amount to about £550,000 for cars and £380,000 on the depot, while provision for £235,000 will have to be made for the purchase of the London United Tramways undertaking. From £500,000 to £600,000 will also probably be required for new lines, and considerable sums will be needed for Greenwich power station and other works. It appears, therefore, that expenditure approaching £2,000,000 on capital account for tramways will be necessary during the next two years.

Miscellaneous.

Two orders have been made by the President of the Board of Trade directing the Custodian of late enemy property to divest himself of copyrights previously owned by German and Austrian nationals, and of patents owned by Austrian and Bulgarian nationals respectively.

A lecture entitled the "History of an Invention" was delivered by Mr. L. W. Wild, M.I.E.E., before the Camera Club on the 18th inst. Considerable interest was displayed by the audience, who followed the slides illustrating the inception and development of the Wild-Barfield electric furnace. Micrographic sections of steels put to various heat treatments were also illustrated.

A representative Committee has been appointed by the Secretary of State for the Colonies to consider and report what steps can be taken to secure the assistance of British Universities in Research Work essential to the protection of the inhabitants of the Colonies and Protectorates from disease and to the successful development of their agricultural and mineral resources, &c. The chairman is Lord Chalmers and the secretary Mr. A. B. Acheson, of the Colonial Office.

In the notice concerning the War Memorial to the employees of Messrs. Laurence, Scott & Company, Ltd., Norwich, which appeared in our last issue, it was stated that 76 ex-service men were now employed by the Company. We are informed that the number of ex-service men very largely exceeds this number, in fact, all ex-service men who have applied have been reinstated. The 76 men referred to are men who have received or are now receiving pensions for disability, and the Company has easily qualified for enrolment under the "King's Scheme."

There is evidence that, under the influence of publicity and public pressure, the Post Office telephone authorities are assuming a more reasonable attitude in their demands for charges for registering the titles of companies, &c. Recently Messrs. Rashleigh Phipps & Company, electrical engineers, changed the style of their firm slightly, and the Post Office demanded from them, and they had to pay, a surcharge of £4 on one of their lines, and were requested to pay the same sum for three other lines. The Company have now obtained a reply from the Postmaster-General to the effect that the application for the unpaid claims will be withdrawn and the sum of £4 already paid refunded.

We have received from Capt. W. P. Durtnall a communication pointing out that the proper solution of the problems now facing the tramway industry would be found in the general application of his Paragon Thermo-Electrification system. If this system were adopted, each tram would carry its own propulsive machinery in the form of a new super-Diesel Paragon internal-combustion engine using heavy fuel oil or residue from gas works. This engine would drive a small generator mounted on the car, and the existing overhead lines or slot system could be utilised to allow an electrical exchange of energy to take place automatically between the various cars. In this way the thermal efficiency of the present system of tramways could be increased from 5 to 6 per cent. to 25 or even 32 per cent., with a great reduction in the tractive effort necessary.

It is announced that starting with next week, *Ways & Means* and *Common Sense* will be amalgamated. *Common Sense* was first published four years ago by Mr. F. W. Hirst, when he relinquished the editorship of the *Economist* and rapidly took a position as a leading exponent of the policy of sound public finance. In its columns, week by week, and through the League to Enforce Public Economy for which Mr. Hirst is also responsible, he has consistently impressed upon the public the evils of Government extravagance. *Ways & Means* was the direct outcome of the work of Mr. Ernest Benn, in the founding of Whitley Councils, and the bringing together of employers and employed, through the Industrial Reconstruction Council, of which he was the creator. *Ways & Means* has acted as a leader of progressive industrial thought, and while pointing the road to prosperity through co-operation between employers and employed, it has always been the most unbending enemy of Government trading and official interference in trade. The policies of the two papers have so much in common that an amalgamation comes quite naturally, and there is no doubt that the added strength arising from a union of two such forces will enable both Mr. Benn and Mr. Hirst to carry on with still better effect the work which they have set themselves to do.

Imports.—The following are official values of electrical machinery, material and apparatus imported into this country (*a*) during October, 1920, and (*b*) the aggregate figures from Jan. 1 to Oct. 31, with increase or decrease compared with corresponding periods of 1919:—

Electrical machinery, (*a*) £197,123 (increase £58,514), (*b*) £1,045,723 (increase £413,880); telegraph and telephone cables, submarine, (*a*) nil (decrease £38), (*b*) £50 (increase £12); other than submarine, (*a*) £2,496 (increase £1,504), (*b*) £10,992 (increase £8); telegraph and telephone apparatus, (*a*) £34,141 (increase £20,175), (*b*) £157,660 (decrease £69,434); other electrical wires and cables, rubber insulated, (*a*) £1,626 (increase £1,245), (*b*) £25,186 (increase £20,310); with other insulations, (*a*) £17,516 (increase £14,956), (*b*) £103,508 (increase £88,537); carbons, (*a*) £24,117 (increase £22,884), (*b*) £120,057 (increase £93,858); glow lamps, (*a*) £10,480 (increase £10,429), (*b*) £50,552 (decrease £163,121); arc lamps and electric searchlights, (*a*) nil, (*b*) £4,014 (increase £3,983); parts of arc lamps and searchlights (other than carbons), (*a*) £1,159 (decrease £6,965), (*b*) £11,389 (increase £54,951); batteries, (*a*) £33,791 (increase £28,650), (*b*) £94,245 (increase £54,496); meters and measuring instruments, (*a*) £9,017 (increase £5,611), (*b*) £69,767 (increase £26,812); switchboards, (*a*) £216 (increase £181), (*b*) £1,561 (increase £387); electrical goods and apparatus unenumerated, (*a*) £100,757 (increase £45,068), (*b*) £651,687 (increase £275,989). Total of electrical machinery, material and apparatus other than uninsulated wire, (*a*) £432,439 (increase £212,217), (*b*) £2,346,399 (increase £700,976).

Exports.—The exports of electrical machinery, material, &c., (*a*) during October, 1920, and (*b*) from Jan. 1 to Oct. 31, with increase or decrease compared with corresponding periods of 1919, were as follows:

Electrical machinery, (*a*) £262,479 (increase £31,468), (*b*) £1,878,525 (increase £390,992); including railway and tramway motors, (*a*) £877 (decrease £11,007), (*b*) £31,923 (decrease £41,749); other generators and motors, (*a*) £176,146 (increase £4,871), (*b*) £1,117,560 (increase £293,139); and electrical machinery unenumerated, (*a*) £85,456 (decrease £1,396), (*b*) £729,042 (increase £139,602); telegraph and telephone cables, submarine, (*a*) £144,411 (increase £98,119), (*b*) £1,369,036 (increase £875,053); other than submarine, (*a*) £81,521 (increase £27,395), (*b*) £784,921 (increase £404,522); telegraph and telephone apparatus, (*a*) £114,579 (increase £76,218), (*b*) £966,641 (increase £648,880); other electrical wires and cables, rubber insulated, (*a*) £149,492 (increase £67,783, (*b*) £1,386,624 (increase £751,254); with other insulation, (*a*) £163,165 (increase £47,264), (*b*) £1,699,149 (increase £904,294); carbons, (*a*) £26,912 (increase £24,324), (*b*) £107,070 (increase £97,637); glow lamps, (*a*) £40,236 (increase £25,198), (*b*) £233,838 (increase £106,783); arc lamps and searchlights, (*a*) £422 (increase £318), (*b*) £15,827 (increase £8,799); parts of arc lamps and searchlights (other than carbons), (*a*) £1,289 (increase £269), (*b*) £11,687 (increase £2,837); batteries, (*a*) £71,904 (increase £43,424), (*b*) £471,095 (increase £117,000); meters and measuring instruments, (*a*) £31,402 (increase £10,389), (*b*) £325,474 (increase £126,547); switchboards, (*a*) £7,818 (increase £5,048), (*b*) £82,675 (increase £42,030); electrical goods and apparatus unenumerated, (*a*) £225,622 (increase £42,778), (*b*) £1,591,969 (increase £568,086). Total of electrical material, machinery and apparatus, other than uninsulated wire, (*a*) £1,321,252 (increase £499,995), (*b*) £10,924,531 (increase £5,044,514).

Imperial and Foreign Notes.

Echuca (Victoria) Council contemplate establishing an electricity supply for the town.

Hamilton (Victoria) Electric Supply Company is making extensive additions to its plant.

Longreach (Queensland) Council has decided to carry out an electric supply scheme.

Colac (Victoria) Shire Council has decided to borrow £15,000 for electric supply purposes.

Urana (N.S.W.) Council is considering the provision of an electric supply service in the town.

Forbes (N.S.W.) Council propose to borrow £20,000 for establishing an electric supply undertaking.

In a report by Mr. R. J. N. Franki to Kyogle (N.S.W.) Shire Council the cost of an electric supply scheme is put at £8,500.

Mr. A. C. Bertoli, has been appointed to supervise the re-organisation of the electric supply service in the shire of Wycheproof (Victoria).

Stawell (Victoria) Council has decided to adopt the electric supply scheme prepared by Mr. T. W. Bridger. The estimated cost is £14,300.

Alterations are to be carried out to the municipal electric supply plant at Tamworth (N.S.W.), and the Council will borrow £20,000 to meet the cost.

In the estimates introduced in the New South Wales Legislature £120,000 is included for the electrification of the Newcastle tramways.

Wellington (N.Z.) Council has under consideration the question of borrowing £300,000 for the erection of an electricity station at Evans Bay.

In consequence of the steep gradients on the Thika branch of the Uganda Railway, it is proposed to adopt electric traction on the section.

The Electrical Suburban Contractors' Association was recently formed at Newtown (N.S.W.). Among its objects are the licensing of wiremen and the fixing of a minimum charge for installations.

The Commonwealth & Electrical Metal Company, Ltd., which has been formed, with a capital of £500,000, to acquire works in Sydney, will also establish workshops at Newcastle for the manufacture of electrical appliances, &c.

Wagga (N.S.W.) Council has agreed to purchase for £35,000 the electric generating plant of the Great Cobar Copper Company. It is estimated that another £15,000 will be absorbed in moving and re-erecting the plant and in laying the distribution network.

Two German firms of tramcar builders have secured from the Stockholm City Tramways large orders for tramcars. The offers received from Swedish and American firms were considerably higher and the German cars can be delivered with more powerful motors in a much shorter time.

Central Illawarara (N.S.W.) Council, having been informed that the project of supplying electric power to populous centres as far south as Kiama from the power house at Port Kembla would cost over £20,000, has invited Messrs. Hoskins, Ltd., to make an offer for a supply from their Wangawilli colliery power house.

Wireless telegraphy will be employed in determining the exact position of the boundary between South and West Australia. The boundary has been fixed at the 129th degree east longitude. The exact position will be ascertained by time-signals from a high-power wireless station situated at some point between Greenwich Observatory, in England, and Sydney, in Australia.

At the recent meeting of Amalgamated Wireless (Australasia), Ltd., the chairman (Sir Thomas Hughes), said the company's activities were progressing satisfactorily. The marine wireless business was growing continually. The Australectric Company had shown remarkable progress in the past few months. The staff was studying the latest developments in X-ray work, a branch which it was hoped to expand considerably. The directors hoped to give some demonstrations of long-distance wireless telephony in Australia during the present financial year.

A deputation recently waited upon the Victorian Premier urging the necessity for the fullest development of the resources of the country for which a cheap supply of power was essential and the desirability of expediting the scheme for harnessing the power of the Kiewa River. The Premier, in reply, said no definite statement could be made as to when the scheme would be carried out until the Electricity Commissioners had considered the data that had been collected. The Morwell brown coal and the Kiewa projects would form part of a general scheme.

According to recent estimates, the cost of converting the Melbourne suburban railways to electric traction will exceed the original estimate of £3,106,000 by £2,000,000. The Railway Commissioners state, by way of explanation, that the scheme has been in progress for nearly eight years, during which great changes had occurred in economic and financial conditions. It will be three years before the scheme is completed. The additional expenditure due to war conditions is £1,000,000, and the additional Customs duties £250,000. The preference to British and Australian manufacturers, consequent upon the cancellation of American contracts, cost £100,000, and additional works, not provided for in the original scheme, account for £550,000 while some minor adjustments and alterations will cost £200,000.

Mr. J. W. Meares, the electrical adviser to the Indian Government, who was recently invited by the Government of Ceylon to report upon the projected Laxapana-Aberdeen hydro-electric scheme, recommends that the scheme be carried out in four stages. The first would develop about 2,000 e.h.p., the second 37,000 e.h.p., the third 64,000 e.h.p. and the fourth stage 96,000 e.h.p. The initial section of the schem would cost about 12 million rupees and the average cost per unit generated at the power house is put at about 2 cents. The power is to be used for working the Colombo suburban railways and for industrial and commercial purposes in Colombo and Kandy and adjoining areas. On the advice of Mr. Meares, the local Government has decided to adopt the scheme provisionally and a detailed survey has now been ordered in order to ascertain the approximate amount of water-power available. It is probable that when the survey is completed the plans and estimates will be submitted to a consulting engineer in London.

At the end of July there were 778 electricity supply works in Japan, with an aggregate capacity of 1,303,551 kw., and a total capital of 1,218,390,960 yen.

At a recent meeting of the Communal Authorities of Borlange and Domnarvet (Sweden), it was proposed to lay electric tram tracks throughout the industrial discricts. The estimated cost is approximately kr. 2,500,000.

It is estimated that the expenditure on the Electrification of the Swiss Railways in 1921 will amount to 52,000,000 frs., in addition to 60,000,000 frs. for the construction of new transmission lines and stations, and 20,000,000 frs. for the purchase of new electric locomotives.

From recent surveys carried out by the Chilian Ministry of Industry it appears that the country has water-power amounting to over 5,000,000 h.p., of which only 100,000 is used at present. A company has just been formed with a capital of £1,500,000 for erecting hydro-electric works.

It is reported that the Allgemeine Elektricitäts Gesellschaft and the Siemens and Halske A.G. have acquired a controlling interest in the Vereinigte Lausitz Glasswerke. At present the A.E.G. and the Siemens Company take the greater part of the output of electric lamp bulbs of the Vereinigte Company.

According to recent investigations by the Finnish Government there is about 1,200,000 h.p. of undeveloped water power in the southern part of the country. The largest sources of power are the River Vuoksen (380,000 h.p.), Kymmene River (165,000 h.p.) and Kumo River (140,000 h.p.). A great proportion of the water-power is the property of the State. The well-known Imatra Falls belong solely to the Government, and the latter can command 30 per cent. of all the power generated by the Vuoksen. The State Water Power Commission has asked the Government to authorise steps being taken for the harnessing of the Imatra Falls. Definite schemes have also been prepared for building a power station of 15,000 h.p. at Anjala Falls on the Kymmene River. It is considered probably that the Government will sanction a portion of this programme. Up to the present only about 170,000 h.p. has been utilised.

It is evident that the German Government mean to make extensive use of wireless telegraphy for home and foreign communications. According to the *Berliner Tageblatt* of the 31st Oct., the German Wireless System is to be organised in three distinct systems, viz., the International, the Home and the Special wireless services. The International system will consist of the overseas service, which will be transmitted by the large wireless stations of Nauen and Eilvese, and the European service, the messages for which will be forwarded by the central wireless station at Konigswusterhausen. The home communications will be sent by the home system (Reichsfunknetz), which is comprised at present of 15 wireless stations. The 13 existing coast stations will serve for communications to and from ships at sea. The Special wireless system is extensive and includes :—The daily European and overseas newspaper service; the wireless press service which is at present in process of formation and by means of which a message sent by one station will be received simultaneously by a large number of receiving stations in Germany; the wireless industrial service for circulating industrial and financial reports which is also in course of preparation; the wireless services for the transmission of wireless time-signals, wireless warnings of storms for ships at sea, and all other important wireless reports for ships at sea, of wireless weather reports, wireless communications with aeroplanes, &c., including postal aeroplanes; and the receiving stations for receiving foreign press reports.

Bankruptcies and Liquidations.

John Harrison, trading as Harrison & Son, electrical engineer, 93, Princes-road, London-road, Southend-on-Sea, has been adjudicated bankrupt.

A meeting to receive an account of the winding up of the Rex Accumulator Company, Ltd. (in liq.) will be held at 9, New Broad-street, London, E.C., on Dec. 14.

A meeting of Pressparts, Ltd. (in vol. liq.) will be held at the offices of Messrs. Abbott, Deeley, Hill & Company, 9, Bennett's-hill, Birmingham. Claims are to be sent by Dec. 9 to Mr. W. E. Alldritt, 9, Bennett's-hill, Birmingham.

Institution Notes.

The Society of Radiographers has been formed, with Sir Archibald Reid as president, to further the interests of hospital radiographers, or X-ray-room assistants.

The object of the prizes which are being given by the Dorset Natural History and Antiquarian Field Club for essays on the "Best Uses of Electricity in Reconstruction after the War and its Practical Generation" is the encouragement of research, experiment and inventions among Dorset students of electrical science.

A paper on "Small Wireless Transmitters, Spark and Continuous Wave Types," was read by Mr. W. Burnet before the Sheffield and District Wireless Society on Friday last. He dealt with the development of small power trench sets for the British army and how the demand for an immediate extension of wireless communication in 1915 led to the introduction of the famous B.F. trench set, and became the mainstay of forward wireless communication in the trenches in France.

At the meeting of the Midland Institute of Mining, Civil and Mechanical Engineers on the 18th inst. Dr. R. V. Wheeler read an instructive Paper on "Firedamp Explosions.' He said that investigation of the subject was important in determining the design of safety-lamps and of flameproof electric switches, and in arranging the construction of machinery for use in mines with due regard to safety. The results which he presented had been obtained during the past 10 years at the experimental station at Eskmeals. The composition of firedamp and its limits of inflammability, &c., were explained. Problems of ignition were also dealt with.

A meeting of the Liverpool Wireless Association was held last week at the Royal Institution, Colquitt-street. The committee was increased and made more representative. Mr. J. Wainwright was elected Hon. Treasurer, vice Mr. C. Wertley who resigned. It was decided to commence a course of progressive elementary studies in "Wireless" especially for beginners, and the first lecture was given on Wednesday. Future meetings will start at 7.30 p.m. and the first half hour each evening will be devoted exclusively to beginners. A substantial sum of money has already been given or promised towards the Association's apparatus fund. Mr. S. Frith, 6, Cambridge-road, Crosby, is Hon. Sec. of the Association.

An exhibition of scientific apparatus will be held by the Physical Society of London and the Optical Society at the Imperial College of Science, South Kensington, on Jan. 5 and 6, 1921. Books may again form part of the exhibition if publishers so desire, but owing to the financial state of the two societies being strained by the high costs of printing, &c., it has been agreed to make a charge to firms exhibiting of £2 per page, with a minimum of 10s. for notices of exhibits in the programme. No other charge of any kind will be made. Firms desirous of exhibiting their apparatus should communicate with Mr. F. E. Smith, Secretary of the Physical Society, at the National Physical Laboratory, Teddington.

Personal and Appointments.

Mr. A. Robson, B.Sc., has been appointed head of the engineering department in West Hartlepool College.

Mr. J. M. Coode, Director of Engineering in the Indian Government Telegraph Department, is retiring from the service.

Mr. A. Preston, resident electrical engineer at Ammanford, has been appointed to a similar position under the Carmarthen Electric Supply Company.

Mr. W. T. David, M.A., D.Sc., has been appointed Professor of Engineering at the University College of South Wales and Monmouthshire, at a salary of £1,000 a year.

Mr. A. Brown, of the order department of the Edison Swan Electric Company, Ltd., celebrated his golden wedding on the 16th inst. A few of the members of the staff with whom he has been associated for 28 years, marked the occasion by presenting him with a clock suitably inscribed.

On the 17th inst., at St. Margaret's, Westminster, the marriage took place of Capt. Wedgwood Benn, D.S.O., D.F.C., M.P.(second son of Sir John Benn, Bart.), and Margaret, daughter of Mr. D. T. Holmes, formerly M.P. for Govan. The Bishop of London (assisted by Canon Westlake) officiated, and Mr. E. J. P. Benn, C.B.E., acted as best man. There was a great gathering of peers, M.P.s, relatives and friends, thus testifying to the great popuarity of the happy couple. There were very many presents, including several from political associations, local authorities, &c. Among those present were :—The Marquess of Crewe, the Earl and Countess of Haddo, Lord Edmund Talbot, M.P., Lord and Lady Gainford, Viscountess Astor, Lady Emmott, Mr. Asquith, Princess Antoine Bibesco and Lady Bonham Carter, Sir John and Lady Benn, Mr. Ernest J. P. Benn and Mrs. Benn, Lady Buckmaster, Major-General J. E. B. and the Hon. Mrs. Seely, Sir James Agg-Gardner, M.P., Major Morrison Bell, M.P., Sir Arthur Fell, M.P., Sir Maurice and Lady Hankey, Sir Godfrey and Lady Collins, Sir Harry Verney, Sir Thomas Bethell, Sir Willoughby and Lady Dickinson, Lady Simon, Lady Newnes, Mr. Walter Runciman, Sir Donald and Lady Maclean, Sir Herbert Raphael, M.P., and Lady Raphael, Mr. George Lambert, M.P., Sir Edward and Lady Boyle, Mr. and Mrs. John Drinkwater, Captain Blair, M.P., Mr. McCallum Scott, M.P., Sir Martin and Lady Conway, Sir Ellis Griffith, Sir Edward Bird, M.P., Sir Edward and Lady Beauchamp, Sir Edward and Lady Shackleton, Sir Albert and Lady Spicer. A reception was subsequently held at the Hotel Cecil.

Tenders Invited and Accepted.

Plymouth Corporation invite tenders for h.t. and e.h.t. switchgear and oil-cooled transformers. Specifications from and tenders to the Borough Electrical Engineer by Nov. 30.

Wandsworth (London) Guardians require tenders by Dec. 7 for two electric lifts at St. John's Hill Infirmary. Particulars from the Clerk of Works by appointment.

Whitehaven Corporation want tenders by Dec. 1 for a d.c. turbo-generator and condensing plant. Specification, &c., from the Borough Electrical Engineer.

The Great North of Scotland Railway Company require tenders by Dec. 9 for six (or 12) month's supply of stores, including telegraph material, castings, oils, &c. Forms of tender from the Stores Superintendent, 80, Guild-street, Aberdeen.

The date for the receipt by the Crown Agents for the Colonies, on behalf of the Government of the Uganda Protectorate for a concession of a portion of the Ripon Falls of the Nile for the generation of electric power has been extended from Dec. 20 to Feb. 19.

Leeds City Council invite tenders for the supply and erection of three-phase switchgear for their generating station. Specifications from the manager of the Electricity Department, Mr. C. Nelson Hefford. Tenders to the Town Clerk, 26, Gt. George-street, Leeds, by December 13.

Canterbury Corporation invite tenders for extra-high-pressure three-phase and medium-pressure d.c. switchgear and cable connections Specifications from Messrs. May & Hawes, 36, Victoria-street, S.W. Tenders to the Town Clerk, Mr. Henry Fielding, by 4 p.m. Dec. 6.

The West Riding Education Committee require tenders by Dec. 2, for work and materials in connection with the alteration of the electric installation at the Training College, Bingley, including the supply of motors, switchboard, wiring, &c. Specifications from the Architect, County Hall, Wakefield.

The Victorian Railway Commissioners require tenders by Jan. 19 for the supply and erection or, alternatively, the supply and delivery only of an electric furnace for their Newport workshops (contract 33,419). Specifications may be seen at the Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W.

The Municipality of Salisbury (Rhodesia) invites tenders for the supply of electric generating plant, switchgear, cable and converters. Tenders to the Town Clerk, Town House, Salisbury, by noon Jan. 13, 1921. Specifications from the Town Clerk and from the Council's Consulting Engineer, Royal Chambers, Johannesburg.

Tenders have been invited for the conversion of the first zone of the Chilean State Railways (from Valparaiso to Santiago) to electric traction. The offers, which are of two classes, will be opened on March 31, 1921. The first class is from those proposing to furnish the electric power, and the second the rolling-stock and equipment.

H.M. Consul-General at Antwerp (Mr. M. C. Gurney, C.M.G.) has orwarded a specification (in French) relative to a Municipal Contract for the supply of armoured 3-phase cables, &c., at the Antwerp Docks. Tenders must be received at the Antwerp Town Hall by noon, Dec. 16. The specification may be seen at the Dept. of Overseas Trade, 35, Old Queen-street, S.W. 1.

The City Electric Light Company, Brisbane, want tenders (by Jan. 20) for a 10,000 kw. turbo-alternator (contract 74), and Dunedin (N.Z.) Council require tenders by Jan. 17 for a 3,000 kw. generator, impulse water-wheel, four 2,000 kw. transformers, and steel pipe line. Specification can be seen at the Dept. of Overseas Trade, 35, Old Queen-street, Westminster, S.W. 1.

Tenders are invited by the dates mentioned for the supply of the following telegraph and telephone material to the Australian Commonwealth Postmaster-General's Department: Queensland: submarine telegraph cable, schedule 513 (Dec. 15). Western Australia: telegraph and telephone instruments and parts, Schedule 689. (Dec. 8.) Tenders forms from the High Commissioner for Australia, 406, Australia House, Strand, W C.2

The Deputy Postmaster-General, Melbourne, requires tenders by Jan. 4 for the supply of switchboards (schedule 1653), and the Deputy Postmaster-General, Brisbane, will receive tenders until Jan. 19 for the supply of testing and telegraph instrument (schedule 517) for the Australian Commonwealth Postmaster-General's Depts. Specification can be seen at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

H.M. Minister at Montevideo (Sir C. Mallet, C.M.G.) reports that the Management of the Usinas Electricas de Montevideo is inviting tenders by 11 a.m. Jan. 14, 1921, for the construction, delivery and erection of a 10,000 kw. generating plant (steam turbine directly coupled to a 3-phase alternator, with exciter, steam pipes, &c.), and a surface condensing plant. Conditions and specification (in Spanish) may be consulted at the Dept. of Overseas Trade, up to Dec. 4,

Buxton Corporation has accepted the tender of Browett, Lindley and Company, for generating plant, £15,822 11s. 6d.

Ilford Electricity Council has accepted an estimate of the Gretna Engineering Company to fit one of the boilers at the electricity works with liquid fuel burning apparatus.

Shanghai Municipal Council have placed an order for one 20,000 kw. turbo-generator set with the Metropolitan-Vickers Electrical Company anf for a similar set with C. A. Parsons & Company.

Manchester Corporation has accepted the following tenders for plant, &c., for the Barton Power Station:—Metropolitan-Vickers Electrical Company, 25,000-kw. turbine and condensing heater; (the contracts for the condensing plant and condensing heater being sublet to Richardson, Westgarth & Company); British Thomson-Houston Company, 1,000-kw. turbo-alternator and switchgear, Babcock & Wilcox, six boilers, &c.; Davidson & Company, fans; and the Lancashire Dynamo & Motor Company, motors.

Stepney (London) Electricity Supply Committee have purchased 1,500 demand indicators from Brighton Corporation, by which a saving of £5,800 has been effected, as compared with a recent quotation for new instruments. The Committee recommend the Council to accept the tender of Kelvin, Bottomley & Baird, Ltd., for four d.c. ammeters, that of the Aron Electricity Meter, Ltd., for two pairs of 5,000-ampere watt-hour meters, and that of Industrial Waste Eliminators, Ltd., for an oil extractor and waste washer at £164. The Committee has purchased 10 tons of troughing from the Dussek Bitumen Co. at £10 10s. per ton.

The London County Council recently invited tenders for the supply of 125 new tramcars, but only three firms submitted offers for the car bodies, viz., Hurst, Nelson & Company (for 50 bodies), at £2,230 each for the existing type and £2,430 for a modified type of tramcar. The figures of the Brush Electrical Engineering Company were £2,245 and £2,455, and of the English Electric Company £2,555 and £2,805.

For 125 sets of swing bolster trucks the following tendered:—Hurst, Nelson & Company, £600 a set; Brush Company, £630; Heenan & Froude, £836 10s.; and Baldwin's Locomotive Works, $4,380 (about £1,262).

The quotations for 125 sets of electrical equipments, &c., were:—Metropolitan-Vickers Electrical Company, £1,300 10s. a set; English Electric Company, £1,306 10s.; and British Thomson-Houston Company, £1,342 10s.

For magnetic brakes for the cars, the Metropolitan-Vickers Electrical Company (a selected firm) quoted £21,875.

No tender contained a firm offer on the basis of fixed prices, and the Highways Committee propose in the case of car bodies to accept the lowest tender for 50 bodies at £2,230 each, and the second lowest for 75 bodies at £2,245 each. In regard to electrical equipments, it is proposed, in order to test the motors offered by each company, to order 50 sets from the Metropolitan-Vickers Electrical Company at £1,300 10s. a set, and 75 sets from the English Electric Company at £1,306 10s. a set. The tenders of Hurst, Nelson & Company for trucks at £600 a set and that of the Metropolitan-Vickers Electrical Company for the supply of magnetic brakes have been accepted.

Catalogues, Price Lists, &c.

In a descriptive list of some 90 pages, recently issued by the British Thomson-Houston Company, illustrated particulars of the design, construction and operation are given of the turbine-driven centrifugal compressors, blowers and exhausters manufactured by them. We hope to give some further particulars in an early issue.

Messrs. A. Verey & Company, Ltd., 52a, Bow-lane, E.C.4, have issued their November net trade price list. It contains a complete range of accessories for electrical installations, arranged in a convenient manner, and there are illustrations and details of a variety of industrial fittings, bowl fittings, &c.

A comprehensive catalogue of radio-telegraph apparatus has been issued by the Economic Electric Company, of 10, Fitzroy-square, London, W.1. Prices and particulars of a variety of radio-telegraph and telephone apparatus and instruments are given, and the catalogue should appeal to wireless amateurs and to mechanicians interested in the subject. Copies will be sent on receipt of 3d. for postage.

An ingenious item in the British Thomson-Houston Company's "Mazda" advertising scheme for the present season is a blotter bearing upon its non-absorbent side a message printed in reversed characters. Those who obey the superscribed injunction to "hold it to the mirror and read its message" will be informed of two important consequences which always follow the use of Mazda lamps. The blotter (No. L-167) is printed in two colours, and is of attractive appearance. The reversed letterpress will pique the curiosity of those to whom it is sent, which, on account of the excellent quality of the blotting side, is likely to be retained in service for many weeks. The blotter is of ordinary envelope size and is suitable for enclosure with business correspondence, &c. Contractors and dealers, desiring copies overprinted with their name and address, should apply to the local branch of the Company, or to 77, Upper Thames-street, E.C.4.

A very telling sermon on the "Importance of Good Lighting" forms the preface to a neat folder on semi-indirect lighting issued by the British Thomson-Houston Company. This folder (No. L-173) contains illustrations and full particulars of ten of the most popular patterns of B. T.-H. semi-indirect fittings. The majority of these fittings are of an ornamental character, and are suitable for the lighting of private houses, offices, &c., while two, of definitely utilitarian design, are intended for factories, workshops, &c. The ornamental fittings are shown with druid, veluria or opal glassware, but, with two exceptions, they can be supplied with alabaster bowls, the prices for this alternative equipment being included. The folder is printed in three colours and contractors or dealers desiring copies of the folder (over-printed with name and address) should write to the Company at 77, Upper Thames-street, E.C. 4.

Patent Record.

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SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919 Specifications.

151,690 **Cummings.** Electromagnetic apparatus. (19 6 19.)

151,696 **Myers.** Electric gramophone drive. (23 6 19.)

151,710 **Lauth.** Electrically-heated liquid-heaters. (26 6 19.)

151,711 **Lauth.** Electrically-heated liquid-heaters. (26 6 19.)

151,712 **Lauth.** Electric ovens for cooking purposes. (26 6 19.)

151,721 **B.T.-H. Co.** (G.E. Co.) Electric incandescent lamps. (27 6 19.)

151,729 **Kelly.** Appliance for inserting at will within certain electric circuits a switch or control or other apparatus. (30 6 19.)

151,745 **Jagger, Jagger & Jagger.** Coupling for electrical cónduits. (5/7/19.)

151,748 **Benjamin.** Operating synchronous telegraph systems. (7 7 19.)

151,751 **Edwards..** Electrical-ignition systems of internal combustion engines. (9/7/19.)

151,759 **Tregoning.** Electric display sign. (12 7 19.)

151,771 **B.T.-H. Co.** (G.E. Co.) Methods of and apparatus for operating upon glass bulbs and other necked glass vessels. (25 7 19.)

151,773 **Harman & Le Bas.** Electric switches. (29 7 19.)

151,778 **Automatic Telephone Mfg. Co., Archer & Simister.** Electric heating apparatus. (31/7/19.)

151,787 **Henley's Telegraph Works Co. & Wakefield.** Removable electric fuse carriers. (13/8/19.)

151,802 **Lely, & Naamlooze Vennootschap Philips' Gloeilampenfabrieken.** Multiple filament electric incandescent lamps. (25 8 19.)

151,818 **Angold.** Apparatus for actuating an electric switch or indicator by the application of predetermined numbers of impulses. (25 9 19.)

151,848 **Lea & Radio Communication Co.** Wave-lengths or frequency indicators for wireless circuits. (6/11/19.)

Relates to wave-length or frequency indicators in which adjustment of the wave-length is effected by varying the inductance, included in the circuit by means of a step by step switch, and varying the capacity of a continuously variable tuning condenser for each value of the inductance, and in the invention the step by step movement is arranged to bring one or other of a plurality of scales carried by a drum into operative relation with a pointer or equivalent device, and the movement involved in the adjustment of the tuning condenser causes the pointer to traverse this scale, which can be graduated to indicate frequencies or wave-lengths.

151,873 **Levin.** Electrodes of electrolytic gas-generators. (31 12 19.)

152,045 **Alexander.** (Benson Electric Co.) Telemotors. (1 4 19.)

152,046 **Alexander.** (Benson Electric Co.) Telemotors. (1/4 19.)

152,047 **Alexander.** (Benson Electric Co.) Telemotors. (1/4 19.)

152,052 **Leonard.** Electric heating resistance elements. (14 4 19.)

152,058 **Harrison.** Electric incandescence lamps. (7/5 19.)

152,062 **Harris & Cook.** Electric fuses. (4 6 19.)

152,063 **International Electric Co. & Baldock.** Electric selective signalling and like systems. (4 6/19.)

152,076 **British Electric Plant Co. & Maudling.** Dynamo-electric machines. (2/7/19.)

152,086 **Murray.** Thermionic amplifiers. (3 7/19.)

152,098 **O'Brien.** Electric burglar alarm. (4/7/19.)

152,099 **Automatic Telephone Mfg. Co. & Flynn.** Selective signalling systems. (4/7/19.)

152,107 **Murray & Telephone Mfg. Co.** Inter-communication telephones. (4/7 19.)

152,128 **Evershed & Vignoles & Needham.** Electrical transmission systems for use in speed controlling, measuring, and/or indicating in signalling by speed variation and for analogous purposes. (10 7 19.)

152,131 **Stevens & Co. & Stevens.** Electric-ignition apparatus for internal-combustion engines. (11/7/19.)

152,145 **Electro-Metals, Ltd., & Robertson.** Electric furnaces. (18/7/19.)

1920 Specifications.

138,101 **Bosch Akt.-Ges.** Battery ignition for internal-combustion engines. (25/11/18.)

138,352 **Toledo Standard Commutator Co.** Commutator assembling devices. (3/3 17.)

139,161 **Deutsche Gas-Luhlicht Akt.-Ges.** Method of producing tungsten incandescent lamps. (17/2/19.)

139,484 **Benjamin Electric Manufacturing Co.** Electric switches. (26/12/14.)

140,062 **Bosch Akt.-Ges.** Adjustable setting lever for electric ignition devices. (11/3/19.)

140,466 **Western Electric Co.** Electric transformers. (15/11/17.)

140,782 **Martinetto,** Induction regulators particularly for varying the voltage of electric transformers. (21/2/19.)

141,339 **Metropolitan-Vickers Electric Co.** Protective apparatus for multiphase alternating current circuits. (4 4 19.)

143,209 **Akt.-Ges. Brown, Boveri, et Cie.** High-voltage distributors for electrical ignition apparatus. (14/5/19.) (Addition to 114,825.)

143,261 **Siemens & Halske Akt.-Ges.** Plate and film holders for Rontgen-ray and like photography. (3/7/17.)

145,049 **Bellini.** Apparatus for directed wireless telegraphy and telephony. (4/11/16. Addition to 22,879/14.)

145,449 **Scintilla.** Current leading-out device in magnetic electric ignition apparatus for single-cylinder internal-combustion engines. (21/6 19.)

145,730 **Krupp Akt.-Ges.** System of connections for regulating the strength of a current in the divisions of a two-part divided current-circuit. (2/1/17.)

150,727 **Western Electric Co.** Telephone systems. (10 9 19. Addition to 144,264.)

151,523 **Antinoro.** Safety fuses for electric circuits. (4/2 20.)

151,533 **Igranic Electric Co.** (Cutler-Hammer Mfg. Co.) Controllers for electric circuits. (1/3 20.)

151,535 **Douglas.** Electric couplings. (2/3/20.)

151,537 **Armstrong.** Brush-holders for electric dynamos and motors and other electric machines.

151,559 **Long.** Automatic telephone station. (27 3/20.)

151,562 **East Anglian Engineering Co. & Waters.** Brush gear for dynamo-electric machines. (17 4 20.)

151,563 **Newland.** Construction of carbon-holder for arc lamps. (29/4/20.)

151,564 **Adams.** Trip mechanism for electric-ignition device for internal-combustion engines. (21 6/19.) (Divided application on 15,688 19.)

151,565 **Adams.** Trip mechanism for electric-ignition devices for internal-combustion engines. (9/9 19.) (Divided application on 15,688 19.)

151,570 **Natkiel, Freedman & Potemkin.** Hair-wavers. (19 5/20.)

151,903 **Joyce & Park Royal Engineering Works.** Electric fuses of the enclosed type. (24 3/20.)

151,904 **Nobuhara.** Means for catching and removing oil from the bearings of rotary electric machines. (26/3/20.)

151,912 **Cummings.** Armature mounting for electro-magnetic apparatus. (19/6 19. Divided application on 151,690.)

151,876 **Orville.** Electrically-controlled combustion system for igniting and burning liquid fuels. (6/1/20.)

152,248 **British Thomson-Houston Co.** (General Electric Co.) Electric heating units. (8 1/20.)

152,257 **Boorne.** Electrodes for electric-arc welding and metal cutting purposes. (3/2/20. Addition to 132,354.)

152,262 **Igranic Electric Co.** (Cutler Hammer Manufacturing Co.) Electric-signalling systems. (18/2/20.)

APPLICATIONS FOR PATENTS.

May 31, 1920.

14,775 B.T.-H. Co. (G.E. Co.) Incandescent lamps.
14,802 Schneider Electric water heaters.
14 807 Morris-Airey, Shearing & Macrorie. Supports for filaments for thermionic values.

June 1, 1920.

14,812 Campbell, Tattersall & Knight. Means for electrically reciprocating hammers pistons, plungers, &c.
14,815 Automatic Telephone Mfg. Co. Arrangement for automatically indicating train arrivals, &c.
14,829 Crabtree. Plug and socket switches.
14,870 Marr. Combined electric switch and plug coupling.
14,873 Remy Electric Co. Switches. (11/6/19, U.S.)
14,899 Dodgson. Relay contact.

June 2, 1920.

14,979 B.T.-H. Co. (G.E. Co.) Protective systems.
14,986 Sterling Telephone & Electric Co. Mine signalling systems.
14,995 Western Electric Co. Electric signalling systems. (20/9/18, U.S.)
14,998 Morgan Crucible Co. & Payne. Electrically-heated tubes, muffles, &c.
15,010 Siemens Schuckertwerke. Apparatus for cooling electrodes. (4/6/18, Germany.)
15,018 Drysdale. (Crickmay.) Electric lamps.

June 3, 1920.

15,050 Fuller. Galvanic batteries.
15,075 Creed & Co. & Lenaghen. Electro-magnetic relays.
15,076 Creed & Co. & Lenaghen. Telephone systems.
15,083 Siemens & Baker. Impulse transmitters for telephone systems, &c.
15,089 Western Electric Co. Protective mountings for electrical apparatus. (24/11/17, U.S.)
15,120 Guinet. Electrodes for vacuum tubes, &c. (26/12/18, France.)
15,129 Goote. Incandescent lamps.

June 4, 1920.

15,137 Taylor. Electric power transmission systems.
15,180 Siemens & Ferreira. Electric indicator or annunciator.
15,188 Holslag. Arc welding, &c.
15,195 Radio Communication Co. & Lea. Modulated wireless, &c., signalling systems.
15,196 Edwards. Electric foot and food heater and vaporiser.
15,202 Reactance or choke coils.
15,205 Oldham. Galvanic batteries.
15,206 Oldham. Portable electric lamps, &c.
15,210 Western Electric Co. Telephone exchange systems. (23/8/19, U.S.)

June 5. 1920.

15,235 Spark. Switches.
15,253 British Insulated & Helsby Cables, Ltd., & Honnor. Fuse carriers, &c.
18,258 Western Electric Co. Telephone systems. (24/1/19, U.S.)
15,274 Nottage. Land line and wireless telephony.
15,276 B.T.-H. Co. (G.E. Co.) Filaments, &c.
15,283 Chamberlain & Hookham & James. Alternating current measuring instruments.

June 7, 1920.

15,316 Western Electric Co. Electric signalling systems.
15,317 Ledwinka. Electrode locking device for welding machines. (19/5/19, U.S.)
15,326 Messinger & Pap. Switch.
15,335 Metropolitan-Vickers Electrical Co. Cartridge type fuses. (5/7/19, U.S.)
15,344 B. T.-H. Co. Generation of alternating current. (29/10/13, U.S.)
15,346 B. T.-H. Co. & Young. Meters.
15,347 B. T.-H. Co. (G. E. Co.) Electric lamps.
15,348 Silica Syndicate & Reynolds. Mercury vapour lamps, &c.
15,349 United Alkali Co. & Pritchard. Graphite electrodes.
15,350 Cotton & Russell. Piezo electric device.
15,358 Smith. Arc lamps.
15,378 Evershed & Vignoles & Moore. Transmission of messages, &c., by electrical means.
15,380 Giles. Tubular electric condenser. (16/6/19, Switzerland.)

June 8, 1920.

15,399 Taylor. Electric power transmission systems.
15,441 Kilburn. (Norske Aktiesdskeb for Elekrokemisk Industrie, &c.) Electric furnaces.
15,449 Walker. Electric signalling apparatus.
15,451 Barker. Detecting magnetisation of watches, &c.
15,453 Schattner. Current limiter.
15,468 Siemens-Schuckertwerke. Multi-phase machines. (14/12/17, Germany.)
15,498 Monnot. Battery plates.
15,517 Rawlings & Ward. Apparatus for transmission of angular indications.

June 9, 1920.

15,544 Clipstone. Electric curtain controlling mechanism.
15,570 Horne. Electro-magnetic drill stand.
15,572 Blaney & Williams. Overhead trollies for tram-cars, &c.
15,576 Bray, Markham & Reiss. Push-button switches.
15,587 Soc. Anon. des Etablissements L. Bleriot. Electric heating apparatus. (5/2/19, France.)
15,593 Lawson & Warren. Electro-deposition of metals.
15,596 Prentice. Combined electrical conductors and casing.
15,602 B. T.-H. Co. Electric lamps.
15,631 Edison Swan Electric Co. & Cofelin. Electric measuring instruments.
15,632 Edison Swan Electric Co. & Coulding. Wireless telegraph valves.
15,655 Forbes. Electro-magnetic clutches, &c.
15,659 Hackett. Telephone apparatus.

June 10, 1920.

15,673 Bimm. Portable electric dust exhauster. (17/1/14, France.)
15,679 Walker. Step-by-step motors.
15,687 Quarmby. Electrical contacts for fuse-boards, &c.
15,692 Walker. Electro-magnetic mechanism.
15,700 Metcalfe. Switches.
15,704 Coventry Movement Co. & Bolton. Switches.
15,717 Radio Communication Co. Vacuum tubes, &c.
15,726 Edison Swan Electric Co. & Wrighton. Electrical indicators.
15,727 Western Electric Co. Telephone transmitter. (22/6/14, Norway.)
15,731 Hastings. Telephonic call systems.
15,734 Fryer. Electrically operated implement for cutting crops.
15,746 Metallbank u. Metallurgische Ges. & Lilienfeld. Electrical precipitation of solid materials from gases. (6/3/16, Germany.)
15,792 White. (U.S. Light & Heat Corpn.) Systems of electrical distribution.

June 11, 1920.

15,814 Bullen & Jenkinson. Switch.
15,850 Stone. Electric wiring.
15,857 Western Electric Co. Telephone systems.
15,861 Pechkranz. Metallic diaphragms of electrolytic cells. (12/6/19, Switzerland.)
15,862 Breisig. Conversion of continuous into alternating current.
15,872 Siemens-Schuckerwerke. High-voltage electrical installations. (13/7/19 Germany.)
15,888 Finlay. Prevention of actuation of switches, &c.
15,902 Zorzi. Protection of three phase circuits.
15,905 Denton. Insulating bushings.

June 12, 1920.

15,909 Duval. Transformers.
15,912 George. Aligning trolley wheels with overhead transmission wires.
15,924 Jungner. Primary galvanic batteries and electrodes.

Companies' Reports, &c.

The directors of **Mirrlees, Bickerton & Day, Ltd.**, announce that there will be no interim dividend on the ordinary shares, but the preference dividend will be paid.

The Electric Construction Company, Ltd., has declared interim dividends in respect of year ending 31st March, 1921, at rate of 7 per cent. per annum on the preference shares, and at rate of 6 per cent. per annum on ordinary shares, both payable 7th December.

The gross receipts of the **Manaos Tramways & Light Company, Ltd.**, for the year ended April 30 were £121,236, compared with £111,276 in 1919, and operating expenses were £88,716, against £83,921, leaving a net operating revenue of £32,519, against £27,355. After deducting debenture interest and sinking fund, interest on loans, loss on exchange, London expenses, &c., the balance is £11,694, which, with balance brought forward (£12,414) makes a total of £24,108. Amount applied towards writing off expenses of issue of debentures is £8,484, and transfer to renewals reserve £5,000, leaving to be carried forward £10,624.

The four-and-a-half per cent. debenture stock (£450,000) of the **Brisbane Electric Tramways Investment Company, Ltd.**, falls due on Jan. 1, but owing to existing circumstances the company has asked the stockholders to sanction the postponement of the date of payment for three years. The Queensland Government has power to take over the tramways at any time after Sept. 20, 1920, but this power has not yet been exercised. The rate of interest is to be raised from 4½ per cent. to 8 per cent., and in the event of redemption in less than three years a premium of 2 per cent. will be paid.

For the year ended June 30 the profit of the **Cape Electric Tramways, Ltd.**, was £77,280, and after providing for debenture interest, redemption of debentures, and taking into account the balance from last year, the net balance is £47,703. From this amount the reserve fund has been credited with £12,000, leaving £35,703. The directors recommend payment of a dividend of 5 per cent. on the ordinary share capital, leaving £11,142 to be carried forward. During the year the tramways carried 25,921,629 passengers, giving a return of £325,085 against 27,993,276 passengers, and £301,792 in 1918-19. The cost of operation is again much higher, owing to the greater cost of all supplies and to the further increases in wages. The rolling stock in Cape Town has been increased by 12 new cars. The Municipality had the power of expropriation of certain portions of the system during the year, but this right has not been exercised. The Municipality has, however, approached the Company with a view to purchasing the whole of the Cape Town system, but no satisfactory arrangement has materialised.

In the course of his address to the shareholders of the **Submersible Motors, Ltd.**, at the adjourned meeting on Thursday last, the chairman (Mr. B. T. Rumble) stated that by the agreement of May 17, 1918, the sum of £63,000 was distributable to the shareholders out of reserves and undistributed profits. The accounts for the period ended March 31, 1918, were not made up, owing to the difficulty of settling Admiralty contracts, &c. The liability for munitions levy and excess profits duty for the year ended March 31, 1917, amounted to £22,722, thus reducing the distributable profits to about £6,000 less than had been distributed in accordance with the agreement. The present position of the company had been affected by the disastrous fire which occurred in November last year. All the shops and plant which were not destroyed were utilised to the full, in order to carry out work in hand. The fire claim had been settled and the re-erection of the main machine shop was well forward.

The report and accounts were adopted; the dividend paid on the preferred ordinary shares for the year ended March 31, 1918, was confirmed, and the proposed final dividend upon the preferred ordinary shares of 5 per cent. for the year ended March 31, 1919 (making 10 per cent. for the year) and the dividend on the same shares at the rate of 10 per cent. per annum for the nine months ended Dec. 31, 1919, were also confirmed.

A meeting of shareholders of the **International Light & Power Company, Ltd.**, was held recently to consider the report and accounts to be submitted to the annual general meeting to be held in Canada on the 13th prox. Mr. Follett Holt, who presided, referred to the company's South American properties, and stated that the Venezuela subsidiary had yielded results in excess even of the favourable expectations expressed at the last meeting. Unless political events upset their calculations, the outlook for 1921 was equally favourable. Referring to the changes that had taken place in the internal affairs of Mexico, he said that both municipal and State administration were suffering from a financial crisis, entailing serious hardship to the electric company. In regard to the company's deposits with the "Reguladora," a State Government institution, their claim amounted to $150,000 United States gold. The municipality of Merida had fallen behind in the payment for public lighting, and strenuous efforts were being made to settle arrears, which amounted to more than $200,000 (Mexican). Payment of accounts for recent months, on the basis of a restricted street lighting service, had been resumed, but the cash position of the Mexican subsidiary, and consequently of the parent company, had been seriously hampered by these two large items of uncollected debts. In Parana labour troubles had been experienced, resulting in a strike, which afforded an opportunity to eliminate a number of undesirable agitators. The accounts showed an increase of gross income of 15 per cent. over last year's figure, and they were able to increase the carry forward from less than £14,000 to nearly £18,000, notwithstanding the exceptional charge to the profit and loss account for accrued interest on a pre-war debt.

dividends had been paid regularly, and were it not for the considerable sums tied up in Merida the cash position of the company would be very comfortable.

Sir Frank A. Swettenham, G.C.M.G., who presided over the annual meeting of the Singapore Electric Tramways, Ltd., last week, stated that there was a loss on the past year's working of £6,537, which, together with £5,406, the deficit balance from 1918, make a total debit of £11,943. The traffic receipts were better by £14,091, owing to the longer distances travelled by passengers and the increased fares which took effect in October, 1919. The decrease in mileage run was chiefly due to the lack of certain materials of which it was impossible to obtain early delivery. Power expenses increased by £4,988, mainly due to the price of coal; traffic expenses showed a small increase, and the maintenance and repairs an increase of £6,376, due to the condition of the track and the consequent heavy wear and tear on the car bodies, trucks and electrical equipment. After exhaustive inquiries for tenders for new rails, they were unable to obtain any quotations either in England or in Belgium, and, consequently, they were obliged to place orders in the United States. The sales of energy for lighting and power to the municipality and the Government showed a small increase, but, as the Municipal Commissioners still refused to modify the terms of the contract, and to pay a fair price for current, the working account for the supply to the Municipal Commissioners showed a loss of £9,333 14s. 7d. Referring to the condition of the track, the Chairman said that during the last two years they had failed to obtain in England rails at any price, and when they succeeded in getting them from America, industrial troubles delayed the shipment for months. Five hundred tons of rails and fittings were now on the spot and they had started re-laying the most important revenue-earning section. Another 500 tons would follow in a few months. With the re-laying of the track the cost of upkeep would be reduced.

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New Companies.

DUNGARVAN ELECTRIC LIGHT & POWER COMPANY LTD. (5,059.)—Reg. in Dublin Oct. 18, capital £8,000 in £1 shares. Objects as title. First directors, T. Power, T. Foley, M. Barry, M. Clancy, D. [illegible], J. Dunn and P. J. Moloney. Secretary, E. A. Ryan. Reg. office, Castle-street, Dungarvan.

ETON & COMPANY. LTD. (171,435).—Private company. Reg. Nov. 16, capital £3,000 in £1 shares, to take over the business and goodwill of H. Devereux and R. Benn in the business of automobile and electrical engineers, &c., carried on by them as "Eton & Company." Secretary : L. Ashby. Reg. office : 260-266, High-road, Balham, S.W.

EVANS (ELECTRICAL) LTD. (171,083.)—Private company, reg. Oct. 28, capital £5,000 in £1 shares, to carry on the business of electricians, electrical engineers and manufacturers, &c., and to adopt an agreement with E. J. Walker. First directors are E. J. Walker and S. L. Durell (managing). Reg. office, 10, Bush-lane, Cannon-street, E.C. 4.

FAIRLESS ELECTRIC WELDINGS, LTD. (171,010).—Private company Registered Oct. 25. Capital £10,000 in £1 shares. To carry on the business of electric, oxygen and acetylene welders, ship repairers, mechanical and electrical engineers, &c. First directors are : G. P Fairless and C. Henson, of Stockton-on-Tees, engineers.

FRYER & HARTLEY. LTD. (170,681.)—Private company, reg. Oct. 7, capital £8,000 in £1 shares, to acquire the business carried on by T. Fryer and T. Hartley as "Fryer & Hartley," and to carry on the business of electricians, mechanical engineers and manufacturers, &c. First directors are T. Fryer, T. Hartley, P. Ogden and L. Wolstenholme. Secretary, P. Ogden. Regd. office, Slack-street, Rochdale.

GENERAL ELECTRICAL CONSTRUCTION AND MAINTENAECE, LTD. (170,915).—Private company. Reg. October 19. Capital £1,000 in £1 shares. To carry on the business of electricians, electrical and mechanical engineers and contractors, manufacturers, exporters and importers of cables, wires, dynamos, &c. First directors are : P. O. Knowles, junr., and A. D. Clarke. Registered Office : 17, Imperial Buildings, Ludgate circus, London, E.C.4.

T. J. GRAINGER & COMPANY, LTD. (171,501).—Private company, Reg. Nov. 18, capital £5,000 in £1 shares, to take over the business of a dealer in electrical goods and colliery and engineering tools and appliances, carried on by T. J. Grainger. First directors are T. J. Grainger (permanent) and C. Meakin. Reg. office : 31, The Side, Newcastle-on-Tyne.

GRINDLAY. ROSS & COMPANY, LTD. (11,457.)—Private company reg. in Edinburgh Oct. 18, capital £10,000 in £1 shares, to carry on the business of electrical engineers and contractors, manufacturers of and dealers in electric, magnetic and other apparatu. First directors are J. S. Paul, J. Marr, J. Grindlay and J. P. Grindlay. Reg. office, 141, Reid-street, Bridgeton, Glasgow.

F. JINKS, LTD. (171,392).—Private company. Reg. Nov. 13, capital £2,000 in £1 shares, to take over the business of a wholesale electrical factor carried on by F. Jinks, at 10, North John-street, Liverpool. The permanent governing directors are F. Jinks and S. O. Henry.

MARLEY TRADING COMPANY, LTD. (171,358).—Private company. Reg. Nov. 11. Capital £1,000 in £1 shares. To carry on the business of manufacturers of and dealers in motor or other direction signals, motor signal machines, electrical and mechanical engineers, &c. Reg. office : 32, Fenchurch-street, E.C.

MILLO COMPANY, LTD. (170,411).—Private company. Reg. Sept. 24. Capital £500 in £1 shares. To carry on the business of electricians, mechanical engineers, suppliers of electricity, &c. Permanent governing directors are : C. Milton (managing), and F. Law. Reg. office : 78, Deansgate Arcade, Manchester.

NATURAFONES, LTD. (171,039.)—Private company, reg. Oct. 26. capital £1,500 in £1 shares, to carry on the business of manufacturers of and dealers in electrical, mechanical, acoustical and philosophical appliances and apparatus, novelties, toys, ironmongery, &c. First directors are A. H. Rutlidge and F. Goddard (managing). Reg. office, 146-8, Borough High-street, S.E.

J. B. WALSH & COMPANY. LTD. (171,396).—Private company. Reg. Nov. 13, capital £10,000 in £1 shares, to take over the business of belting merchants, general mill furnishers, wholesale electrical factors and dealers in lubricants, &c., carried on by J. W. Walsh and L. Bradbury. First directors are J. B. Walsh, L. Bradbury and (secretary) J. H. Jones. Reg. office : 34, Pall Mall, Manchester.

WEBIRKOATE, LTD. (171,475).—Private company. Reg. Nov. 17. capital £7,000 in £1 shares, to carry on the business of mechanical and general engineers, electricians, &c. Life directors are J. B. Webb and S. Burkinshaw. Reg. office : 111, Kingsland-road, E. 2.

WESTINGHOUSE BRAKE SUBSIDIARIES, LTD. (171,046).—Registered Oct. 26. Capital £40,000 in £1 shares. To acquire certain assets belonging to the Westinghouse Brake Co., Ltd., to carry on the business of manufacturers of railway brakes and rolling stock for railways, and appliances for lighting railway and other carriages, &c. The first directors are : J. W. Cloud, Lord Southborough, Lt.-Col. M. Craddock, and J. H. Luke.

YUKON ENGINEERING COMPANY, LTD. (171,326).—Private company. Reg. Nov. 9. Capital £2,000 in £1 shares. To carry on the business of mechanical and electrical engineers, ironfounders and manufacturers of engines, agricultural implements, motor cars, &c. First directors are : J. G. Bower and M. E. M. Vint. Secretary : A. M. Jackson. Reg. office : 9, Lower Regent-street, S. W. 1.

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics."—"Egypt as an Air Centre"; "The Problem of the Helicopter," by M. Damblanc; and "Commercial Aviation in Germany."

"The Cabinet Maker."—"Organisation in the Furniture Trade" "Modern Swedish Furniture"; and "A New London Furnishing Enterprise."

"The Chemical Age."—Special scientific-instrument Number.

"Farm and Home."—"Farming Affairs at Westminster"; "The Cottager's Ideal Pig"; and "The Cost of Mill Production."

"The Fruit-Grower."—"Reform of Covent Garden Market"; "Discouraging Food Production"; and "The Chrysanthemum Eelworm."

"The Gas World."—"The Manufacture of Neutral Sulphate of Ammonia," by S. V. Evans; "The Tests of Gas for Calorific Power"; and "Discussion on Modern Conditions of Labour."

"Gardening Illustrated."—"The Potato Crop"; "Chrysanthemum Blanche du Poitou (illustrated); "Apple Annie Elizabeth" (illustrated); and "Cropping the Allotment."

"Hardware Trade Journal."—"Electric Lighting of Shop Windows. —V."; "Hardware Business with New Zealand"; and "Cutting Tools."

"Ways and Means."—"Prospects of British Trade in Australia," by S. W. B. McGregor; "An Exhibition with a Difference," by Hamilton Fyfe; and "The Business Side of Parliament."

Forty Years Ago.

(THE ELECTRICIAN, NOVEMBER 27, 1880.)

GLASGOW.—Mr. Swan is to describe and exhibit his lamp to the members of the Philosophical Society of Glasgow during this winter session.

MR. EDISON'S LAMP.—The Patent Museum, South Kensington, now contains Mr. Edison's "original lamp," accompanied by a certificate stating that it burnt for 1,390 hours.

EDISONIA.—The stockholders of the Edison Electric Light Company received a circular the other day assessing them 60 dollars a share, to meet the expense of recent experiments.—*Operator*.

THE ELECTRIC RAILWAY.—This new wonder of the age, says the *Standard*, will be first seen in Berlin. Messrs. Siemens have obtained a concession for a suburban line from Lichterfeld to Teltow.

CYPRUS.—The report of "Her Majesty's High Commissioner" states that, "contrary to my expectations, the latter (the telegraph) is being used by the public far more than I thought it would."

INDUCTION AND THE TELEPHONE.—According to the *Daily News* a highly important discovery has been made by a firm in Neuchatel. They have devised a means of completely preventing the induction of the electric current from one wire to contiguous wires. This invention will greatly promote the efficiency of the telephone and extend its use.

Prices of Metals, Chemicals, &c.

TUESDAY, NOV. 23

		Price	Inc.	Dec.
Copper—				
Best selected.........	per ton	£89 0 0	—	£7 0 0
Electro Wirebars...	,,	£92 0 0	—	£6 0 0
H.C. wire basis......	per lb.	1s. 1 9/16d.	—	11/16d.
Sheet	,,	1s. 3¾d.	—	9/16d.
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. 7¾d.	—	9/16d.
***Brass* 60/40—**				
Rod, basis	,,	0s. 9¾d.	—	⅛d.
Sheet, basis	,,	1s. 3¼d.	—	½d.
Wire, basis	,,	1s. 2¾d.	—	½d.
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£46 0 0	—	—
Lead Pig—				
English	,,	£32 0 0	—	£4 0 0
Foreign or Colonial	,,	£30 15 0	—	£3 15 0
***Tin*—Ingot**	,,	231 10 0	—	£5 15 0
Wire, basis	per lb.	0 3 0½	—	1d.

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £17 15s.

,, (Roll Brimstone).—Per ton £17 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £40.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 1s.

Sodium Chlorate.—Per lb. 5½d.

Rubber.—Para fine, 1s. 4¼d.; plantation 1st latex, 1s. 1¾d. to 1s. 1½d lb.

The metal prices are supplied by British Insulated & Helsby Cables Ltd.

Arrangements for the Week.

FRIDAY, November 26th (to-day).

INSTITUTION OF ELECTRICAL ENGINEERS.—STUDENTS' SECTION.

6.30 p.m. At City and Guilds Technical College, Leonard-street, London, E.C. Paper on "Electricity and the Paper Making Industry," by Mr. A. J. C. Watts.

PHYSICAL SOCIETY AND THE OPTICAL SOCIETY.

7 p.m. At the Imperial College of Science, South Kensington, London, S.W. Joint Discussion on "The Making of Reflecting Surfaces." Papers presented by Messrs. H. N. Irving, J. W. French, F. Ellerman, J. Rheinberg, R. S. Whipple, C. W Davidson, J. W. T. Walsh, W. G. Collins, R. W. Cheshire and Prof. Féry. Demonstrations will be given by Messrs. H. A. Hughes and F. Simeon.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

7.30 p.m. At the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne. Paper on "Some Experimental Work in Connection with the Injection and Combustion of Fuel Oil in Diesel Engines," by Eng. Commander C. J. Hawkes.

SATURDAY, November 27th.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—GRADUATE SECTION.

6.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. Paper on "Boiler Upkeep," by Mr. C. A. Suckan.

MANCHESTER ASSOCIATION OF ENGINEERS.

7 p.m. At the Memorial Hall, Albert-square, Manchester. Paper on "Modern Developments in the Manufacture and Utilisation of Coal Gas," by Messrs. F. J. West and T. A. Tomlinson.

MONDAY, November 29th.

INSTITUTION OF ELECTRICAL ENGINEERS.—INFORMAL MEETING.

7 p.m. At the Chartered Institute of Patent Agents, Staple Inn Buildings, High Holborn, London, W.C. Discussion on "Electrical Transmission on Petrol Vehicles," opened by Mr. A. F. Harmer.

TUESDAY, November 30th.

INSTITUTION OF ELECTRICAL ENGINEERS.—S. MIDLAND CENTRE, STUDENTS' SECTION.

7.30 p.m. At the University, Edmund-street, Birmingham. Paper on "X-Rays and their Application in Engineering," by Mr. S. Payman.

INSTITUTION OF ELECTRICAL ENGINEERS.—SHEFFIELD SUB-CENTRE OF N. MIDLAND CENTRE.

7.30 p.m. At Royal Victoria Hotel, Sheffield. Opening Meeting and Smoking Concert.

SHEFFIELD ASSOCIATION OF METALLURGISTS AND METALLURGICAL CHEMISTS.

7.30 p.m. At Royal Victoria Hotel, Sheffield. Paper on "Some Alloys in the Casting Shop," by Mr. J. Kent Smith.

WEDNESDAY, December 1st.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.

7 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, Holborn, London, W.C. Lecture on "The Influence of Production Costs on Designing," by Mr. F. W. Pitt.

PAISLEY ASSOCIATION OF ELECTRICAL ENGINEERS.

7.30 p.m. At the Y.M.C.A. Rooms, Paisley. Paper on "Armature Winding," by Mr. W. R. Scott.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN.

7.45 p.m. At the Chamber of Commerce, New-street, Birmingham. Paper on "Defects in Mild Steel," by Mr. D. H. Ingall.

LIVERPOOL ENGINEERING SOCIETY.

8 p.m. At the Royal Institution, Colquitt-street, Liverpool. Paper on "The Design and Construction of Large Commercial Fuel Oil Depots," by Mr. G. K. Dell.

FRIDAY, December 3rd.

INSTITUTION OF MECHANICAL ENGINEERS.

6 p.m. At Storey's Gate, London, S.W. Paper on "The Human Factor in Industry," by Mr. A. Ramsay. *Adjourned Discussion.*

INSTITUTION OF ELECTRICAL ENGINEERS.—STUDENTS' SECTION.

6.30 p.m. At King's College, Strand, London, W.C. Discussion on "The Modern Tendency to Trusts. Is it Beneficial?" opened by Mr. A. Serner.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Electrolysis as Applied to the Measurement of Water," by Mr. G. F. Shotter.

SATURDAY, December 4th.

INSTITUTION OF BRITISH FOUNDRYMEN.

4 p.m. At the College of Technology, Manchester. Paper on "Modern Metallurgical Investigation," by D. F. J. Brislee.

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Notes.

The Utilisation of Tides.

THE utilisation of the power of the tides to drive electrical machinery and thus to obtain a much-needed supply of energy at a cheap rate has long been an idea with great attractions for both engineers and inventors. The view point of the two classes has, however, been different. For the engineer knows that it is impossible to get more out of a machine or of the tide than is in it already; and that though it is sometimes possible to get power in more or less abundant quantities by all sorts of out of the way means, it is not always either efficient or financially sound to do so. The inventor has no such qualms, and it therefore follows that what his schemes lose in feasibility they gain in picturesqueness. It is doubtless for these two reasons that the utilisation of tidal power has not gone further than it has done up to the present. In this country there is the added reason that such power (as indeed applies to all water power) is generally remote from districts where it can be satisfactorily used.

The Severn Barrage Scheme.

WE have always contended that more use could be made of the water powers of this country than has hitherto been done, and we are therefore glad up to a point that the Ministry of Transport, as will be seen from an article which we publish on another page of this issue, has considered in some detail the question of utilising the tidal power of the Severn on a line corresponding roughly to that followed by the present Severn tunnel. The scheme provides, apart from extensive shipping, road and railway facilities which will be necessary if the district is to develop into an industrial area, for a barrage which will contain a turbine house and automatic sluices for regulating the flow of the tide up and down. To ensure a fairly constant power supply a storage basin will be provided on the Wye near Tintern, into which water will be pumped at high tide from a station near the ill-omened Beachley. When the main tidal and river flow are insufficient to provide the power required the water stored in this basin will be released to drive turbines in the Wye power house. The effect of the river bore seems to have been entirely neglected. The article states that by this means a steady load of 500,000 H.P. can be obtained with a peak load of over 1,000,000 H.P. at a cost of 0·5d. per unit. The capital cost of the scheme is not explicitly stated, but we understand that £30,000,000 is about the figure. This is a great deal of money.

The Real Barrage.

FINANCE is, indeed, the real barrage to the scheme, much stronger and more elaborate than any physical one that can be erected. Welcome though the proposal is, to state socialists, civil engineers and daily press editorial departments on the look out for stunts, we very much doubt its electrical expediency at present. Even if we accept that 500,000 H.P. estimate as correct we are faced with the further problem that to get this power to places where it could at present be used will mean an expenditure on transmission lines, which has apparently not been considered and is certainly not included in the above estimate. The Ministry of Transport's view is that factories would come to the neighbouring sites, but we may well ask how far this is likely and, if it is likely, how far it is possible under the present conditions of financial stringency? The scheme, as it stands, also lays itself open to those fluid monetary operations of which the less we see in the electrical industry the better we shall be pleased. The combination of bridges, roads, railways and electricity supply under one capital and trading account makes it easy to set off the losses under one heading against the profits (if any) under the others, and makes it difficult to discover the true position of any one of the items of the whole.

The Severn Scheme and Electricity Authorities.

THERE is another point in connection with this matter which is of great interest, considering the position of electricity supply affairs not only in the West of England but throughout the country. If the Severn scheme is seriously to be put in hand it may adversely affect the formation of Joint Electricity Authorities or other means of co-ordinating the electric supply in the areas delimited by the Commissioners. The primary purpose of such bodies is, in one way or another, to ensure a bulk supply to the various existing undertakings. But the intimation that there might be as in this Severn scheme a super-bulk supply shortly available must alter the whole complexion of affairs in some of the areas. Though it would not make Joint Authorities unnecessary it would reduce them to a kind of Administrative Board for their several areas. Most of the schemes are not due for some months yet, so before they assume final form, there may possibly be forthcoming something more definite from the Ministry of Transport which will enable the promoters to gauge more accurately the probable effects of this new proposal.

Sinn Fein and Electricity Supply.

In our issue of February 6, 1920, we called attention to the vulnerability of large power stations to attack, either by the military forces of some hostile country or by riotous civilian elements of our own nationality. We suggested that the matter was one for the adoption of some form of protection in order that the disorders following on the failure of electricity supply over a large area, which would be the result of the generating plant being damaged or passing into the possession of attacking forces, might be avoided. Though the possibility of such an occurrence happening in the near future had not escaped us, we did not realise how soon the necessity for some such form of protection, as we had advocated, would become evident in actual practice. That this is the case is, however, abundantly shown by the capture of a Sinn Fein document containing plans for the destruction of the Stuart Street power station of the Manchester Corporation.

A Technical School for Rebels.

Of the political side of this matter we do not propose to speak, but there are one or two other points to which we may draw attention. The station was visited under the protection of a pass such as is issued to officials, employees, and their relatives, and a very complete idea of the lay-out with a plan of attack, both evidently written by some one with engineering knowledge, was the result. And to make assurance doubly sure men were to be trained at the Pigeon House Fort Station of the Dublin Corporation to stop the turbines and to operate the switchgear at Manchester, had the proposed attack become effective. Incidentally this shows up the former municipal body in a peculiarly complacent light. In the article we mentioned above we said that an attack by a mob of the usual kind on electrical plant would result in the attackers being repulsed with heavy loss. The same point is made by Mr. P. M. Heath, deputy town clerk of Manchester, in a statement to the Press. This, however, would have been no attack by unskilled men (the character of the report is sufficient to show that), but a well-thought-out scheme led by men with technical knowledge who deliberately proposed first to stop the plant and then to render it unfit for use. Against such an attack the only defence is a prevention of entry, except to those who have real business within, admission only through small well-protected entrances, that can be closed by electrically-operated portcullises if necessary, and the surrounding of the whole of the power station area with such protection as would render unauthorised ingress difficult if not impossible.

No London County Council Omnibuses.

The London County Council have been singularly unfortunate in their attempts to obtain legislative sanction to improve their tramway services. Early in the year they promoted an ambitious scheme for the construction of a number of additional tramway routes (about 39 miles in length), and for the inauguration of omnibus services. The majority of the borough councils, as is their habit, however, refused their consent to the construction of tramways in their areas, and as the House of Commons declined to suspend the Standing Orders, the tramway clauses had to be dropped. No doubt there were grave objections to many of the projected lines, but a few of them would have formed useful connecting links to the existing tramway routes. It was therefore unfortunate that the Parliamentary Committees were precluded, owing to the obsolete veto of the borough councils, from considering the scheme as a whole on its merits, especially as the Minsitry of Transport favoured this course.

Act II.—Extraordinary.

When the truncated Bill came before the House of Commons Committee a further act in the drama opened. All the clauses relating to the proposed omnibus routes were struck out, except those which provided links between the Council's tramways north and south of the Thames, while on November 25th the climax was reached when a Select Committee of the House of Lords rejected the remaining clauses dealing with that question. The Chairman, Lord Wemyss, explained that the Committee were unable to approve clauses giving the Council powers for such a purpose. His reason apparently was that, as during the inquiry the Council and the officers of the "Combine" had expressed a desire for co-operation, pending the establishment of a traffic board for London, the L.C.C. and the "Combine" should put this aspiration into practice, and help the tramways to meet the needs of the public by supplying more omnibuses. This is all very well, but why could it not have been discovered before ?

Real Waste of Money.

For what it all really amounts to is this: After an expenditure of several thousand pounds the County Council is in the same position as when it started, and we are still, and are likely to remain, without that co-ordination of the transport services which is so urgently needed in London. The manner in which the Bill has been mangled by the Committees is, indeed, a good illustration of the uncertainty of our Private Bill procedure, and recalls the well-known methods of the Circumlocution Office with certain modern improvements. It is costly, cumbersome and inefficient, and reform is urgently needed. A much better way would be to refer such a Bill, after a report by the Ministry of Transport upon its provisions, to a Joint Committee of both Houses of Parliament. This would save expense, and it might introduce more consistency into the procedure. It is, however, probably much too business-like ever to be adopted.

The Visit of Dr. Graham Bell.

Inventors are an unfortunate race. It is given to few of them to see the children of their brain in practical form, to fewer still to see that practical form placed on the market, and to fewest of all to reap any of the fame or financial advantage which should be the reward of years of effort and disillusion. When, then, we find a man whose invention has not only been manufactured in hundreds of thousands, but has sustained the stresses of time with hardly an alteration, and who 35 years later receives the acclamations of the scientific world, notice in the daily press, and even mention in the pages of "Punch," we may say without contradiction that he is lucky indeed. That is the situation of Dr. Alexander Graham Bell, the inventor of the telephone. We hasten to add our voice, which is the voice of the electrical profession and industry of this country, to the chorus which has so unanimously welcomed Dr. Bell's return to his native land after so long an absence.

The Reasons for Fame.

We feel that a part of this acclaim is due to the fact that Dr. **Graham Bell** is really a sort of Rip Van Winkle. For the causes stated above it is reasonable to suppose that when an invention has reached the stage of industrial development which the telephone, with all its popularly-supposed backwardness, now possesses, the inventor must be dead, probably for many years. And though this is far from being the case there is nevertheless a singular appropriatness in the presence of Dr. **Bell** at the meeting last week of the Wireless Section of the Institution of Electrical Engineers. For he has been the cause of one great step forward in the science and art of inter-communication, and we do not doubt that a combination of his invention with those with which the Wireless Section is most closely connected will lead to a still further advance along those lines. He himself mentioned that direct communication had been established between Honolulu and the Eiffel Tower, one-third of the distance round the world, and foreshadowed the coming of world-wide telephony, of course, by wireless means. There seems no reason why this prophecy should not be fulfilled at an early date. We hope that Dr. **Bell** will be alive to see it. That would indeed be an epoch-making event.

◆

Telephone Reform.

"The Times" is still plugging away at the short-comings of our "archaic telephones," animadverting on the policy of drift and muddle that exists and laying all the blame both for real and supposititious sins of the system at the door of the Post Office administration. Except that it makes good copy we wonder what the object of it all is, and what result is expected to accrue from the mass of statistics and evidence that had been so copiously poured out. One unexpected result it has had, however. The original articles have caused the Post Office authorities to reply pointing out that they are not so black as they are painted, and that even if they have not reached the high ideal set them by their critics they have at least done as well as could be expected. Now, in two further articles the critic replies re-iterating his accusations of neglect, and pointing out how many more telephones there might be than there are if only the Post Office would adopt business methods. But what is the good of advertisement if you can't supply the goods, and what is the good of starting on a great scheme of telephone development when the cry is all for economy ? No doubt it could be done, and no doubt the Post Office are not the people to do it, but could anybody do it just at the moment ?

◆

American Development No Guide.

As regards what the Post Office has done, as Mr. **Atkinson** truly pointed out in his Presidential Address, the number of telephones per head of population is not a fair basis of comparison between this country and America. Here if we want to communicate with a neighbour we go across to his house a few yards away. But in large tracts of America the nearest neighbour may be miles distant, and "running across" is not therefore possible—hence first the telephone and then all these statistics. But a comparison of messages per telephone would doubtless tell a different story, and is therefore kept carefully in the background while the annual cost of a telephone (another point of argument), is fallacious in a comparison unless the number of calls made on it is also given. For this reason we are sorry and not a little surprised to find "The Times" correspondent, whose identity is an open secret in electrical circles, upholding a flat rate system in contradistinction to other more economic methods of charging.

The Telephone Authority Fallacy.

And after all where does all this detailed criticism lead ? What is to be done to effect an improvement ? The telephone system of the country cannot be handed back to private ownership. Even if it could, the improvement might not be so great as some anticipate. A Telephone Authority *ad hoc* would have as its only advantage a change in nomenclature—a very poor thing to offset against numerous disadvantages. We admit the telephone system needs improvement, but surely the best way of bringing that about is to encourage the Post Office to improve it. It is not an heroic method, but it might have the desired result.

◆

The Cry of the Research Worker.

If the National Union of Scientific Workers wish to avoid their policy and actions being misunderstood they will have to word their resolutions a little more clearly than has recently been their habit. If they do not, they must not expect everyone to be so quickly convinced of their honesty of purpose as they are themselves. In a recent issue we criticised what we supposed was their attitude towards the policy of the Department of Scientific and Industrial Research ; but it would seem, from a letter from Major **Church** which appears in another column of this issue, that we have not got the true facts of the case. Unfortunately, a careful perusal of his letter still leaves us doubtful what these true facts are, and we must therefore hold to our former statement that the research worker, as represented by the National Union of Scientific Workers, is more eager to improve his own lot than to safeguard the country from exploitation. If we accept all their strictures against the Department of Scientific and Industrial Research, the Research Associations and the various trade combines, and admit their statement that discoveries are not being used for the public advantage, still the fact remains that the firms concerned are taking all the commercial risk and the research workers are being paid whether their work is technically or commercially successful or not. In a large proportion of cases it must obviously be neither. We shall be no party to the exploitation of the scientific worker ; and while we consider the National Union can do much good work in preventing this, we do not think they will find the best results are obtainable along the lines upon which they are now working.

◆

"Finsbury."

It is human nature that opposition to a proposal reaches its maximum almost at once, and that unless it is kept supplied with energy gradually dies away. In any reform, therefore, the forces of conservatism possess an undoubted advantage, and rely upon gaining their case by following the well-known policy of Brer Rabbit. This is what has been happening in the case of Finsbury Technical College. When we called attention last July to the proposal to close the College agitation was at its height, and it seemed as if at one time the Governing Body might be brought to re-consider their decision. Since then, however, the summer holidays have intervened, many things have happened, and above all the voices of those who wish the College to remain open have died down. The letter from Mr. H. M. **Dowsett**, which we publish in our correspondence columns this week, is therefore opportune. He calls attention to the place which Finsbury fills in our educational curriculum, and that it supplies something which is given by no other Institution. We hope that the petition which is to be presented to the City and Guilds' Institute will not fail in its effect, and that some means will be found to keep the College open. But there is no time to be lost.

Fundamentals of Distribution.

The reports issued by the Coal Conservation Committee and the Nitrogen Products Committee between them drew a great deal of attention to the need, not only of employing as carefully as possible the fuel available in this country, but of investigating methods whereby the same amount of energy might be generated either with a less expenditure of fuel or accompanied by the production of by-products which would have a high market value. The oscillations emitted by these reports have excited receivers of many kinds, and, as will be seen by a reference to our columns during the past twelve months or more, much study and many suggestions have been made as to how these important questions might be solved.

Universal Economy Necessary.

If, however, we are to obtain real economy in electricity supply, and more, if we are to be in a position to supply electrical energy cheaply for both industrial and domestic purposes, our investigations must not stop short at the power house. We must look into the design and operation of the apparatus employed by the consumer and we must also examine carefully the conditions under which the network has been laid out, is being extended and is performing its duties to discover whether in each and all of these fields improvements cannot be effected.

Especially is the last of these worthy of attention. The more so as it has been unwarrantably neglected in the past, because being by its nature remote from the eye of the controlling authorities it has been naturally disregarded in favour of more immediately obvious problems, and because it has been considered that all had been done that could be done when the network had been laid out with due regard to engineering principles and with a more than sufficient margin of safety both in copper and other materials to render its operation reasonably uneventful. Once again we have been depending on a factor of ignorance, miscalled the factor of safety, a policy so rightly stigmatised by Prof. Jenkin in his address to the Engineering Section of the British Association.

The Needs of an Economical Age.

It is obvious that in this economical age matters cannot be left thus, and that we must examine present conditions to discover whether our networks are being inefficiently overloaded or equally inefficiently underloaded; and must base future extensions on well thought-out rules rather than on rules-of-thumb, so that we may get the last kilovolt-ampere out of every ounce of copper, whether it be placed underground or overhead. This is the more important in that for some time at least development in electricity supply will be achieved mainly by interlinking existing stations rather than by building new ones, and for that reason the net work will be a greater economical factor than the power station, even if it does not always remain so. The Papers by Mr. W. B. Woodhouse and Mr. R. O. Kapp which were presented to the Institution of Electrical Engineers last week, are therefore most opportune. They are also a little disappointing.

Interesting Matter and Platitude.

This adjective applies particularly to Mr. Woodhouse's Paper, for while it contains a large amount of interesting matter it also contains a great deal of platitude. The result is an undigested mass instead of a palatable dish, and digestion is not assisted by the parentheses being almost as long and as interesting as the main theme, so that it is not until we come to the conclusions that we discover what the main object of the Paper really is. The pitfalls spread by this construction were, in fact, too much for the perspicacity of most of the speakers in the discussion, who confined themselves to criticising details rather than broad principles. We must confess that this criticism is the result of a second and even third reading, for a casual perusal of the Paper hints at a value which a closer study does not confirm. The reason for this appears to be that Mr. Woodhouse, instead of drawing on the wide practical experience he has had of large networks, and deducing therefrom data for future use, has allowed himself an excursion into an idealism, which, though of academical interest, does not help us much further towards the goal, which the principles we have laid down above requires that we should reach.

Electricity Supply in the Sahara.

If (and this criticism applies equally to Mr. Kapp's Paper) a scheme were proposed for turning the Sahara into an industrial area, and if we were commissioned to prepare a complete power supply scheme for it we should turn to Mr. Woodhouse's Paper with a sigh of relief and use it as our Bible. But even England is not quite so undeveloped electrically as all that, and in considering the future lay-out of networks we must to a large extent be guided by conditions as they now are. With this as our starting point, is either Mr. Woodhouse or Mr. Kapp going to help us more than a few steps along the road? For in real life the best we can do is to enumerate a few, not too rigid, principles which combined with certain approximations, will assist development by reconciling conflicting considerations with theoretical necessities. To do this it is better not to attempt to visualise a complete scheme, but to advance slowly from point to point, adjusting our methods to our opportunities. For the extension of an electricity supply network is like a battle in which the conditions are always in a state of flux, and, as there is nothing rigid about it, it follows that a plan that is excellent one moment is impracticable the next, an abundance of book study will not replace a clear realisation of present needs.

Two Excellent Starting Points.

From the practical point of view, Mr. Kapp's Paper is the better of the two. It is true that he would like to fix the position of the power station by the demand on the network (which, to say the least of it, is hardly a constant quantity), but he also realises that in practice the choice of site cannot be made in this way. The apparatus that he describes for fixing the site is its own condemnation, for it might easily happen that with it the station would be located in the middle of a wood or on top of the principal cinema theatre in the town; and so it can act as little more than a guide. He makes the good point that for financial reasons consideration must be given jointly to the position of the power station and the E.H.T. network to obtain the best economical results, and the argument equally applies to the choice of sub-station position. Having thus stated his text he proceeds to show us how to develop it in a very interesting series of temperature charts, but though we read what he has to say with interest, as, perhaps, providing us with a means whereby economy can be obtained, we are all the while a little sceptical as to whether his plans will really tend to that end.

The Real Problem.

To us the transmission problem really resolves itself into this: The obtaining of a continuous and adequate supply with a maximum of financial economy and without dangerous heating or overloading and with a maximum engineering economy. It is not an easy problem, and can be considered from any number of points of view. Two of these may well be those taken by Messrs. **Woodhouse** and **Kapp**, and we do not mean to imply that their Papers are entirely without value at this juncture. But the authors do seem to be rather on a country branch line, on which, if we take a train, we shall only arrive at a remote junction, instead of some place well on the main line to industrial efficiency.

Electricity Supply in London.

The most interesting part of the report of the Special Committee of the London County Council on Electricity Supply, which is dated October 21, 1920, and has just seen the light of day, is the statement that the Electricity (Supply) Act as it now stands, shorn of its compulsory clauses, does not allow the inauguration of a satisfactory and workable scheme of electricity supply in the London area. It is essential, the report goes on to say, that the clauses in the Bill now before Parliament which deal with finance should become law before the time comes for the submission to the Electricity Commissioners of any scheme under the 1919 Act. Whatever may be thought of the truth of this dictum when applied to the country as a whole, its essential veracity as regards London is sufficiently evident on a closer study of the Committee's report.

The Financial Rock.

The Committee feel, and there will be general agreement with them, that difficult as the technical problems of electricity supply in London are, they pale into insignificance before the administrative and financial problems. However, the matter must be tackled without delay. It is, therefore, proposed that the London County Council should constitute a Joint Electricity Authority on which would be represented not only the Council itself but also the extra-London local authorities, as well as the undertakers, the railway companies and other large consumers. This authority would from the beginning control the use and extension of existing undertakings, and thus by a process of peaceful penetration would gradually acquire the ownership of all the generating plant in the area and a good deal of the supply network as well. A scheme on these lines is to be submitted to the Electricity Commissioners in order that they may hold the necessary inquiry.

The Position of the Private Undertakings.

The reasons for this policy are as follows: If those supply undertakings in London which are now privately owned are to be acquired under the Electric Lighting Act, 1888, as would be the normal course, the purchase must be postponed until 1931, when they can be obtained on terms which are considered favourable or harsh, depending on the point of view. To delay purchase until that date would, however, hold up any movement towards consolidation. On the other hand, to purchase before that date would mean the addition of a sum for goodwill to the 1931 purchase price, and therefore an extra burden on the new authority when such things are not lightly borne. There is the further drawback to this policy that no one knows how the 1888 Act will be interpreted, and it is therefore best, if possible, that it should receive no interpretation at all.

If therefore ownership of the plant can be obtained in the way we have outlined above and the buildings and mains purchased at a price equal to the first cost, less depreciation, the Council will have made a good bargain, and the cause of unified electricity supply in London will have been materially assisted, at any rate on the engineering side. We understand that the privately owned electricity supply undertakings in London have been consulted in this matter, but all the same it would be interesting to know what they think of this arrangement for their gradual dissolution. It gives them better terms than the 1888 purchase clause, it is true, but not so good terms as the price they might get by compulsory acquisition under the present Act. They stand to get a little more than the substance and a little less than the shadow, and therein may lie its virtue in their eyes.

Some Engineering Problems.

Great as the financial and administrative difficulties of the scheme suggested undoubtedly are, there are also certain engineering problems which are not going to be very simply overcome, even by a Joint Electricity Authority. What, for instance, is to be the policy of this body regarding systems of supply? In London these are many and various. Is the Authority going to take the heroic but almost impossible step of inaugurating one system of distribution or are they going to leave things as they are? In any event there must be a large amount of unproductive capital expenditure—in the first case in making the necessary changes, in the second in the purchase of interim generating plant which will be required for extending certain of the present stations, but which will have to be discarded when the capital station at Barking or elsewhere comes into being.

The only solution would seem to be the interlinking of all the various local systems now operating in London, the installation of generating plant in a few selected stations to meet the present demands for electricity supply and the demands for electricity supply which are likely to arise in the near future, and the choice of this plant on such lines that when the time comes it can be efficiently transferred to the capital stations wherever they may be. It must be recollected that the present problem of electricity supply in London is just as difficult as the future one will ever be, and that whatever policy is adopted means must be taken to see that there is no check in development, especially during the years of interregnum, before any new stations can be set to work.

A Scheme—the Important Thing.

To a certain extent, however, these are matters of detail which, though they must receive careful consideration later on, are not of such immediate importance as the preparation of a scheme which can be laid before the Commissioners before March 31st next. The suggestions that have been put forward by the Electricity Committee contain the roots of the matter, and with them as a basis it should be possible to draw up something worthy of consideration by the Commissioners. The inquiry which will be held as a result will enable modifications to be made and will bring weaknesses to light, but will at the same time, we hope, at last lead to some solution of the present chaotic state of affairs.

It is regrettable that the high hopes raised by the passing of the Electricity (Supply) Act have so far failed of realisation, and that of all the schemes put forward not one has reached a stage where a joint Authority can get down to work. As we feared, local prejudices have once again been strong enough to prevent progress, and obstruction and indecision are holding back a development which can only be for the country's good. If, as we hold, the development of electricity supply is one of the most essential factors in our industrial prosperity, the sooner the Electricity Supply Bill now before Parliament or some modification of it is passed the better. Compulsion is a weapon which must be used with care, but there are times when it is necessary to employ it, and this seems to be one of them.

Mathematical Analysis of the Mechanical Forces Acting on Switches and Busbars.

By L. B. W. JOLLEY, B.A. (Cantab.).

The writer has had occasion to investigate mathematically the forces acting on switches and 'bus-bars at periods of short circuit. After making the necessary calculations it was apparent that the method usually adopted was open to serious question, and involved the solution of the problem originally investigated by Ampere of "action-at-a-distance." The criticism of this method by later mathematicians, and its subsequent substitution by the method which may be termed the "energy method" is dealt with later in the Paper.

It is proposed to deal first with the problem in some detail, viz., that of the force on isolating links and switches under both these headings comparing the results obtained, but it should be explained that the "action-at-a-distance" method has already been dealt with in the "Electrical World," Vol. LXIX., pp. 504 and 505 by Loebinstein. The writer criticised the method and the findings of Loebinstein in a letter subsequently published in the "Electrical World."

Method of "Action-at-a-Distance."

Ampere's original formula, based on experimental evidence, stated in effect that if two elements of conductors δs and $\delta s'$ in one plane carry currents I and I', and further if the distance between these elements is r and their direction is at angles θ and θ' to the line joining them then the mechanical force of attraction or repulsion is

$$\frac{kII' \,.\, \delta s \,.\, \delta s' \,.\, \cos\theta \,.\, \cos\theta'}{r^2}.$$

If this formula is applied to the isolating link illustrated in Fig. 1, the force of repulsion between an element δl in FE and element δa in $F\,G$ is

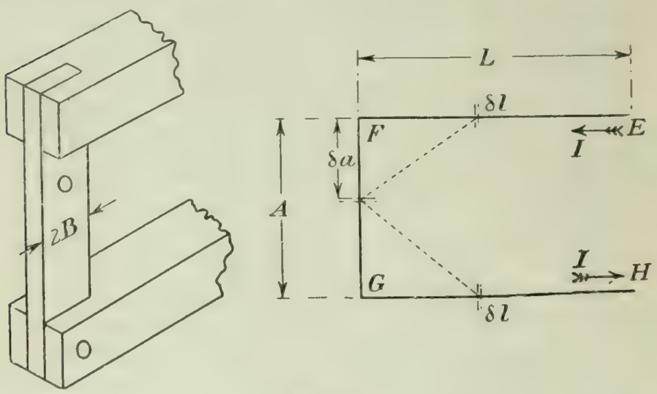

Fig. 1.

$$\frac{k \,.\, I^2 \,.\, \delta a \,.\, \delta l \,.\, \cos\theta \,.\, \sin\theta}{r^2}.$$

This equals

$$\frac{kI^2 \,.\, a \,.\, l \,.\, \delta a \,.\, \delta l}{(a^2+l^2)}.$$

The torque tending to open the switch which is pivoted at point G is therefore

$$\frac{k \,.\, I^2 \,.\, a \,.\, l^2 \,(A-a)\delta a \,.\, \delta l}{(a^2+l^2)}.$$

The total torque tending to open the switch supplied by the portion $F\;E$ is therefore

$$k \,.\, I^2 \int_0^A \int_0^L \frac{al^2(A-a)da \,.\, dl}{(a^2+l^2)}.$$

If this is integrated it is found that the result is an infinite torque, and the lower limit of integration with respect to "l" has, therefore, to be made a finite quantity and not zero. The integration therefore becomes

$$T_1=kI^2 \int_0^A \int_B^L \frac{al^2(A-a)da \,.\, dl}{(a^2+l^2)^{\frac{3}{2}}};$$

and it is at once seen that B is equivalent to the semi-blade width. It is not necessary to take the width of the conducting bars into account by introducing a lower limit for the integration with respect to A as the factor is negligible.

Integrating, the following value for the torque due to $F\;E$ is obtained

$$T_1=\frac{kI^2A}{3}\log\frac{AL(B+\sqrt{A^2-B^2})}{AB(L+\sqrt{A^2+L^2})}.$$

If B is assumed to be small as compared with A this reduces to

$$T_1=\frac{kI^2A}{3}\log\frac{AL}{B(L+\sqrt{A^2+L^2})}.$$

The force of repulsion between an element δa and δl in $G\;H$ is

$$\frac{kI^2(A-a)l \,.\, \delta a \,.\, \delta l}{\{(A-a)^2+l^2\}^{\frac{5}{2}}},$$

and the torque tending to open the switch is

$$\frac{kI^2(A-a)^2l^2 \,.\, \delta a \,.\, \delta l}{\{(A-a)^2+l^2\}^{\frac{5}{2}}}.$$

Hence the total torque due to $G\;H$ is

$$T_2=kI^2\int_0^A\int_B^L\frac{(A-a)^2l^2 \,.\, da \,.\, dl}{\{(A-a)^2+l^2\}^{\frac{5}{2}}}.$$

Integrating, the value for T_2 is found to be

$$T_2=\left\{\frac{AL}{3\sqrt{A^2+L^2}}-\frac{B}{3}\right\}kI^2.$$

Neglecting the term $\frac{B}{3}$,

$$T_2=\left\{\frac{AL}{3\sqrt{A^2+L^2}}\right\}kI^2.$$

The curious fact regarding this equation is that there is no term containing a logarithm whereas in the expression for T_1 there is.

The total torque acting in the blade is therefore

$$T=T_1+T_2=\frac{kI^2A}{3}\left[\log\frac{AL}{B(L+\sqrt{A^2+L^2})}+\frac{L}{\sqrt{A^2+L^2}}\right]. \quad (1)$$

Having arrived at a formula by the "action-at-a-distance" method it is interesting to enquire into the views held by mathematicians on this controversy.

Clerk Maxwell in the final paragraph of his treatise on "Electricity and Magnetism" states:—

> If something is transmitted from one particle to another at a distance, what is its condition after it has left the one particle, and before it has reached the other? If this something is the potential energy of the two particles, how are we to conceive this energy as existing in a point of space, coinciding neither with the one particle nor the other? In fact, whenever energy is transmitted from one body to another in time, there must be a medium or substance in which the energy exists after it leaves one body and before it reaches the other . . . Hence all these theories lead to the conception of a medium in which the propagation takes place.

Again Jeans in "Electricity and Magnetism," p. 140, says:

> The whole electrostatic theory has so far been based simply upon Coulomb's Law of the inverse square of the distance. We have supposed that one charge of electricity exerts certain forces upon a second distant charge, but nothing has been said as to the mechanism by which this

action takes place. In handling this question there are two possibilities open. We may either assume "action-at-a-distance" as an ultimate explanation, *i.e.*, simply assert that two bodies act on one another across the intervening space without attempting to go any further towards an explanation of how such an action is brought about or we may tentatively assume that some medium connects the one body with the other, and examine whether it is possible to ascribe properties to this medium such that the observed action will be transmitted by the medium. Faraday in company with almost all other great natural philosophers definitely refused to accept "action at a distance" as an ultimate explanation of electric phenomena, finding such action unthinkable unless transmitted by an intervening medium.

and later on, p. 443 :—

> "We accordingly attempt to construct a theory on the hypothesis that the forces result from the transmission of stresses by the medium. This in turn compels us to assume that the energy of the system of currents resides in the medium."

Jeans then proceeds to prove that the energy of a system of currents is $\frac{1}{2}xi^2$ where x is the self induction of the circuit.

These quotations have been given in order to labour the point that all deductions from the "action at a distance" theory are utterly false and liable to lead to entirely erroneous results. The reason for dealing with the matter at this length is because the writer has seen several cases where important deductions have been made from the original premise that the mechanical force was proportional to the inverse square of the distance and it will now be demonstrated that the formula obtained by the "energy" method gives rise to a totally different result.

ENERGY METHOD.

Take now the circuit illustrated in Fig. 1, and assume the switch opens an amount $\delta\varphi$ as shown in Fig. 2.

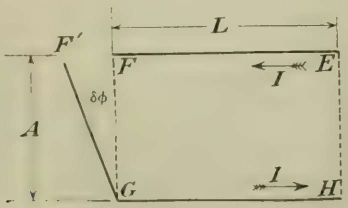

FIG. 2.

Let the area of the rectangle *EFGH* be "*s*."

Then $s = AL.$

Differentiating $\delta s = A\delta L.$

Triangle $GFF' = \frac{1}{2}A^2 . \delta\varphi. \quad \therefore A . \delta L = \frac{1}{2}A^2\delta\varphi.$

Let x be the coefficient of self induction of the *closed* rectangle *EFGH*, then the change of self induction due to the opening of the blade is δx.

The energy of the system is $\frac{1}{2}xi^2$ and the rate of change of energy is

$$\frac{1}{2}I^2\frac{dx}{d\varphi} = \text{torque on blade,}$$

and
$$\frac{1}{A} \cdot \frac{dx}{dL} = \frac{2}{A^2} \cdot \frac{dx}{d\varphi}.$$

Therefore the torque
$$= \frac{A}{4} I^2 \frac{dL}{dx} \cdot \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

This is the fundamental formula from which the solution of the problem may be attacked.

Now Winkelmann in "Handbuch der Physik," Vol. II., p. 595, gives as the formula for the self induction of a closed rectangle

$$x = 4\left\{A \log \frac{2\,AL}{M\,(A+\sqrt{A^2+L^2})} + L \log \frac{2\,AL}{M\,(L+\sqrt{A^2+L^2})} + 2\,(\sqrt{A^2+L^2}-A-L)\right\}.$$

Differentiating x with respect to L the following is obtained

$$\frac{1}{4} \cdot \frac{dx}{dL} = \log \frac{2\,AL}{M\,(L+\sqrt{A^2+L^2})} + \frac{\sqrt{A^2+L^2}}{L} - 1.$$

In the above, the symbols A and L have been interchanged so as to suit the convention at the commencement of this paper.

M is the geometric mean distance of the cross section of the conductor. This is defined by Maxwell as the geometric mean of all the distances between all pairs of elements in the section, but it is beyond the scope of this article to inquire how the quantity M appears in the equation for the self-induction. Suffice it to say that for a square of side "b"

$$\log M = \log b + \tfrac{1}{3}\log 2 + \frac{\pi}{3} - \frac{25}{12}.$$

$$\therefore \qquad M = 0{\cdot}44705\,b = 0{\cdot}45b$$

for the purposes of calculation. In this case $b = 2B$ and $M = 0{\cdot}9B$. In the case of a rectangle (Fig. 3)

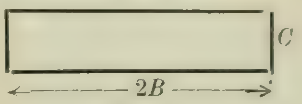

FIG. 3.

of sides $2B$ and c the *GMD* is approximately

$$0{\cdot}22\ (2B+c).$$

Now in general for switch blades $2B = 5c$, and hence the $GMD = 0{\cdot}22\,(2B+2/5B)$.

$$= 0{\cdot}53B$$

Hence the following equation for the torque in the blade is arrived at :

$$T = AI^2\left\{\log \frac{2\,AL}{0{\cdot}53B(L+\sqrt{A^2+L^2})} + \frac{\sqrt{A^2+L^2}}{L} - 1\right\}$$

(in C.G.S. units).

Now if the torque is in ft. lbs. and A and L are in inches, and the current is in amperes.

$$T = 0{\cdot}187\times10^{-8}AI^2\left\{\log \frac{2\,AL}{0{\cdot}53B(L+\sqrt{A^2+L^2})} + \frac{\sqrt{A^2+L^2}}{L} - 1\right\} \qquad (3)$$

It will at once be apparent that this formula is similar to (1) but it will be demonstrated later that it gives rise to very different results. The assumption made, however, deserves consideration at this stage.

It has been assumed that the rectangle is a closed one and it is manifest that when the value of L is small compared with A, the torque will be large, as the term $\frac{\sqrt{A^2+L^2}}{L}$ will preponderate. The reason why the torque is high is due to the excessive influence of the leg *EH* as a closed circuit is being considered. This is exactly the opposite in the case of formula (1) where this term is inverted and appears as $\frac{L}{\sqrt{A^2+L^2}}$ and hence in this case for small values of L the torque is small. At first sight it would appear therefore as if (1) represented more truly the facts of the case. But it is necessary to remember that no electric circuit is ever open in the sense that L has a small value and the leg *EH* does not exist as the circuit is always finally closed by the generator or alternator.

This is an added reason why the "action at a distance" method should not be considered and beyond quoting some actual results calculated from the formula the method will be dropped as being unsound.

The following table indicates the values of the torque for values of

A = 12 in., B = 1·0, 0·5 and 0·25 in.
L = 5, 10, 20, 30 and 40 in., and I = 20,000 amperes.

TABLE I.—*Formula* (1) "*Action at a Distance*" *Method.*

B	*L*				
	5	10	20	30	40
1·0	6·8	8·6	9·6	10·2	10·3

The figures in the Table represent torque in lb. feet.

(*To be concluded.*)

The Arc Generator as an Engineering Mechanism.

A cursory glance at the technical journals and the proceedings of scientific and engineering societies in all countries will show the seeker that as much attention as ever is being paid to the developments in our knowledge of radio matters, and to attempts to improve the methods used in wireless telegraphy and telephony. This is not surprising. Every day is adding to our investigators' familiarity with processes and methods, both indicating desirable changes, to achieve more efficient working, while accompanying this are a number of theoretical problems whose solution as often as not is as useful to the development of the science as it is interesting to the discoverer. If, however, an examination of the source of information we have mentioned above is made a little more detailed it will be found that though wireless telegraphy is still a science, and is as well becoming more and more a factor of the greatest practical importance in industrial communication, it has not yet developed into a branch of engineering. Yet it is obvious there must be an underlying fallacy in this supposition. For though the powers employed in radio working are insignificant compared with those with which the term super-stations is associated, yet they are considerably larger than those employed in either ordinary telegraphy or telephony, both of which there is no doubt come under the head of

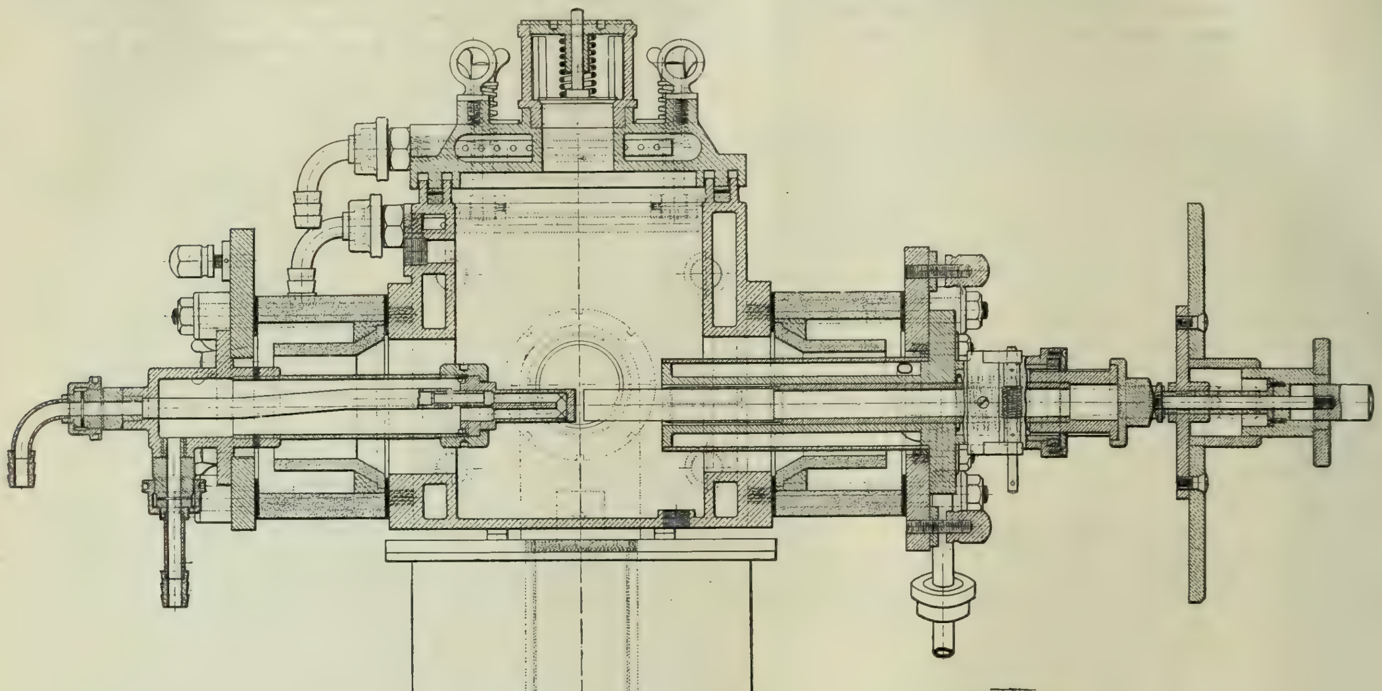

Fig. 1.—Side Elevation of 10 kw. Arc Generator.

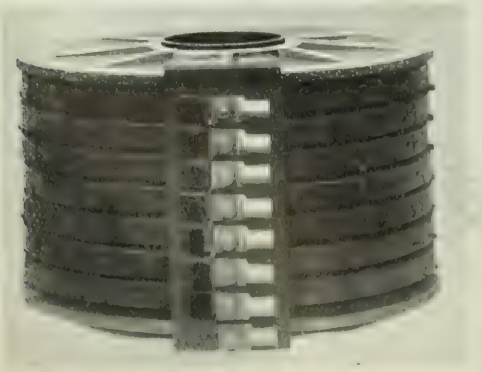

Fig. 3.—25 kw. Field Coil.

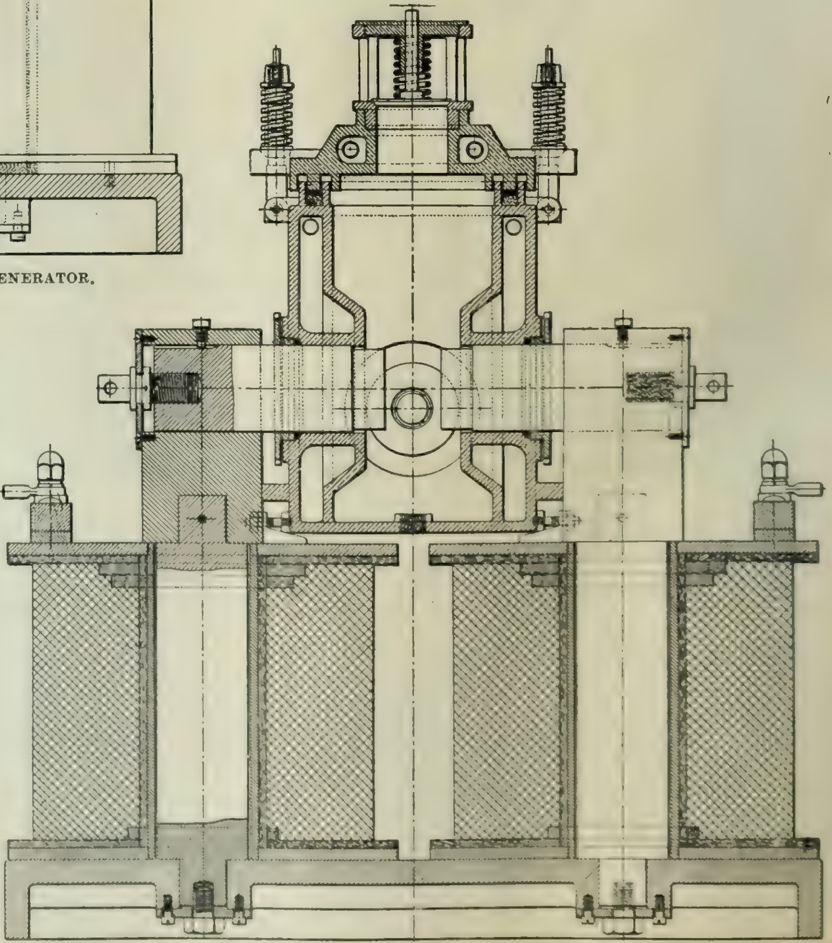

Fig. 2.—End Elevation of 10 kw. Arc Generator.

electrical engineering; and if we consider the apparatus employed in them we arrive at the same conclusion. It is therefore evident that the engineering side of the wireless science has been unaccountably neglected by writers and too often, it must be added, by those whose business it is to construct the necessary apparatus and equipment. Nevertheless, if wireless telegraphy is to develop along the right lines in the future careful attention must be paid to the application of engineering principles in the construction of the apparatus used, and a short description of some modern wireless apparatus which we recently inspected will show how this is being done.

The Arc Generator.

We may take as an illustration of our text the arc generators and auxiliary apparatus which are being made in various sizes by Mr. C. F. Elwell at his works in South London. We give sectional drawings of the 10 kw. pattern in Figs. 1 and 2. The general principles of design followed in this apparatus are equally applicable to generators of 5, 10 and 25 kw. output, except that in the last named and larger sizes the magnetic circuit is usually embedded in concrete, and is sometimes supplied with bronze feet, and a bronze supporting frame to take the weight of the horizontal field coils off the pole pieces. In this case the field coils (Fig. 3) are not placed in position until after erection, an operation that is easily effected by removing one of the pole pieces. Fig. 4 shows sectional views of this generator and Fig. 5 a general view of the apparatus in position.

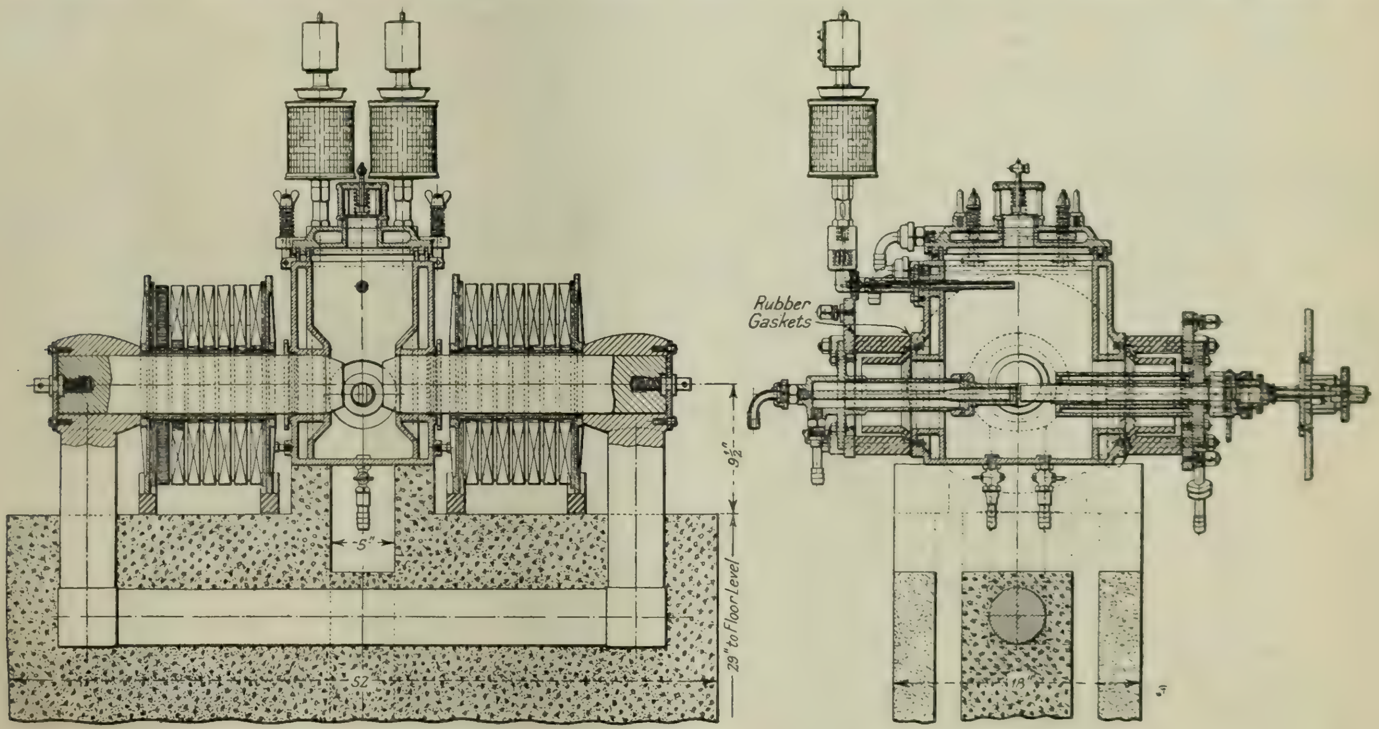

Fig. 4.—Sectional Views of 25-kw. Arc Generator.

Dealing first with the magnetic circuit, this consists of a cast-steel base and two steel uprights, each of which carries a head into which the pole piece is screwed. Necessary adjustment of the latter is effected by means of a square headed screw. This adjustment is necessary in order to ensure that the field in which the arc operates is of suitable strength and to avoid sparking or actual contact with the copper anode or carbon cathode between which the arc is struck. Further, as the output of the arc depends on both the capacity and inductance of the aerial circuit, an adjustment of the field may be necessary to secure the most efficient working. This may reach as high a figure as 50 per cent. if the field and the circuit constants are suitable.

Arrangement of the Electrodes.

The arrangement of the two electrodes is fairly evident in the illustrations (Figs. 1 and 2). The copper anode which is not adjustable is held in a massive porcelain sleeve insulator, and is fitted with a flattened wedge shaped tip which is renewable, both anode and tip being water cooled.

The anode tip, which is renewable, usually lasts a long time, several months at least, though it may be accidentally burnt out, as for instance in case of a failure of the water supply. In such an event it can be easily and quickly changed. In the more important stations duplicate sets are installed, and in case of any trouble with the running set, such as that just mentioned, it is generally possible to carry on for a short time until the duplicate set can be started up, so that no serious interruption of communication need be feared. In general, it may be said of arc apparatus as a whole that, while small troubles sometimes occur, they are not liable to serious breakdowns, so distinguishing them from the high-frequency alternator and other similar apparatus.

The cathode is of carbon, it being found that artificial graphite is better than ordinary carbon, at any rate in the larger sets, and it is, of course, also softer than the carbons used in arc lamps. This carbon is held in a brass sleeve, so arranged that the carbon is consumed to as near as possible the bitter end. Except in the larger sets, where direct connection is allowed between the cathode and the frame for reasons of safety and convenience, it is also insulated from the body of the generator in a similar manner to the anode, but is carried in a tube, the outer end of which is formed into an ebonite mushroom head. This head is held in a small rectangular brass frame, as shown in the illustrations, which frame also contains a helical spring on which the inner end of the rod that forms the arc striking mechanism presses. The outer end of this rod is a small button placed at the centre of a large ebonite hand shield.

This shield also carries, concentrically with the striking rod, a screw device of the ordinary kind, which allows a fine adjustment of the carbon cathode to be made. This cathode is kept rotating by a small worm drive operated by a small motor driven by a flexible shaft and installed alongside the main apparatus. A cathode of a 350-kw. set is illustrated in Fig. 6.

Insulation Problems.

It may be noted here that a feature of all this apparatus which generally gives rise to some speculation at first sight is the care used in the design of, and the massiveness of the insulation. This is, of course, necessitated not by the pressures employed, but by the extremely high frequencies. Indeed with frequencies as high as those employed in wireless work, ordinary insulating methods are quite impossible, and generally held ideas on the subject have to be radically revised. Another reason for care on this question are the inductive kicks generated when the arc goes out. Such high frequencies are, of course, not dangerous to life, and it may with truth be said that the arc apparatus is eminently safe in its operation, as no high-tension low-frequency energy is used, that employed being direct current on the one side and high-tension high-frequency alternating current on the other.

The Magnetic Circuit.

As regards the magnetic circuit we have already said that the pole pieces are adjustable in order to allow an easy method of increasing the field should this be necessary. For the same reason these pieces are given a cone shape and the yokes are generously dimensioned to avoid saturation. This is, of course, important, owing to the fact that, the shorter the wave length, the stronger the field needed to give good results. Another reason for generous dimensions is the need of reducing heating as much as possible. At the same time there is no point in forcing up the copper above a certain limit for the sake of obtaining a little better arc. In this, as in other matters, economic considerations must be kept in view.

The field-coils are usually connected in series with the arc, though in the larger sizes they are sometimes separately excited for ease of adjustment. The field-coils of the smaller sets are wound with cotton-covered wire of square section, and in the larger sizes with bare copper strip, which is would on flat, in spiral coils like a clock-spring, with mica insulation between the turns, and air-spaces between the several spiral coils, thus providing good ventilation and also good insulation against high-frequency discharges. The coils are heavily insulated from the cores and frames with mica, the field windings being thus made practically indestructible. A number of terminals are fitted on the outer ends of the spiral coils, whereby an additional means of adjusting the field strength is provided. The field-coil units rest on metallic sectors which in turn rest on the concrete foundation or bronze frame, the height of the field-coils being adjusted so that the coil is properly centred in them. A field coil ready for transport is shown in Fig. 7.

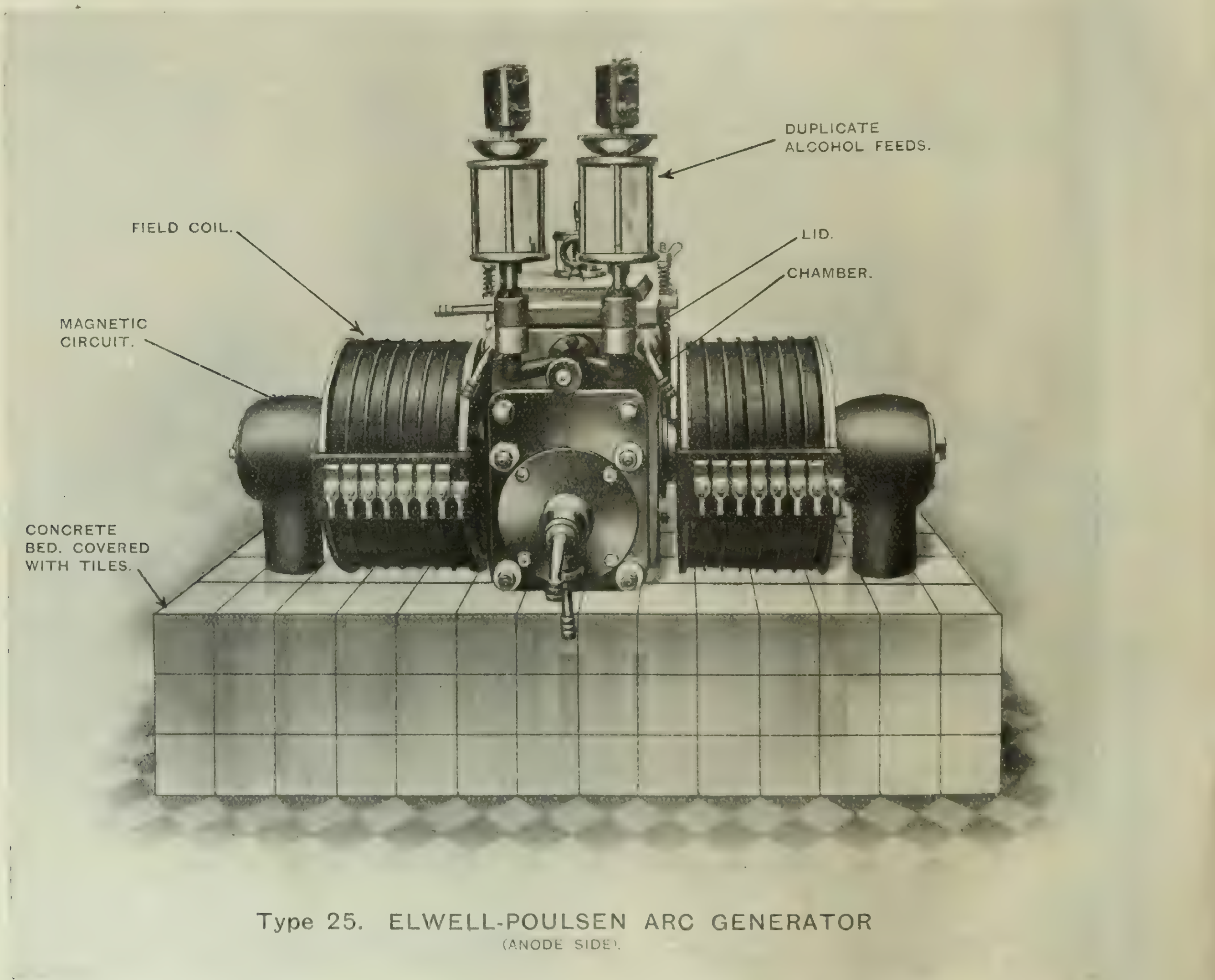

Fig. 5. View of 25-kw. Elwell-Poulsen Arc Generator.

The Supply of Hydro-carbon.

As is well known, the Poulsen arc operates in a hydro-carbon atmosphere. This can be supplied either by coal gas or by some liquid fuel, such as alcohol or benzine. To effect this, as will be seen from the illustrations, necessitates suitable supply arrangements. In the case of coal gas, supply is made through the base of apparatus, and control is effected by a tap in the ordinary way. In the case of liquid fuels a reservoir, or on the larger sets two reservoirs, mounted on the top of the apparatus, and complete with filling dishes, are employed. These reservoirs can both be used for the same fuel or two different fuels, so that the mixture of hydrocarbons best suited to local conditions may be employed. For instance, by employing a volatile fuel to start with, and then changing over to one less volatile, quick starting up and efficient working may be secured. The reservoirs are carefully insulated by means of ebonite insulators, and are fitted with an adjusting sight feed device, so that the supply of fuel run into the arc chamber may be controlled. The feed tube is adjusted so that the liquid fuel does not drip directly on to the electrodes of the arc. The lid of the arc chamber is firmly secured by wing-nuts and springs, which at the same time allow it to be quickly opened, and make a thoroughly gas-tight joint, with the aid of a grummet of soft asbestos packing. It is necessary that the chamber should be cleared of air before the arc is struck, otherwise a slight explosion may occur; this, however, is quite harmless, and is effectively taken care of by a safety valve of ample size, which is fitted on the lid.

Alcohol is the fuel most commonly employed when a supply of coal-gas is not available. It is easily volatile and contains comparatively little carbon; in the latter respect it is even better than coal-gas since it causes less sooting. However, if the chamber is cleaned out once a day, which is quickly and easily done, trouble from sooting need not be feared.

The body of the chamber and in the larger sizes also the lid and the cathode-holder is water-cooled, being connected in the same water-circulation system as the anode, already mentioned. In the smaller sizes the lid of the chamber instead of being water-cooled is provided with cooling fins.

Little need be said about the water supply necessary. If the supply available is abundant, ordinary thermo-siphon circulation can be used, otherwise a small circulating pump must be installed. It is hardly necessary to add that great care must be taken to secure that all joints are watertight, especially those which might allow admission of water into the arc chamber. If, however a leakage of water does occur, it is possible to carry on operating for a short time, and to provide for such contingencies the chamber is fitted with a drain. Incidentally, the entrance of water into the chamber leads to an excessive consumption of the cathode, which under normal conditions tends to build up rather than to be consumed, owing to the fact that it draws a supply of carbon from the gas or liquid employed.

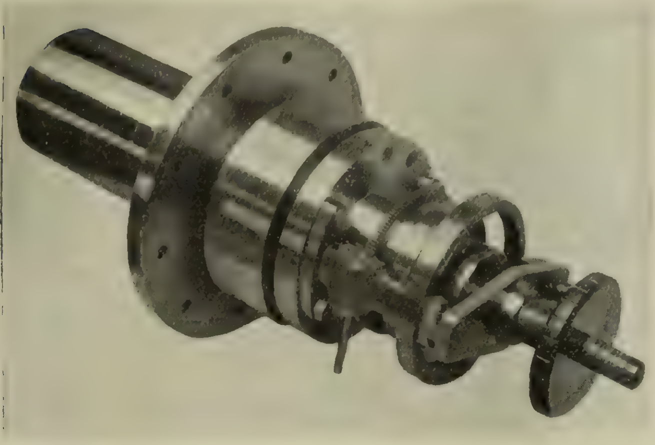

Fig. 6.—Latest Type of 350-kw. Cathode.

Switch Gear.

It is equally true of wireless, as of a great deal of other electrical apparatus, that its operation is largely in the hands of relatively unskilled personnel, and that, therefore, the more foolproof and the more simple the control apparatus the more efficient is its working likely to be. For the control of the apparatus which we have just been describing, therefore, one switch only is used for effecting all the operations, and by its means each operation is carried out in proper sequence by the employment of suitable interlocking. Thus, the movements of one handle on the switchboard turns on the cooling water or starts the circulating pump, starts the motor for rotating the negative electrode, opens the valve supplying the gas or alcohol switches on the direct-current circuit and cuts out the starting resistance. Besides this "pooh-bah" handle, the switchboard also contains a water-gauge, showing the gas pressure in the chamber, and a gauge showing the pressure of the circulating water. There are Weston moving coil instruments for measuring the direct-current amperes and volts, and a hot-wire ammeter for measuring the output of high-frequency current to the aerial. On a larger switchboard which we saw going through the shops there was also an ammeter in the earth lead, which remains at zero so long as the insulation is good, but gives a deflection in case of any leakage to earth from the aerial.

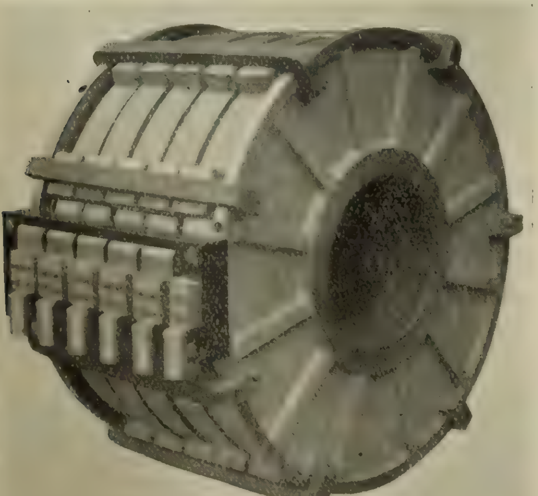

Fig. 7.—Field Coils, Wedges and Iron (Bars only for Support).

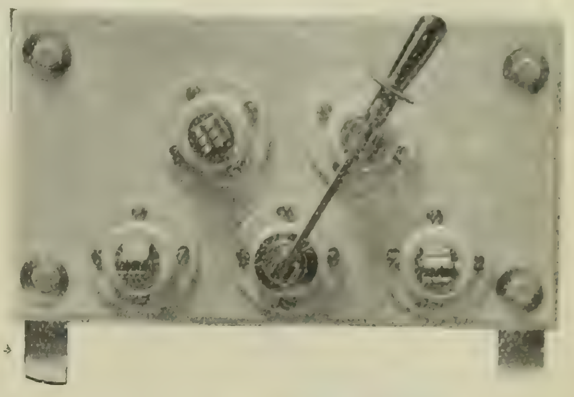

Fig. 8.—Four-Point Wave Change-over Switch (Small Size).

A starting resistance has been mentioned; this is cut out while starting up, after which there is no resistance in the direct-current supply circuit. Unlike any ordinary arc, the Poulsen arc will burn steadily without needing any resistance in series with it; choking coils are, however, connected in the circuit supplying direct current to the arc, for the purpose of preventing high-frequency current from flowing back into the D.C. circuit and breaking down the insulation of the dynamo, and in this the inductance of the field-windings of the arc also assists.

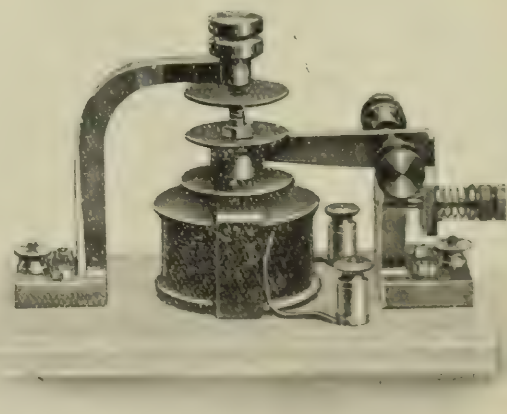

Fig. 9.—Single Contact Relay Key (Small Size).

The arcs are constructed to deal with D.C. inputs of from 2½kw. up to 400 kw. or more. The D.C. voltage required is about 400 for the smaller arcs up to 800 or 1,000 for the largest ones.

In showing that engineering principles and conditions have their place in the design and manufacture of wireless apparatus we have confined our attention practically entirely to a consideration of the main engineering apparatus. The lessons that can be drawn from this are, however, equally applicable to much of the auxiliary equipment, such as inductances, relays, keys, insulators, &c. To suppose that wireless work and engineering are not closely connected is, therefore, proved to be in the highest degree fallacious.

The Distribution of Electricity.[*]

By W. B. WOODHOUSE.

An electricity supply system commonly develops in two stages, first as a series of isolated nuclei, second as the association of these nuclei into a compound organism. In future we may see the redistribution of the industrial population over a wider area, and electricity should be available for districts where new developments of industry may be anticipated. The density of demand will vary, and it may be necessary to group together districts which it would be uneconomical to treat separately. In a well-contrived national system of supply, provision must be made for growth, higher pressures being adopted as circumstances demand. A system of interconnected stations avoids the necessity of placing stations in areas of heavy demand. Users may be divided into three classes: (1) Domestic and small power users, 0 to 50 k.v.a.; (2) factories, mines and workshops, 50 to 2,000 k.v.a.; (3) users over 2,000 k.v.a. Present limitations have resulted in detail distribution pressures of 100 to 250 volts, which are so generally established that they must be accepted. The pressure for power distribution to factories varies according to the density of demand. It may be economical to use two pressures—*i.e.*, 2,000 and 10,000 volts, which the author has adopted in Yorkshire. In the past, a limit has been set by the maximum safe pressure of generation—11,000 volts. The third pressure is that for interconnection of stations and transmission lines. The author indicates various alternative systems, including transmission at 30,000 volts and 20,000 volts respectively.

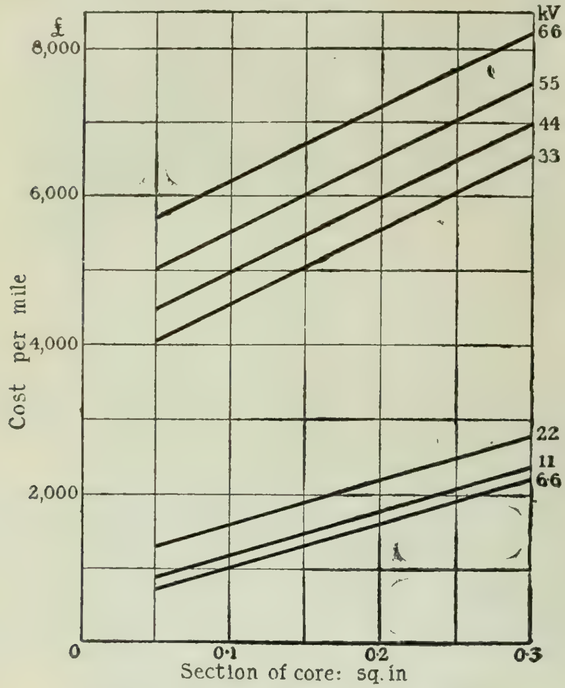

Fig. 1.—Cost of Cables in Ground.

Capital Expenditure.

Capital expenditure consists of three items: (1) Cost of excavating trenches, laying and jointing cables, reinstating ground surface; (2) cost of copper, insulation, sheathing, armouring and initial manufacturing costs; (3) extra insulation, increment of sheathing and armouring costs, depending on the maximum potential gradient permissible. (1) is independent of the cross-section of the cables, (2) is dependent on cross-section, and (3) is necessitated by higher pressures. The cost per mile of cable *in situ* is given by A_c+B_c(area of core)$+C_c(KV)^2$, where KV is the working pressure in kilovolts and A, B and C are constants (*see* Fig. 1). The cost of overhead lines may be similarly analysed and may be expressed by

$$A_0+B_0\times\text{area}+C_0(KV)+D_0(kV)^2.$$

For pressures between 6,000 and 60,000 volts the cost of an overhead line may be regarded as proportional to the pressure. The cost of a sub-station may take the form $A_s+B_s\,(kVA)+C_s(kV)^2$.

The Analysis of Losses.

Losses in the distributing system comprise (1) resistance or copper losses, (2) magnetic or iron losses, and (3) dielectric or leakage losses. Fig. 2 shows the variation in losses with load factor. The author in the original Paper, attempts to simplify the calculation of these losses by a consideration of the variation of the shape of the load curve likely to be met with in practice. In most cases the load factor of the losses is about 16 per cent. less than that of the load.

The cost of energy may be divided into production or working charges, administration or management charges, and investment or capital charges. The cost of energy after transformation or transmission may be expressed by $S_1(1+c)\ 36{\cdot}5\ b_1F_1$, where c is a term dependent on the expenditure independent of demand, and b_1 the cost per kelvin after transformation; values of the constants may be adopted according to the class of supply.

The economical size of cables may be deduced as follows: Let P =cost of losses in pounds per annum per kilovolt-ampere of maximum load, Q=annual capital charges on the increment cost of a mile of cable per square inch of conductor, a=section of each conductor in square inches. Then, for a three-core cable the annual cost of losses per mile is $0{\cdot}000128\ PI^2/a$ or Qa, and the current-density is

$$I/a=88{\cdot}4\ \sqrt{Q/P}.$$

In a three-phase system the pressure drop per mile due to resistance is proportional to I/a, and therefore to $\sqrt{(Q/P)}$. For copper conductors the pressure drop per mile is approximately

$$E_r=6{\cdot}23\ \sqrt{Q/P}.$$

Determination of Weight of Copper.

Dealing with networks, the simplest condition occurs when the load is uniformly distributed over an area. With a circular area and central feeding point, the total weight of conductor is equal to that required, with the same current density, to supply the total load concentrated at a point $2/3R$ from the feeding point, R being the extreme radius of the area. In practice other considerations arise. The author takes a rectangular network, the load per unit area p being equally distributed between N sub-stations. If the area A is square with sides R miles long, and the distance between sub-stations D miles, the load per sub-station will equal $pA/N=p\,.\,D^2$. The route length of mains will be

$$L=\frac{(R-D)2R}{D}=2R(\sqrt{N}-1).$$

The total weight of copper is proportional to $(N-1)\,.\,pAR/2N$. As the number of sub-stations increases, we approach a limiting value when the weight of copper is that necessary to supply the total load concentrated at a point distant from the feeding point by $\frac{1}{2}R$. In practice, networks are not rectangular nor uniform, but the equations are of service in indicating governing conditions.

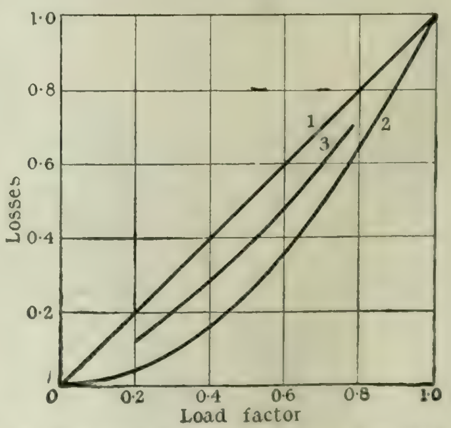

Fig. 2.—Variation of Losses with Load Factor.

The maximum section of high-pressure conductors is determined by the maximum permissible dielectric stress and minimum mass to withstand overheating under transient faults or short circuits. A minimum section of 0·05 square inches appears necessary for pressures above 10,000 volts. The permissible current density is approximately proportional to the circumference of the core or the square root of the area. This is approximately true for three-core cables. For an 11,000-volt cable laid direct in the ground I is roughly equal to $742\sqrt{a}-37$, where a has any value between 0·05 and 0·3 square inch. It appears that three-core cables of the same type of construction may be obtainable for pressures up to 60,000 volts, and that present methods of construction limit the size to 0·25 square inch for the highest pressure.

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[*] Abstract of a Paper read before the Institution of Electrical Engineers.

THE COST PER KILOVOLT-AMPERE TRANSMITTED.

The cost per kilovolt-ampere transmitted by a cable per mile of route may be derived from the expression for the cost of cable per mile, and that for the economical current density. The cost of overhead lines per kilovolt-ampere transmitted is not likely to increase as rapidly as the pressure, and therefore as regards capital expenditure there is no economical limit to the pressure used. The limit is imposed by (1) the minimum size of conductor required for mechanical strength, (2) the subdivision of circuits necessary for security of supply, (3) the limitations imposed by capacitance, regulation and leakage losses, and (4) the increment cost of substations with higher pressures.

The author's conclusions are summarised as follows :—

1. Three or more pressure systems are necessary for economy.
2. The detail distribution pressure is fixed by present use ; a single-phase pressure of from 200 to 250 volts is established.
3. The size of the distributing sub-stations is determined by the density of load and the size of power users' installations.
4. The distance between these sub-stations depends primarily on the detail distribution pressure ; the sub-stations should be as widely spaced as considerations of pressure drop permit.
5. The main distribution pressure is determined by the number of sub-stations in the area, the total load and the economical balance between expenditure on mains and sub-stations. In industrial areas a pressure of 10,000 volts appears economical.
6. The extent of each power distribution network may be reduced with economy as the load develops and the size of sub-stations increases.
7. The transmission pressure is primarily determined by a consideration of pressure drop and total power ; no advantage is gained by exceeding a minimum fixed to meet demands anticipated to arise in a period determined by the rate of growth of load.
8. Main sub-stations are determined in number by the load on the power distribution networks, the pressure distribution and the number of generating stations.

Some Economic Aspects of E.H.T. Distribution by Underground Cable.*

By R. O. KAPP.

Centralised generation in super-power houses should achieve conservation of coal supplies, and a diminution in the cost of electricity. Beyond a certain size no appreciable gain in economy is to be expected, while the cost of extra-high-tension distribution increases, so that ultimately the capital charges on the extra-high-tension system may compare with the coal bill, and even exceed it. The cost of the distribution system may be as low as £4 per kilovolt-ampere of maximum demand, or as high as £19, according to the size of the area, density of demand, or situation of the power house.

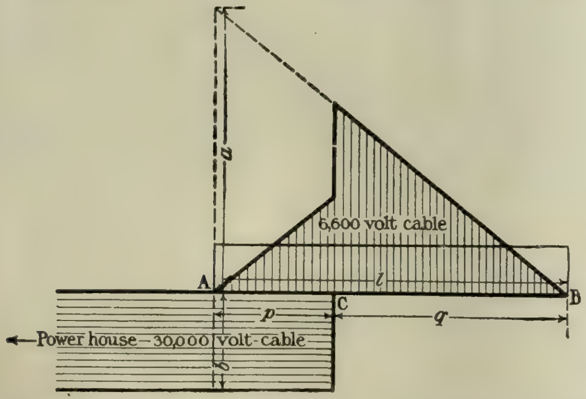

FIG. 1.—COST OF E.H.T. DISTRIBUTION WITH TRANSFORMER HOUSE AT POINT C AND LOAD EVENLY DISTRIBUTED.

The increasing size of distribution systems introduces new problems, and, in future, reductions in the cost of electricity may be made rather by economies in this field than through increases in generating efficiency. Distribution problems are therefore receiving much thought. In the Paper the following are the chief aspects considered: (1) The choice of the most economical position for the power and transformer houses. (2) The choice of the most economical voltage. (3) Various types of cable lay-out. (4) Means of ensuring that all radial feeders shall be fully loaded. (5) Methods of making fullest use of the current-carrying capacity of cables. (6) The use of tariffs for obtaining the best use of the distribution system.

SELECTION OF POWER HOUSE SITE.

Cheapest distribution is obtained when the power house is nearest the largest or most concentrated load. In the original Paper the author compares graphically the relative costs of distribution systems with various positions assigned to the power house. But the choice of number and position of power houses is in practice rarely much effected by considerations of cost of distribution, coal and condensing water being generally determining factors. If the power house is far away a transformer house within the town-boundary, supplied, say, at 30,000 volts, may be used to step down to a lower pressure, say, 6,600 volts. Accordingly the selection of a suitable position for the transformer house is of interest. Fig. 1 shows the expenditure on cable theoretically needed with a load distributed evenly over the town. The limits of the supply area are A and B, the transformer house is situated at C. The length of the town, l, is divided in the ratio p/q by the transformer house. Let a be cost per yard of 6,600-volt cable, b, the cost per yard of 30,000-volt cable needed to supply entire town load. The shaded area shows the total cost of cable within the limits of the town. Then it follows that, for minimum cost of distribution,

$$\frac{p}{l}=\frac{a-1}{2a}.$$

In the original Paper the author traces a similar diagram for a town in which the maximum demand is greatest at the centre, and evenly reduced to zero towards the outskirts. In this case,

$$\frac{p}{l}=\frac{1}{2}\sqrt{\frac{a-1}{a}}$$

p should be theoretically equal to $\frac{1}{3}AB$ in the case shown in Fig. 1, and 0·4 AB in the second case considered. If the power house is on the fringe of the town it may pay to supply the distant parts at 30,000 volts. The best position of the transformer house within this area, according to the above formula is one-third the distance across the area, and this should be the point of lowest potential; otherwise part of the cable system may be overloaded. The trans-

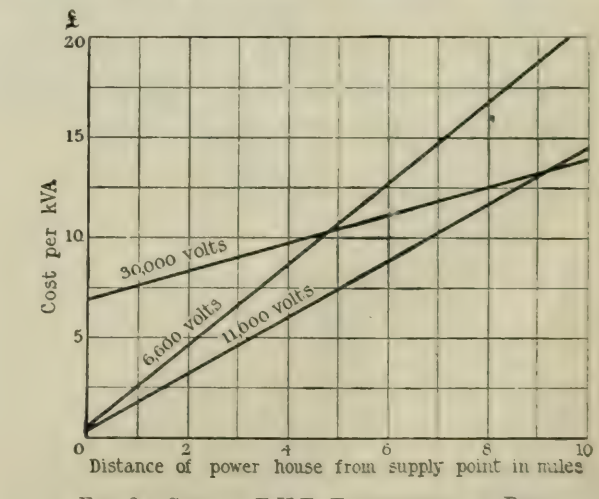

FIG. 2.—COST OF E.H.T. TRANSMISSION IN BULK.

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* Abstract of a Paper read before the Institution of Electrical Engineers.

former house voltage can be adjusted by suitable transformer tappings, and the author suggests a convenient grouping giving 15 possible ratios.

Most Economical Voltage.

In practice we should select the highest safe voltage at which (*a*) we can sell power, (*b*) generate power, or (*c*) transmit power. These pressures appear to be 6,600, 11,000 and 30,000 volts, though the latter is probably not the ultimate limit for underground cables. Fig. 2 shows the cost of transmission for these three voltages.

Cable Lay-out.

The relative advantages of various types of cable lay-out are discussed in the original Paper, and are classified as "star," "cobweb," "ring main," and "herringbone" systems. The suggestion is made that on a "cobweb" type of lay-out induction regulation should be installed on link feeders to equalise the load on different radial feeders. The total load capacity of a distribution system might be increased in this way at comparatively slight cost as shown in Fig. 3.

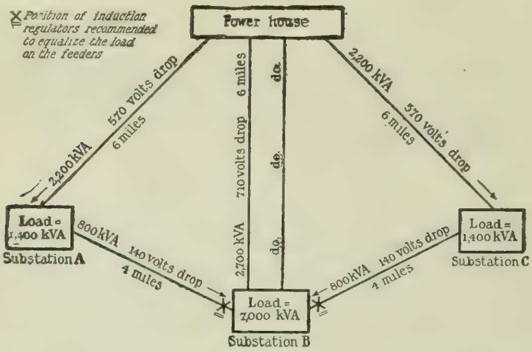

Fig. 3.—Uneven Distribution of Load between Feeders.

In the original Paper the author presents a diagram showing the cost per kilovolt-ampere per mile for 6,600-volt cable, under the best conditions for heat dissipation. Up to about 0·25 sq. in. the cost per kilovolt-ampere per mile is less the greater the cross-sectional area of copper, but the expense of stand-by cable, and cable boxes is increased.

Load Capacity of Cables.

The safe limit of loading for cables is difficult to determine, as great fluctuations occur during the twenty-four hours. The problem is to determine the continuous load equivalent to a given varying load, *i.e.*, giving the same maximum temperature rise. The root-mean-square of the load, applied to tramway motors, would work out too low for cables, owing to the progressive heating effect during twenty-four hours. Fig. 4 is a temperature chart of a cable during this period. The smooth logarithmic curve is a heating curve corresponding to the steady load giving the same maximum temperature as the actual varying load. The temperature chart assumes a constant load for one hour, and each part is a small portion of a heating or cooling curve, similar to the smooth logarithmic curve. The vertical scale of temperature is based on the equation

$$\frac{y}{T}=l-e^{-\frac{x}{c}},$$

where y is the temperature rise after time x, T is the ultimate steady temperature, c a constant depending on the heat capacity of the cable, and the amount of heat it can dissipate in unit time. The scale of temperature is such that a unit represents final steady temperature when unit load is taken by the cable.

In the original Paper the author explains how temperature charts for twenty-four or more different loadings can be traced on transparent paper, and placed in the correct position above a template curve. c, in the equation referred to above, is the time taken by cable to reach 63 per cent. of its final temperature, and is called the "time constant." Other temperature charts, all corresponding with a given load diagram, are also presented, in which the author also gives a curve showing the proportion of equivalent load continuous load to peak load, corresponding with various time-constants in hours. A typical temperature chart for transformers, assuming a time-constant of 10 hours is given, and a curve connecting transformer losses and load.

Continuous Rating of a Cable.

The method of procedure, in order to find the safe continuous rating of a cable, is as follows: The most severe daily load curve of the year is selected, and is divided into hourly averages, the square of each average load being written on the load curve. A piece of tracing paper is prepared in accordance with Fig. 4, vertical lines corresponding to intervals of an hour with a spacing determined by the time-constants in hours of the cable. The square of the load is written along the top of the paper against each hourly interval, and a vertical scale of square of load marked on the left of the paper. The transparent paper is placed over the template curve so that the assymptote of the latter is in a position corresponding with the square of the load for the first hour of the day, and the curve goes through the origin of the chart. Trace the curve for the first hour. Then move the paper vertically until the assymptote of the lower template curve is on the square of the load for the second hour and move the paper horizontally until the template curve passes through the point reached by the temperature chart at the end of the first hour. Thus the curve can be traced for the second hour, and the process repeated for each succeeding hour until the complete chart is built up.

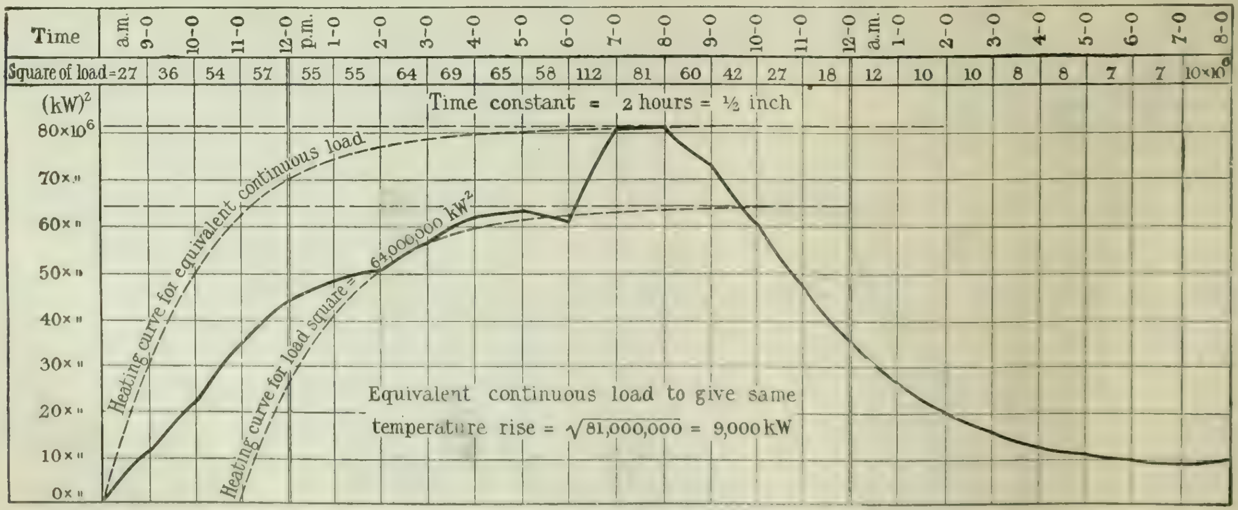

Fig. 4.—Temperature Chart of Cables on September 25th, 1919.

In the author's opinion it will be to the advantage of supply undertakings, and consumers, if large electricity works charge for power on a tariff designed to encourage the use of good power and load-factors. In view of the very general misapprehension as to the importance of this and similar questions that are of public importance in connection with the supply of electricity it is suggested that the time has come when electricity supply departments should advise their consumers how to keep down excessive peaks and to improve the power-factor.

Institution of Electrical Engineers.

A fairly large audience assembled at the meeting of the Institution of Electrical Engineers on Thursday, November 25th, to hear Mr. W. B. Woodhouse's Paper on "The Distribution of Electricity," and Mr. R. O. Kapp's Paper on "Some Economic Aspects of Extra High-Tension Distribution by Underground Cables," abstracts of which will be found elsewhere in this issue. There was the usual diffidence about occupying the front seats in the lecture theatre, with the result that late comers found the only sitting room was right down in front, and thereby, no doubt, unwillingly, caused a maximum of disturbance. This is a point to which early arrivals might pay attention for their own good. There is such a thing as being too modest.

Mr. Woodhouse did not attempt to read his Paper in full, and while giving a few selections from his brief made the important admission that networks could not be accurately projected on the lines he had laid down. This is a point on which we have commented elsewhere. We were glad to see that the lantern had sufficiently recovered from its indisposition of the night before to enable Mr. Woodhouse to exhibit some interesting load curves, though we should have liked to have had a little more time to study these than either the author or the operator gave us.

Mr. R. O. Kapp also did not attempt to read his Paper in full, but he attempted to cram rather too much of it into a limited time, with the result that he became incoherent. One audible and important point was that though networks gave little trouble there was more capital tied up in them than in any other part of the system, and that the attention which was now attracted to them was the direct result of the war. He pleaded for the pooling of ideas on this subject, and said that the object of his Paper was to start the pool by throwing a few ideas into it.

The President on the Papers.

We were glad to see that the President opened the discussion, though we were disappointed when he left off just as we hoped he was going to begin. He made the amusing and quite apt remark that on the first reading of Mr. Woodhouse's Paper he suspected that the author would conclude by adding up all his equations, find the minimum, and leave the consulting engineer with nothing more to do. He rightly emphasised the fact that though Mr. Woodhouse had covered a very wide field he had also left an immense opening for skilled and experienced individuals to adjust the many conflicting elements. He asked that the meeting should confine itself to a discussion of the network part of the two Papers, announcing that there would be a full discussion on tariffs later on in the session. This is something to look forward to.

Distribution an Art, not a Science.

Mr. P. V. Hunter introduced a new note into the usual preliminary congratulatory remarks, by saying that the Papers were neither too long nor too discursive, but spoilt it all by going off in the usual way to criticise them in detail. He agreed with Mr. Woodhouse that the distribution of electricity was often an expensive necessity under present conditions. At the same time it was a necessary economy, as it enabled advantage to be taken of the savings obtainable by placing power houses in the most favourable positions. The main transmission pressure should be determined purely by what was the cheapest voltage per kilovolt-ampere per mile at which energy could be transmitted. This was only qualified at extremely high pressures, when an individual feeder might carry more than its share of the load. Distance in this country was not a determining factor, whatever voltage was employed. Protective apparatus was used not to protect individual equipment, but to prevent the spread of the results of the breakdown, and to limit its effects. This might well be more insisted upon. As regards voltage-drop cables and overhead lines were not comparable. With the former voltage drop was not so important as in the latter, owing to the reactance. As regards heating effect dielectric losses would be of little importance in limiting the current, in spite of the cable makers' guarantees of carrying capacity for cables with the same size of core. It was true that as the working pressure rose the guaranteed current fell, not because the dielectric losses were substantially larger, but because the cable makers knew less about what was happening. This is an interesting secret. Though a good deal of Mr. Hunter's criticism was directed to details he came sharply back to the main point as he concluded by quoting Mr. Kapp's statement as to the difficulty of making generally applicable rules for designing cable lay-out schemes, and said that for many years to come the design of high-pressure systems would be more an art than a science. Those concerned might well act accordingly.

The Abandonment of Kelvin's Law.

Mr. H. M. Sayers began by calling attention to a lamentable act of jettisoning. It appeared that Mr. Kapp had thrown over Kelvin's rule. The limiting factor for E.H.T. underground cables, according to Mr. Kapp, was heating, and if that was so Mr. Sayers asked why did not Kelvin's rule apply, as Mr. Kapp implied it did not? The reason, he understood, was that in E.H.T. work Kelvin's law would give a higher current density than it was safe to work with. In reality there was no difference between low and high-tension distribution, except when it came to allowing for voltage drop. Mr. Sayers seemed rather hurt at this upsetting of the authorities, but he must console himself with the fact that as our knowledge advances it is sometimes necessary for the authorities to be modified. He concluded by saying that the whole question was one of heating, and he thought the problem was to what limits of pressure should the heating be taken into account instead of the economical density.

The Advantages of Tie Lines.

If the columns of the Institution "Journal" devoted to discussion were integrated a large proportion of the total would be found to be contributed by Major A. M. Taylor. On this occasion he stuck closer to his point than usual, which is not always the subject of the paper under discussion. He objected first to Mr. Woodhouse's statement that the transmission pressure was primarily determined by a consideration of pressure drop and total power and suggested that it was not possible to have too high a pressure. United States practice was to go in largely for tie lines connecting the various generating stations. The cost of such a line at 30,000 volts was £0·4 per kilovolt-ampere per mile and at 60,000 volts was £0·55 per kilovolt-ampere per mile, falling steadily as the voltage rose. For a 60-mile transmission line at 30,000 volts the cost was, therefore, £24 per kilovolt-ampere and £12 per kilovolt-ampere at 100,000 volts. Tie lines in this country would be an enormous advantage to many station engineers who were short of power, and would prevent a good deal of the present strain on the generating plant. The increased demand that could be satisfied would more than pay for them. The use of single-phase cables had been suggested. The difficulty was that the maximum voltage gradient was at the edge of the core and it fell off rapidly.

Mr. E. T. Painton, who addressed the meeting from the back of the room, was the best speaker, as far as delivery went, and his remarks could be clearly heard. He suffered, like others, under the delusion that the papers were on the subject of the relative advantages of overhead and underground transmission, and directed his remarks entirely to that subject. He objected that Mr. Woodhouse did not go into the question of whether high tension cables were justified economically, and pointed out that even for low voltage distribution overhead lines were considerably less costly than cables. Even with an overhead line there was an economical limit to which the voltage could be raised, and there was a definite minimum of cost which also occurred at a definite voltage. Nevertheless, the most economical voltage with a overhead line was considerably higher than with an underground cable. He objected that the expressions given by Mr. Woodhouse for the cost of the line per mile were useless as they stood, and pointed out that with the overhead lines the rate of increase of cost with voltage was much less steep than was the case with a cable. This enthusiastic supporter of overhead transmission was developing his theme at great length when he was cut short by the President's bell, and the meeting came to an abrupt end until December 9.

The Discussion at Manchester.

Our Manchester Correspondent sends us the following account of the discussion on Mr. Woodhouse's Paper, which took place on November 23:—

It is to be hoped that this Paper, when read before the Institution in London and at the other territorial centres, will evoke more discussion than it did on the occasion of its first reading at Manchester. Despite Manchester's reputation for constructive criticism only two speakers rose to discuss this Paper, although the meeting was quite well attended. The Paper is discursive, and takes a wide outlook, and this may probably account for the fact that few members present really grasped the issue which the author raised. Mr. Woodhouse urged the more extended application of high pressure cables, and in his reply lamented that so few representatives of cable makers were present.

Mr. H. A. Ratcliff emphasised the author's reference to a recognition in a system of power transmission and distribution of the time-element. Higher working pressures introduced from time to time as the need arises are likely to be more economical than the immediate adoption of the highest pressure necessary for the country as a whole. The speaker gave two useful formulæ—both favourably commented upon by Mr. **Woodhouse**—to be considered in conjunction with formulæ advanced by the author. The first is used in connection with calculations respecting the cost of load factor losses :—

$$f = F^{\frac{3}{2}},$$

where f=load factor of losses ; and F= load factor of the load. The formula used by Mr. Woodhouse is

$$f = \tfrac{1}{2}(F + F^2).$$

The second formula concerns the current carrying capacity of cables, where 33,000 volt, 3 phase, paper-insulated cables are being used :—

$$I = \sqrt{aD},$$

where a=sectional area of conductor per phase in square inches and D=diameter over lead-covering, in inches. The author's Paper contains a formula for cables operating at 11,000 volts :—

$$I = 742\sqrt{a} - 37,$$

where a=conductor area in square inches. Dielectric losses in cables are proportional not only to the charging current and working pressure (as stated by the author), but also to the temperature of the cable and the power factor of the cable, regarding the latter as a capacity. Mr. Ratcliff showed how the power factor may rise rapidly with temperature according to the character of the cable, and urged that for high pressure working cables are required in which the power factor, while rising slowly with temperature, also has a low initial value. Fortunately, cables of this type are now being manufactured, although Mr. **Woodhouse**, in reply, emphasised the importance of maintaining low temperatures.

Mr. Watson on the Future.

Mr. S. J. **Watson**, judging by the reception his remarks received, apparently voiced the experience of many members when he pointed out that in individual supply systems, invariably where a new load is least expected and where conductors are of smallest size, there the greatest demand arises ! The speaker gave an interesting forecast of the figures the ultimate demand for electricity in industrial areas might be expected to reach : he suggested ½ h.p. per head of population. This works out at about 700 units per head per annum, and Mr. **Woodhouse**, in reply, felt it would be a long time before that figure would be reached, as at present the average demand is 300 units per head. However, in the mining industry 2 h.p. are used per man employed, which, with a family of four, is ½ h.p. per head. As in this way the application of electricity becomes more extended, Mr. **Watson** feels it undesirable to generate at any great distance from the centre of population, as the failure of, say, a 50,000-kw. cable would be a serious matter. He suggested 10,000 kw. to 20,000 kw. as the limit for commercially-useful cables, urged the necessity for not tapping main transmission lines, and cited the dangers attendant upon tapping a 33,000-volt line—a voltage that will become general—inter-connecting two large generating stations. Mr. **Woodhouse**, in his reply, regarded this as a debatable matter, as ring mains are not without disadvantages ; considering a triangular area with stations at the apexes, he would undoubtedly inter-connect through the central point, from which all control would be undertaken.

Finally, the great issue of overhead lines versus underground cables was touched upon. Mr. **Watson**, while agreeing that main lines will never be overhead, felt that the latter admit of enormous extension as secondary lines for general purposes, especially as their cost for increasing voltages is not as great as in the case of underground cables. Mr. **Woodhouse** indicated that much is known respecting high-tension overhead transmission, but we need to explore the possibilities of the high pressure cable. The danger of interruption of service in industrial areas with overhead lines is very real, a thunderstorm being sufficient to close down the supply.

The Discussion at Newcastle.

Mr. **Woodhouse**'s Paper was also discussed at Newcastle, and we give below a brief account of the Proceedings.

Mr. **Townley** considered the higher cost of losses to be very important in the case of consumers taking large loads for short periods, and that this should be provided for in the tariff.

Dr. **Bowden** pointed out that although isolated areas may not be commercially economical at the moment, they were often of great use in the development of supply. Regarding high pressure cables he considered that the increased dielectric losses were offset by the reduced copper losses, the result being generally constant.

Mr. C. **Vernier** did not agree that the extra cost of insulation, sheathing and armouring in the case of cables was proportional to the pressure, nor that the cost of overhead lines was proportional to the pressure. The problem of constructing reliable 66,000-volt underground cables was now nearly solved, but the question of cost would need careful consideration.

Mr. C. **Wilson** suggested that overhead lines might be made use of for developing loads in small areas on account of their cheapness. These lines could be replaced by cable at a later date when the load grew sufficiently.

Mr. **Fawssett** referred to the necessity for specifying the cable temperature when considering dielectric losses as the losses increased rapidly with the temperature.

Mr. **Woodhouse** (in reply) said that in considering the cost of overhead lines it must be remembered that the use of high pressures and larger powers necessitated wider spacings, longer supports and more elaborate terminal arrangements, and he therefore adhered to his original statement.

The Reason Why :

II.—Good Timekeeping is Essential.

By W. J. HISCOX.

The rules and regulations in regard to timekeeping are but imperfectly understood by the average operator. He knows, of course, that it is necessary for the factory to open at a definite time, and that a standard time for closing must be adopted. He is also reconciled to the presence of the automatic time recorder, although there *was* a time when he regarded this as an instance of red tape. It is, however, in the factory where the piece work or bonus system is in operation that he is apt to become exasperated at the methods employed to ensure good time keeping, arguing that, as the man cannot earn if he is not there, he should be allowed some latitude in the matter of attendance.

The timekeeping system has, in the large factory, been elaborated of late, and a specific time department has been established. The operator fails to recognise that he is the primary cause of this, and that, under modern conditions, timekeeping must be regarded as an integral part of the factory organisation. "But," argues the operator, "why should a man be penalised because he loses half-an-hour or half-a-day ? He is on piece work, and can usually make up the time that he loses. Good timekeeping is not absolutely essential." Strange to relate, it is. The fact that the man can make up the time he loses is no argument, for, strictly speaking, he cannot. It is surmised that if he puts in a full week, he earns, say, five pounds, and that if he loses half-a-day he can, by working harder, still earn five pounds per week. Now, looking at this in the broad sense, it is apparent that, if he can lose half-a-day and still earn five pounds per week, he can, by working the full week, earn five pounds ten shillings.

Timekeeping and Production.

The more a man earns, the more he should be producing, thus by losing half-a-day he is restricting production, and if, after losing half-a-day, he still earns as much that week as he did the preceding week, when he did not lose any time, then it is evident that, generally speaking, he is not earning what he should be. Not only is he restricting his own individual production, but he is restricting the collective production of his department, for the more he produces, the more also can his fellows produce.

The bad timekeeper dislocates planning, and when this happens output is adversely affected. Planning is based, not on the time given, but on the estimated time taken. The time given for a certain job may be twenty hours, but it is expected that it will be completed in fifteen hours, and the planning is based accordingly. Now, if through losing time, eighteen hours are taken on the job, then three hours are lost, even though the man has succeeded in keeping under the time limit.

Unpunctuality and Wasted Machinery.

Apart from this, there is the loss due to idle machinery or wasted space, for, after all, it is the space rather than the operator which counts. Every square foot in the factory is surveyed and valued, and the space occupied by the bad timekeeper has a valuation fixed upon it, the appurtenances, such as machine tool, bench vice, &c., being taken into consideration. Thus for half-an-hour, or half-a-day, this space is a dead loss, for nothing is being produced, and all the hustling in the world afterwards will not make up that which is lost.

It is, however, in the shop producing small quantities of various parts that the bad timekeeper's influence is more sharply felt, for here the individual job is so small that any delay is directly felt. A small job may be wanted in half-an-hour, but as the operator is absent it has either to await his arrival, or be handled by another man, this latter course usually upsetting the arrangements made in connection with another job. A slight delay in connection with an early operation will often cause a deal of trouble later, as the following illustration shows. The next job for the fitters was the assembling of five electric motors, and the only pieces missing were the ten bearings which, owing to the absence of the turning operator, had not come through in the correct sequence. When they eventually came off the lathe, they had to go to the milling section, and, by reason of the delay in the turning section, there was no milling machine available at the moment. The job therefore had to wait until a machine was free, and by the time the bearings reached the fitting shop the initial delay had increased threefold. The bearings, not being in the fitting shop at the appointed time, prevented the fitters from starting on the motors, and so another job had to be put in hand. The five motors referred to had to wait until the job in hand had been completed, and half-a-day lost on the bearings, on account of bad timekeeping, meant one week's delay in the final delivery of the motors, a serious matter to the firm which prided itself upon its deliveries.

The Effect of Bad Timekeeping in the Early Stages.

We are experiencing difficulty in getting castings at the present time, and the following true illustration will show the far-reaching effects of bad timekeeping in connection with the early stages of manufacture. An engineering factory, dependent upon an outside foundry for its casting supplies, arranged with a foundry for a weekly delivery of twenty large castings. The foundry could only allocate one man on this particular job, and the promise was based on the man producing four castings per day. The factory arranged for other supplies elsewhere, and planned their machinery department accordingly. The man in the first foundry turned out his four castings per day, but he developed the habit of absenting himself from work every Monday. (Saturday in this foundry did not count.) The result was that the foundry could deliver only sixteen castings per week instead of twenty, and one week in every five the operators in the machinery department had practically to stand off, because sufficient supplies of castings were not available.

In another case a two-handed job was seriously delayed owing to the bad timekeeping of one of the operators. The other man kept good time, but he had to remain idle for some time, as he was unable to proceed single handed. Although at his work, he was losing money, for he was unable, by reason of the absence of his partner, to progress fast enough to make bonus. That man certainly was not sorry when the firm, in accordance with the regulations, penalised and finally discharged the bad timekeeper.

It is not suggested that a man can always be at work to the minute, and in certain cases the loss of half-an-hour or of half-a-day can be condoned. It is, however, against the habitual time loser that this article is directed, for the effect of his shortcomings is felt by his fellows as well as by the firm. There is also the case of the man who, though always in to time, always takes five or ten minutes to start work. Hundreds of hours are lost weekly through this cause, and it is therefore essential that the activities of the timekeeper do not cease with the time recorder. Time is money, and this fact must be driven home. The restrictions which are so often resented are in most cases the direct result of the action of the men themselves, for were they to apply themselves in a businesslike manner, the need would cease to exist.

Mr. E. F. W. Alexanderson on Wireless Transmission.*

The entry of the Corporation with which the author has been connected for the last twenty years upon the field of radio communication, has been a gradual growth, and a natural consequence of its general activities in power engineering. Engineers specialising in alternating current technique were in a natural position to take up the problem of designing the alternators and transformers needed in radio technique. These differ from those used in the power technique principally in the fact that the number of alternations per second is about one thousand times as great. This speeding up of the performance one thousand times involved many new problems, but the most remarkable fact to record is that the generally established principles of alternating current power technique can be applied to the radio technique almost without change. This means that the magnetic properties of iron which had been reduced to an exact science by Steinmetz thirty years ago had to be studied again at radio frequencies, but it was found the Steinmetz laws of hysteresis, eddy currents and skin effect were as accurate at two hundred thousand cycles per second as at twenty-five cycles. It was furthermore found that the established conceptions of phase displacement, power-factor, leading and lagging currents were as applicable and useful in the high-frequency as in the lower frequency technique.

The Essentials of Radio Communication.

Keeping in mind the origin of the modern art of radio communication in the two widely separate realms of knowledge, power engineering and electro physics, we find that the essential parts are a modern electric-power plant working at high-frequency; second, a network of wires a mile long, supported on tall masts; third, on the opposite side of the ocean a little glass bulb full of shooting stars. The question is: What does really happen?

Does the electricity generated by the alternator emanate from the antenna and flow in an undulating stream through the air, or through the water, or through both? If we search for it in an aeroplane, we find it, and if we submerse ourselves in a submarine and search for it, we find it, and yet we are told it is not there. Does the little electron, as an individual, take a leap off the aerial wires and after devious paths find its home in the glass bulb on the other side of the ocean? We are also told that it does not.

The Ether Theory as an Explanatory Basis.

We were once told by the physicists that all space was filled by a fine substance that was called ether, and that the light and heat that radiated from the sun were a wave motion in the ether. The physicists now tell us that there is no ether, but still they say that light is a wave motion. Be this as it may, for the purposes of visualising what takes place in radio transmission, it is convenient to cling to the theory of the ether.

The distance that a wave can travel before it fades out is proportional to its length. We may therefore introduce the idea of wave length, which is the distance from the crest of one wave to the next. In radio communication it has been observed that the distance over which reliable communication can be maintained is about 500 times the length of the ether wave that is used. It may be more than a coincidence that the distance to which a sound wave travels in air, and that a wave on the surface of water will travel before it fades out is also about 500 wave lengths. The average wave length of sound of spoken words is about 1 ft., and we know that if we speak loud our voices will carry a distance of about 500 ft. The exceptions to this rule that will occur to anybody are also significant. We know what distances voices will carry over a lake in a quiet evening. We also know what extraordinary distances radio signals will carry sometimes on a quiet night. These are exceptions that prove the rule, and the rule refers only to reliable communication under normal conditions.

A radio transmitting system is designed for the purpose of producing waves in the ether which we call electromagnetic waves, and for controlling the rate at which the waves are produced, in such a way that a train of successive waves will carry the meaning of articulate speech or telegraphic code. If we wish to send a message a long distance, we must select a long wave. The distance to Europe is 5,000 km. If this distance is to be bridged by 500 wave lengths, each wave length must be at least 10 km. (6 miles), or as it is usually expressed 10,000 metres.

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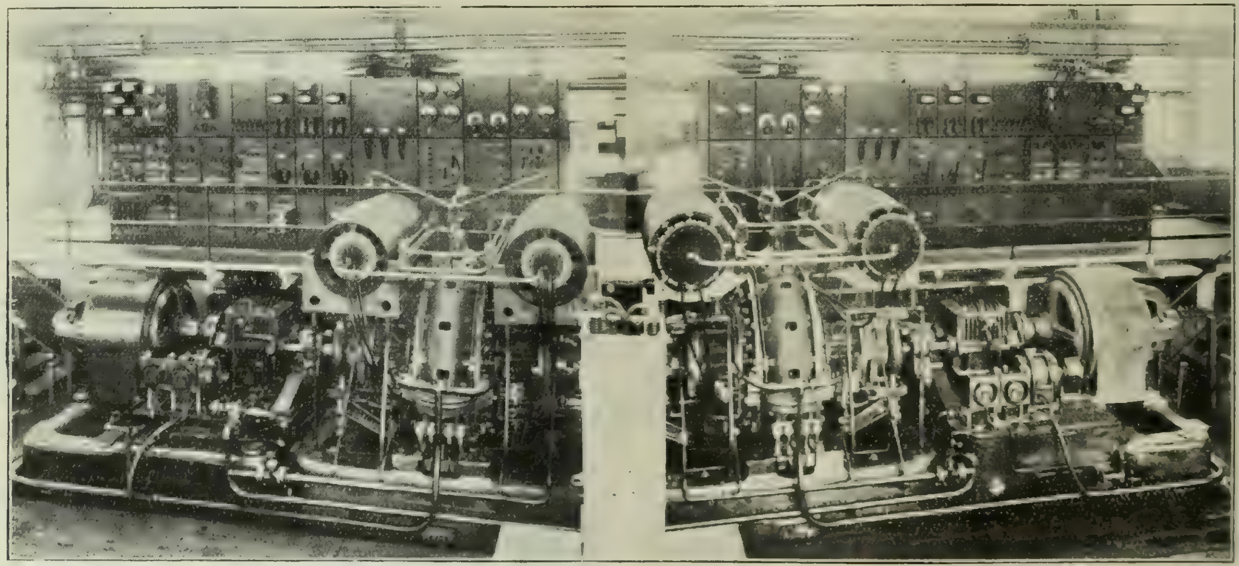
* Abstract of a lecture delivered at a joint meeting of the Radio Institute of America and the New York Electrical Society.

A Boat Analogy.

We can produce water waves by rocking a boat. If we rock a canoe we get a short wave, but if we rock a larger boat we get a correspondingly longer wave. To rock the boat requires energy, and in order to produce a wave of suitable length, the energy must act through an intermediate member which has suitable size and proportions.

In radio transmission the energy is furnished by the high-frequency power plant, but in order to transform this energy into waves there is required the intermediate member which makes contacts with a large volume of the medium which carries the wave motion. This medium is the ether and corresponds to the water or the air in the more familiar forms of wave motion. The member that transfers the energy to the ether is the antenna, and corresponds to the hull of the rocking boat.

Now the wave is a successive displacement of the medium, and the initial displacement produced by the member acting upon the medium is proportional to its volume. The water displacement of the boat corresponds to the effective volume of the antenna. The maximum voltage at which the antenna can be operated corresponds to the maximum angle to which the boat can be rocked before it ships water. This is the voltage at which the surrounding air breaks down under the electrostatic pressure. The displacement in the ether is really a measure of volume, as is apparent from the consideration that the charging current at the limiting voltage is proportional to the two horizontal dimensions. The third dimension or the height appears directly in the product, and is expressed in metres.



View of a Two Unit Radio Station Using 200 kw. High Frequency Alternator.

The Antenna Height as a Factor.

The height of the antenna is the most expensive of the three dimensions by which we may create electric displacement in the ether. The tendency in stations designed for greatest economy is therefore towards structures of moderate height and great length, whereas, the tendency in the past, when dynamic efficiency was the principal consideration, was towards towers of great height. The unit of performance on the old basis was kilowatts consumed by the antenna. The unit on the new basis is ether displacement. This modern measure of antenna radiating capacity is the number of units of ether displacement that can be produced at the voltage which is limited by the breakdown of the air.

The antennas of the stations of New Brunswick and Marion which are now used in transatlantic service are each 1 mile long. In the new radio central station which is being built by the Radio Corporation on Long Island there will be ten or twelve antennas, each a mile and a-quarter long. This station is intended to communicate efficiently with all parts of the world. When very long distances are to be spanned correspondingly long waves will be used. For efficient transmission of these long powerful waves an antenna will be needed that makes contact with a large volume of ether. This will be accomplished by combining several of these antennas into one unit. At other times the same antennas will be used for the simultaneous transmission of several messages over shorter distances.

The Multiple Tuned Antenna.

The shifting of radiation power which has been referred to is made possible by the use of the multiple-tuned antenna which has been described in a previous paper before the Institute of Radio Engineers. The New Brunswick and Marion antennas are now tuned so that each acts as six single antennas operating in multiple. The combining of several units in multiple is only a further extension of the same principle. When two such antenna groups are connected in multiple the loss resistance is reduced to one-half. Hence the efficiency of the antenna is increased so that a given power produces more radiation. Still more important is, however, the fact that more power may be utilised at this increased efficiency, and so the net result is that the amplitude of the radiated wave is doubled, which means that four times as much energy is radiated.

The Radio Central Station in Practice.

The economical factors that point to the radio central station as the practical solution of the problem of long-distance communication are practically the same as those that created the central electric power station. Broadly speaking, they provide for the utilisation of the plant investment and operating force to the utmost by shifting the equipment from one service to another, and combining it to meet various demands. New York is a natural communication centre, and the service must extend to Europe, South America and westward. Another radio central station at Hawaii is being equipped to serve as a relay for all points on the other side of the Pacific Ocean. While it is winter on the northern hemisphere, the radiating power to Europe can be much reduced, but this is the season when the South American traffic requires a maximum radiation because of summer conditions then existing on the southern hemisphere. The New York radio central station can then divert some of its radiating power from the European to the South American circuits. There will also be daily fluctuations in traffic load, which will occur at different hours due to the difference in geographic longitude. Thus the peak load of European traffic will occur at different times than the South American and Western traffic. The central station equipment can be utilised so as to take advantage of this.

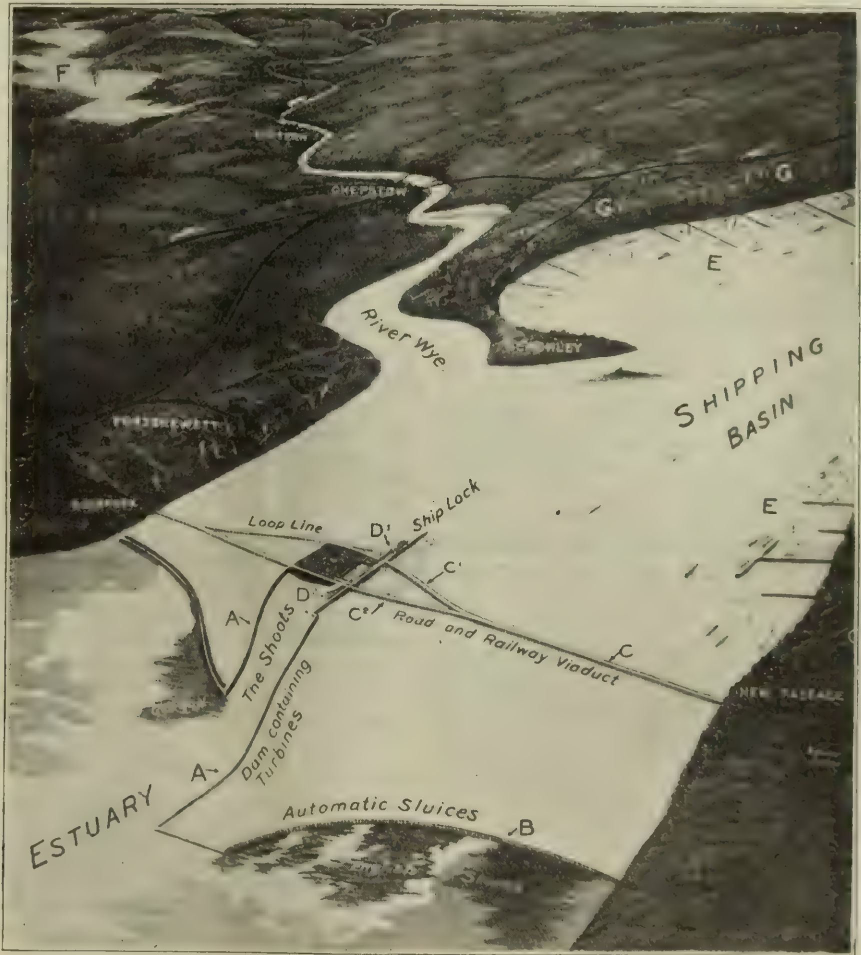
The realisation of transatlantic telephone for commercial purposes is another object of the radio central installation. Transatlantic telephony will, no doubt, be a luxury for some time to come. The radiation intensity needed for telephony is much greater than for telegraphy, and a plant designed purely for telephony might prove prohibitively expensive. However, the flexibility of the radio central where any number of antennas can be combined when desired to produce a more efficient radiation will make an extra powerful transmitter available when needed, while the plant may be used in a more economical way at other times for telegraphy.

The Severn Barrage Scheme.

The attention of electrical engineers who read the daily newspapers will have been attracted by paragraphs giving some details of a scheme proposed by the Ministry of Transport for utilising the tidal power of the Severn. Anything that appears in the daily newspapers on such subjects is generally open to suspicion, and technical readers may, therefore, be forgiven for thinking there is nothing in it. This, however, is far from being the case, and we give below some information on the subject which has been officially supplied to us by the Ministry of Transport.

THE UTILISATION OF THE TIDES.

About two years ago a scheme for the utilisation of the tidal power of the Severn was suggested to the Water Power Resources Committee. The power available on this river exceeds all the other potential sources of inland water power within the United Kingdom, and is also unique in combining all the conditions essential to the economic development of tidal water power on a large scale. These conditions present an exceptionally high range of tide, an estuary of large capacity, an ideal geographical situation, in relation to the industrial centres of the country, and suitable land along the banks of the estuary for the development of industrial operations. The necessity for immediate increased railway communication between South Wales and other parts of the Kingdom, the long-felt need of access over the Severn Estuary for vehicular traffic, and the possibility of combining these with a large scheme for cheaper power for industrial purposes, therefore led to a detailed study of the whole project being undertaken by the Minister of Transport.



BIRD'S-EYE VIEW OF THE SEVERN BARRAGE SCHEME.

A HALF-MILLION HORSE-POWER SCHEME.

These studies, which have been worked out by the Civil Engineering Department of the Ministry, have resulted in the formulation of a comprehensive scheme, on a site below Beachley, which provides over half a million horse power during a 10-hour day with a peak-load capacity of over a million horse power, at an estimated cost for generation at present-day prices of a little over a half-penny per Board of Trade unit.

In order to appreciate the magnitude of the power to be made thus available, comparison may be made with the world's greatest water-power installations :—

Amalgamated Niagara Falls Power Company .	385,500 H.P.
Big Creek Development Pacific Light & Power Company	350,000 H.P.
Ontario Power Company	200,000 H.P.
Capdella, River Flamisell, Spain	150,000 H.P.
Toronto Power Company	146,000 H.P.
Keokuk Dam on the Mississippi	150,000 H.P.
Kinlochleven (Scotland)	30,660 H.P.

In addition, the scheme provides for a road for vehicular traffic over the Severn, thus obviating the present detour between Newport and Bristol *via* Gloucester. It also provides for the quadrupling of the Great Western Railway Company's line between the West of England and South Wales at a considerably less cost than could be achieved in any other way. And lastly, it creates a locked basin for shipping purposes above the line of the Severn Tunnel, of over 27 square miles in extent, a very large portion of which will be suitable for the accommodation of vessels of the largest size and which would be usable at all states of the tide.

The scheme, therefore, may confidently be anticipated to lead to vast industrial development by bringing shipping further up the estuary, and thus nearer to the existing industrial areas.

SOME DIFFICULTIES OF THE USE OF TIDAL POWER.

As is well known, one of the difficulties in connection with tidal power is the impossibility of generating power at a constant rate during the day, thus necessitating some methods of energy storage. This is to be effected in the Severn scheme by pumping sea water into high level reservoirs during high tide and using this stored water to supply the turbines at low tide.

To provide this storage a reservoir will be provided near Tintern Abbey, and it is intended to force the water up from the low level of the River Wye through a 40 ft. tunnel driven through more than a mile of solid rock.

There will be two separate installations required in connection with the power scheme: A great concrete barrage across the Severn within which sluices and turbines will be installed for utilising the power of the tides, and with which will be combined the road bridge and the railway bridge mentioned above; and an energy storage plant, comprising a high-level lake and tunnel in combination with a pumping and turbine house on the banks of the tidal portion of the Wye.

DETAILS OF THE SITE.

The site which has been selected for the barrage has been the subject of careful study. It lies close to the line of the Severn Tunnel, at a place where the estuary is about 2½ miles wide, with low-lying country on either side. The greater part of the bed of the river is exposed at low water, and there are great sheets of rock known as "English stones" covered with seaweed, which occupy an area of very nearly a square mile. The upper structure of these rocks is "Keuper marl," and between these rocks on the English side and the rocks on the Monmouth shore side there is a wide, deep channel of solid Pennant sandstone, known as "The Shoots." The rocks on either side shelve steeply into this deep gully, which is rather wider and very much deeper than the Thames at Westminster. It is proposed to construct the hydro-electric barrage along the edge of these rocks on either side of the river, utilising the "Shoots" as the tail race, and here, also, a reinforced concrete dam will be built. Within this dam there will be chambers, in which the turbines and generating machinery will be housed.

The water in the part of the estuary above the dam at high water will be trapped, so as to create an artificial difference in the level between the water above the dam and the water in the estuary below the dam, for a period of several hours round the period of low tide. During these hours, when the difference of level exists between the water inside and the water outside, sufficient water inside will be allowed to pass through the turbines in the hydro-electric barrage to generate upwards of a million horse-power.

Large horizontally hung sluices extending right across the "English stones" will be used for this purpose, these doors automatically allowing water to pass above the dam to replenish the upper part of the river while the tide is rising, and will automatically shut on the turn of the tide, and so prevent the water trapped above the dam from escaping, except through the turbines.

A SECOND POWER HOUSE.

The second installation comprises the large high-level lake and tunnel already alluded to, in combination with a power house on the banks of the tidal portion of the River Wye. In this power house electrical energy derived from the tidal turbines in the Severn and transmitted by power cables will be used to force the water up to the reservoir at such periods as the supply of tidal power permits. When, however, the demand for electrical energy is greater than the tidal turbines in the Severn are able to supply, or when for tidal reasons the turbines are idle, this power house will automatically cease to function as a pumping station, and will function instead as a generating station, the high-pressure turbines operating on water supplied from the reservoir.

The scheme will also provide for electric locomotives for towing ships into and out of the locking basin, and for duplicating the railway and roads, so that there is always a free passage for traffic.

Reviews.

Automobile Starting, Lighting and Ignition. By VICTOR W. PAGE. (London: Hodder & Stoughton.) Pp. 815. 21s. net.

It will probably be a matter of surprise to many engineers that a volume running to 800 pages should be devoted entirely to the above subject, and this without in any way dealing with questions of theory or design. As a result of the great popularity of electric lighting and engine starting for automobiles, there has grown up during the last few years a large industry, which has been developed, in very many cases, by firms not originally in the electrical engineering trade. This has led to the isolation of automobile electrical engineering.

The book is devoted entirely to American examples, and whilst this limits its utility somewhat, there are, nevertheless, so many American cars sold in this country that it should prove of considerable value. The subject is dealt with on the assumption that the reader has little, if any, electrical knowledge, and, accordingly, Chapter I. is devoted to "Elementary Electricity." This part of the work is by no means satisfactory, and there are a number of bad errors. On page 24 we are told that, "the chemical action liberates gas bubbles which are charged with electricity." One of the worst examples occurs on page 30, when the author speaks of "a current of 4·4 volts." Again, on page 59, we are told that "a watt is a volt-ampere-second." It is particularly unfortunate that errors of this sort (of which there is a large number) should occur in a book intended to educate the reader in electrical matters.

Chapters II., III. and IV. deal with the elementary principles of ignition, dynamos and starters, and the treatment is quite good and the illustrations are profuse and excellent. Chapter V. describes typical starting and lighting systems and is good. Chapter VI. is devoted to "fault finding," and is one of the best in the book. Chapter VII. describes miscellaneous electrical devices for use on cars. The rest of the volume, with the exception of Chapter XIII., deals in detail with some of the more popular makes of electrical equipment.

Chapter XIII. explains the working of electrical-measuring instruments and their use in making special tests. It is well written and useful, but unfortunately the assumption is made that the reader possesses a particular *make* of testing instrument. We seem to have seen the subject treated in a very similar manner in a booklet issued by the manufacturers of well-known electrical instruments.

A very large number of wiring diagrams of various American cars is given at the end of the book. Of these 41 apply to cars made during the years 1917-1918 and 51 refer to the period 1919-1920. These diagrams are most valuable.

The book should be of much service to garages in this country, and as a reference volume for those interested in lighting and starting systems. The illustrations are unusually profuse and of very good quality. C. H. STEPHENSON.

Fuel, Water and Gas Analysis for Steam Users. By J. B. C. KERSHAW, F.I.C. (London: Constable & Co.) 2nd Edition. Pp. xii.+201. 12s. 6d. net.

At a time when fuel economy is most urgent any information which will aid the steam engineer to increase the efficiency of boiler plant should be welcome.

The efficiency of a boiler plant is determined firstly by the efficiency of the furnace, and secondly, by the efficiency of heat transmission from the hot gases through the boiler plates to the water. The efficiency of transmission may be seriously reduced by the use of impure water and the consequent formation of scale, and for a determination of furnace efficiency a knowledge of the composition of the fuel and the flue gas is essential. A book such as this, which clearly describes how the fuel, water and flue gas may be analysed and how such analyses may be put to practical use, cannot fail to be of interest to those concerned with boiler house economy.

It is a pity that the author does not select one heat unit and use it consistently throughout the book. What advantage is obtained by recording as is done in the first chapter, the calorific values of solid fuels in pound-calories per pound, and those of liquid fuels in British Thermal Units? In the two chapters dealing with the calorific values of fuels the only temperature recorded in degrees Fahrenheit is the temperature of an air bath. All the temperature differences obtained in calorimetry are measured in degrees Centigrade and the calorific values are consequently given in pound-calories. But in the last chapter, dealing with heat carried away by the flue gases, the author selects the Fahrenheit scale and measures heat quantities in B.T.U. The consistent use throughout the book of the Centigrade thermometer and the pound-calorie unit of heat would undoubtedly have been advantageous. In dealing with furnace losses the author rightly insists upon the serious loss incurred by the formation of CO due to restricted air supply.

This second edition contains a new chapter on the calorific valuation of gaseous fuels. In the description of gas calorimeters the author says that the water flowing through the calorimeter in a given time is measured by volume, and that if greater accuracy is required the water must be weighed. But why should not the water be weighed in all cases, since it is weight and not volume which is required.

Shorter Notice.

A Text-Book of Machine Drawing for Electrical Engineers. By EDWERD BLYTHE, A.M.I.Mech.E. (London: The Cambridge University Press.) Pp. vii.+81. 20s. net.

So many excellent books on machine drawing for mechanical engineers have been published that one wonders if such a demand actually exists. On the other hand, however, machine drawing text books dealing entirely with electrical detail are almost unknown.

It is also unfortunately true that very few engineering schools or technical institutes attempt to deal with machine drawing from a purely electrical point of view, and while the mechanical engineering side of technical education will always be greater than the electrical, there must still be a big demand for tuition in electrical drawing. It is very possible that this neglect has been caused by the want of a suitable text book, in which case the book under notice admirably fills a place.

The author has endeavoured to present a number of systematically progressive examples, which will lead the student through the elementary stages of projection of simple pieces of apparatus to the preparation of drawings of a similar nature to those found in the up-to-date workshop and drawing office. The examples have been selected with the view of illustrating not only fundamental principles, but also the most modern types of electrical apparatus, and for that reason the book should prove useful, not only for teaching purposes in technical institutes, but also to others who are engaged in drawing offices and works. The drawings are large and clear, and are good examples of draughtsmanship. The book can be strongly recommended to technical teachers and also students and apprentices engaged in electrical engineering work. E. P.

Correspondence.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Before this letter is published the decision of the meeting of the Institution of Electrical Engineers, to be held on December 2, regarding the proposed increase in subscriptions, will be known. Whatever that decision may prove to be, the following points are of permanent interest.

Apart altogether from considerations merely of an increased amount to be paid for the same services as were given before the war, because of the change in the currency value, it must be borne in mind that the Institution has large ideals and objectives in view, and the attainment of these will involve expenditure on a still more extended scale. The value of the co-operation of the Institution in technical matters is realised in high official quarters; the ever widening applications of electricity make it more and more important that the organisation of the Institution should keep pace with the progress that is being made; and the Institution must in due course become an even more valuable asset to the nation than it now is. Some day, let us hope, the Council will be a great body, dealing with matters of policy and development only, and delegating its local activities to a subordinate body, which will become the Committee for a London Territorial Centre, which will be constituted on the same lines as the other Centres. There may have to be sectional organisations within the main body of the Institution forming part of a great whole, to which it will be not only a privilege, but also a necessity, for every qualified man to belong.

All this cannot be accomplished without funds, and one hopes that the Council have gone far enough in the increases they are now asking for. Subscriptions were not raised all through the war period, and that is something to claim as a virtue. But this has curtailed the activities of the Institution, as, for example, in the case of the "Journal." Proposals have been made to sectionalise the "Journal," and send to each member only the part concerning his work. That would be a great mistake, for the "Journal" is one of the few sources of information as to what is going on outside one's own usually rather narrow groove. But an efficient "Journal" costs an enormous sum to-day, and more money must therefore be obtained for this purpose.

Much is said about what one gets in return for the subscription. The organisation of the Institution into Territorial Centres makes the privileges almost uniform all over the country. That is the justification for a fixed subscription as against the differentiation which obtains in other Institutions which have a less complete Territorial organisation. But is there not another side of the question? It is not what are we to get that we should think most of; rather ought we to think of what we may give, and remember that by contributing with the necessary liberality to the funds of the Institution we are laying the foundation of a still wider and more extended scope for the profession to which we have the honour to belong.

Possibly, if all those Associate Members of the Institution who are qualified, and can afford, to transfer to full Membership, had always done so at the earliest possible date, the present increase in subscriptions would not have been necessary. But, lest the comparatively trifling additional amounts now suggested should prove insufficient fully to support all the widening objects of the Institution, may it not be urged that all those who might transfer to the senior grade of Membership should do so as soon as they can, and so provide a still greater income? I, myself, delayed far too long in making the change, until I realised the point about giving as well as getting. For many years, too, I attended scarcely any meetings, although they were held almost at my door; and I used to wonder what the Institution was doing for me. Then I found it was doing a great work, and I was so lazy that I would not go out and simply take what was being offered to me. Now. I cannot be thankful enough to the Institution for all that it has done for me and for all that it has taught me. May I pass on the hint of my own experience to some of those who have been saying, *Cui bono?*—I am, &c.,

Newcastle-on-Tyne, THOMAS CARTER,
Nov. 27, 1920. M.Inst.C.E., M.I.E.E., Fel.A.I.E.E.

THE FUTURE OF "FINSBURY."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Unless a determined effort is made to influence the decision of the Council of the City and Guilds' Institute, Finsbury Technical College, the pioneer institution for the training of engineers and chemists, will be closed in July next. It has been suggested that alternatively the college curriculum may be restricted to that of a super trade school for chemists. But in either case Finsbury, as we know it, would cease to exist, and the cause of technical education, and the interests of the engineering and chemical professions would receive a severe blow.

A Finsbury training stands for a scientific education largely conducted in the laboratory, and under professors who are practical men and acknowledged leaders in their respective professions. An education on a broad basis, but with the instruction in the various subjects cut to the needs of the particular industries concerned, so that the training given in two or three years is equivalent for many purposes to that obtained in three or four years at other colleges!

A proud claim truly, but one which was constantly made by the revered late Principal of the College, Prof. S. P. Thompson, and which the long list of its old students whose names have become famous, goes a long way to confirm.

Finsbury, with its world-wide reputation, is to be closed. Why? The City and Guilds' Institute, which up to the present has provided 60 per cent. of the college income, has less funds available now than in pre-war years, but if the tradition of the college is to be maintained an additional income of some £5,000 must be provided, which is necessitated solely by the depreciation of the currency. It is also urged that the proposed outlay by the London County Council on the Northampton Polytechnic, about a mile from Finsbury, will meet all the needs of that district. This is a misunderstanding of the objects of the two educational centres which is not shared by the London County Council as that body has now disclaimed any intention to compete with Finsbury in any respect.

Another reason for the Institute's decision is undoubtedly the belief that its old enthusiasm in the cause of technical education is no longer necessary, that the University of London movement and the London County Council between them will effectively cover the entire field of technical education required by the metropolis so that the present is an opportune moment for the College to close its doors. This is very far from the truth There always will be a demand for a short course of specialised practical training without the finish provided by the University, but of a different character than that of the trade schools and polytechnics of the London County Council.

A college having this intermediate programme must be free from control by the syllabuses and inspection of University or County Council, and therefore, is not provided for by any public funds; clearly it must continue to look to voluntary effort for its maintenance, and the City and Guilds' Institute should be encouraged to realise that to close Finsbury, which has this character, would not only be a pity, but a grave mistake; Finsbury must be maintained with its three departments intact, and in a flourishing condition.

A petition to the Institute to reconsider its decision has been drawn up and copies are available for signature among other places, at the Institution of Electrical Engineers and the Institute of Chemistry. It is to be hoped that the Councils of these two bodies and of the Institutions of Civil and of Mechanical Engineers, will not remain passive spectators of this movement of protest, but will interest themselves officially in the fate of this college which had trained so many of their members that it deserves a determined effort on their part to prevent its useful career being brought to an untimely end.—I am, &c.,

Chelmsford, H. M. Dowsett,
November 30. M.I.E.E., F.Inst.P., M.Inst.R.E.

THE CRY OF THE RESEARCH WORKER.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Under this heading in your issue dated November 19th you have taken the members of the National Union of Scientific Workers severely to task for their attitude towards the Department of Scientific and Industrial Research, as outlined in the resolution moved by Prof. Soddy at the annual council meeting of the Union.

You appear to be under the impression that the criticism of the Department by this Union is based on the fact that the scientific worker is not permitted to receive the entire profits derived from the utilisation of his discoveries, in addition to the salary for which he had agreed to carry on his researches. This is absolutely untrue. We have contended that the scientific worker should be adequately paid for his work, but have made no claim for any legal title to the profits realised from his work. What we have protested against is (in the words of the memorandum of the executive of this Union), "the policy of assisting with public funds close corporations of profit-seeking firms, to secure a virtual monopoly of certain branches of scientific knowledge for the exclusive benefit of those firms (or the combines in which they are, or may later on, be organised), and handing over scientific workers, whose salaries are paid, in part, out of public funds, to the services of these corporations, under conditions which exclude the State, the community and the scientific workers from any share in the control of the product of their work."

The possibility of our resolution being misconstrued had already been pointed out in a sympathetic "leader" in the "Pall Mall Gazette" of November 15th., the writer of which, however, gave our members the benefit of the doubt. If your comment is due to the ambiguous wording of the resolution they adopted, the fault lies at the door of those who framed it and him who moved it, being possessed of the conceit that none could doubt the honesty of their motive, and that their avowed policy, as outlined on many occasions (though not afforded the same wide publicity) was enough to combat any such impression.

Scientific workers realise that their work has been used too often in the past to the disadvantage of the community. The present policy of the Department of Scientific and Industrial Research does not provide adequate safeguards for this interest. There has been, as Prof. Soddy said, "a very important and insidious change of policy on the part of the Government towards the fostering of industrial scientific reasearch." This change is manifested in their official publications, and it is not denied, although "A Correspondent" in "The Times" of November 22nd declares that the original provision that "discoveries made by institutions, associations, bodies or individuals in the course of researches aided by public money shall be made available under proper conditions for the public advantage" is adhered to in practice. This is an apology, not a defence or even a justification for the present avowed policy.—I am, &c.,

A. G. Church,
Secretary,
London, Nov. 29. National Union of Scientific Workers.

P.S.—The memorandum of the executive of the National Union will be forwarded to any of your readers who care to apply for it.—A. G. C.

THE E.P.E.A. DEMANDS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In connection with the demands of the Electrical Power Engineers' Association and their threatened strike, a very considerable Press campaign in the electrical papers has been organised to further the aims of that Association, but as far as I am aware nothing has so far been published setting forth any of the reasons why the great majority of undertakings, municipal and company, have refused to adopt the schedule of salaries and conditions attached to the same. I propose therefore briefly to state some of those reasons.

The so-called National Joint Board responsible for framing the schedule of salaries is a self-constituted body. It is true, it is composed of representatives of associations of both municipal and company undertakings, but these associations were never in any way authorised by their respective member undertakings, or certainly only by a very minute proportion of them, to negotiate, or draw up a schedule of salaries. The undertakings were not consulted and had no voice directly or indirectly in drawing up the schedule, and indeed few, if any, knew that it was being prepared. This is entirely contrary to the usual procedure of Whitley Councils, which, I believe, is that each District Council draws up its own schedule and the National Council, more or less formed out of or elected by the District Councils, revises the schedule, allowing considerable latitude for local conditions, &c. To accept this schedule would be to acknowledge the right of this self-constituted National Joint Board to dictate in future anything else they may think fit. There is no question of dishonouring an agreement, as no agreement has been made.

As regards the schedule itself, which is based on payment in proportion to plant capacity, just now many undertakings, possibly at the suggestion of the Electricity Commissioners, are installing relatively large units, resulting in a very abnormal proportion of spare plant—in some cases as much as 150 to 200 per cent. In such cases 15 to 20 per cent. addition to the technical staff salaries which it would involve obviously could not be entertained when there is no corresponding increase of revenue. A fairer basis would appear to be maximum demand or units sold. Technical men will admit that a station with ample spare plant is easier to run than one with little or no spare plant, and the basis of salaries in proportion to plant capacity is a further direct incentive to employers to delay extensions as long as possible.

The grading of the scale leaves much to be desired. Length of service is apparently not taken into account, the man who has been a month in his berth receiving the same as one who has completed several years. Cases are also quoted of young men who have been advanced in position to give them a chance instead of bringing in outsiders, who under the scale would earn six or seven times their pre-war salaries notwithstanding their experience in no way warrants it. There are others who have quite recently obtained in competition positions in other undertakings at substantial advances and who, under the scale, would obtain 20-25 per cent. increase.

The coupling of the clerical and commercial staff with the technical men is one the municipalities will certainly not entertain. They contend that a clerk is a clerk whatever department of the Corporation he is in and different salaries cannot be considered for the electricity department. It is further pointed out that there is the Municipal Councils Administrative Technical and Clerical Whitley Council.

Whilst the various Municipal Committees and Company Boards are inclined to be very sympathetic to the technical staff, it is a question how far they are likely to permit interference by outside bodies, such as Whitley Councils with the management of an undertaking, and further, this is not exactly the time to enforce unreasonable demands when output and revenue is decreasing in many towns owing to bad trade. Some of the junior engineers in smaller provincial stations should also remember that their training and qualifications are not all that can be desired.—I am, &c.,

Electricity Undertaking.

At a re-union of all ranks of the Tyne Electrical Engineers, R.E., on Friday last at North Shields, the Duke of Northumberland, hon. Colonel of the unit, presented a number of decorations to officers and men. Lieut.-Col. E. Robinson, in a retrospective sketch of the unit, pointed out that 57 honours and awards were received by officers, N.C.O.s and men. With respect to the future the position was uncertain, but they were allowed to recruit up to 286 men. At present they had 71 finally approved.

Permanent Magnets.

A Paper on "Permanent Magnets" was recently given by Prof. E. H. Crapper at a joint meeting of the Sheffield Society of Engineers and Metallurgists and of the North Midland Centre of the Institution of Electrical Engineers.

The lecturer, in pointing out the importance of magnetic phenomena, stated that in his opinion magnetic facts were indissoluble from the physical and mechanical properties of the material. He drew attention to the importance of various factors recently introduced for determining the relative value of permanent magnets. In dealing with testing he emphasised the necessity of making measurements in an exact manner, and of correlating the conditions under which the test was made. He dealt fully with cobalt alloy steels as regards their extraordinary properties as permanent magnets compared with other steels. He went on to say that test results obtained under laboratory conditions could be actually applied to practice, and that of two samples the results obtained from the manufactured article in each case had a definite relationship to the critical points decided in a laboratory test.

In the course of the discussion Dr. T. F. Wall questioned whether very great reliance could be placed on the results even of predicting the properties of the permanent magnet. He asked whether it would not be possible in the face of the extraordinary magnetic properties of cobalt steel to use this material on small auxiliary dynamos, and thus do away with the excitation losses.

Mr. Kayser stated that the external energy of the magnet depended on the volume of material in the magnet, although a certain constant, as given by Prof. Crapper, combined the volume with the magnetic properties. Thus the comparison of this constant for various materials would give the energy per volume. He stated that though the approximate analyses of two steels might be identical, and their treatment in making them permanent magnets was identical, yet their magnetic properties might be widely different.

Prof. Crapper, in replying, said that he was not trying to suggest methods of chosing magnets, but rather putting forward to the actual magnet manufacturers' methods of finding what, if anything, was wrong with their product, and also how it could be put right.

Heating and Cooking Notes.

Considering Each Job on its Merits.

It is to be regretted that many persons dealing with the sale of electric radiators do not realise that they are virtually selling heat and an electric heating service. To sell a 1 kw. fire for use in a room requiring at least 3 kw. is not only to take an unfair advantage of the customer, but tends to bring electric heating into disrepute. In the majority of cases electric heating is required for conveniently and quickly heating a room. It is therefore essential that the heaters should be of ample size. Once the room is warmed a portion of the fire element can be switched off and less current employed to maintain the temperature.

It is also a mistake to show a customer a fire and to say "this fire costs so much and consumes so many units per hour, which will cost so many pence." Most probably the heater will only be full on for half an hour. The better plan is to ascertain the size of the room to be heated and then to recommend a fire on the basis of 1·5 watts per cubic foot of air space in the room. This will be sufficient under ordinary circumstances to heat the room in from 20 to 30 minutes, after which half or two-thirds full heat will maintain it at the required temperature. It has been proved in practice that this method works out more economically so far as current consumption is concerned than installing, say, 1 watt per cubic foot. Undoubtedly greater satisfaction is obtained by the user by this method. Where there are large windows in large rooms it is also good practice to employ more than one fire in order to obtain a better distribution of heat, say, by installing 250 or 500 watts on the skirting or wall below the windows. This method warms the cold air as it comes into the room.

New Arora Apparatus.

In our issue of September 24 we referred to a new oven and two fires which had been produced by the Arora Company. We have now received a copy of this firm's latest catalogue and note that two further designs have been added to the range of their fires. The "Canopy" fire shown in Fig. 1 is of particularly attractive design. It is made of sheet iron supported on a cast iron frame, and finished bright black with the exception of the four sides of the opening, and the bottom shelf which are finished in polished metal. The metal reflecting surfaces brought into prominence by the black background produce a very pleasing effect. The loading of the fire is 2·25 kw., and heat control is provided for by means of two switches mounted on the side of the fire.

The other new "Arora" model is a one bar, 750 watt fire. It consists essentially of a single element mounted in a sheet iron rectangular box supported on four feet, the feet being fitted with bolt holes for fixing purposes. The front of the fire is finished in polished nickel, and the base portion in bright black enamel. Terminal connections are provided, but no switch. This is shown in Fig. 2.

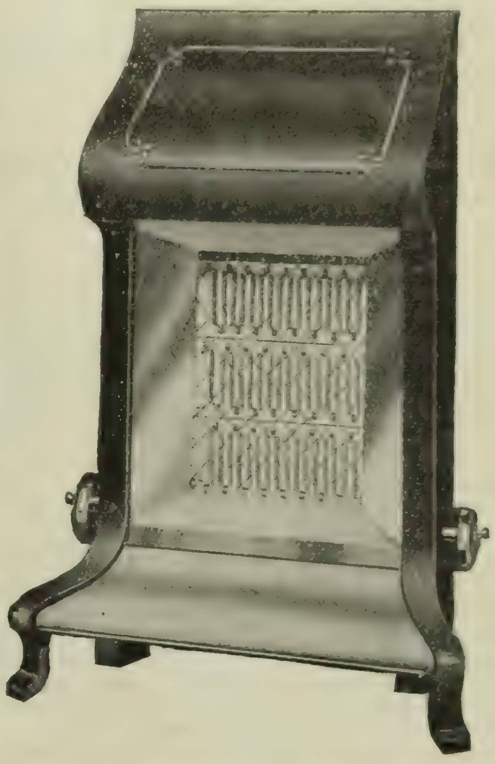


Fig. 1.—"Aurora" Canopy Fire.

We are informed that this company has a large stock of fires and ovens, and prompt delivery can therefore be offered to customers. It is also satisfactory to know that although the factory is working on standardised lines and methods of production, enquiries for special designs are welcomed, and quotations will be submitted for both cooking and heating appliances for industrial, marine and domestic purposes.

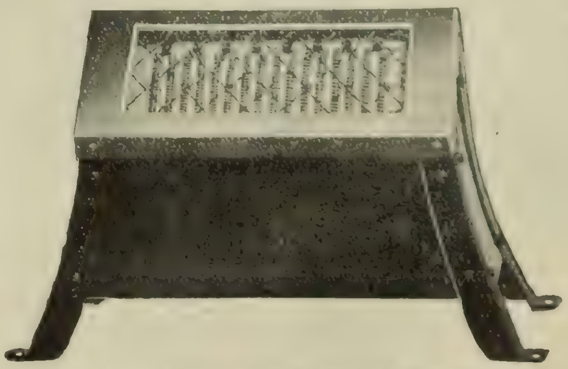


Fig. 2.—"Aurora" 750 Watt One Bar Fire.

An American Combination Fan and Heater.

In connection with electric hair driers the principle of using a fan to blow air over a radiant heater element has been in use for some years, but in the United States success has recently been obtained by applying the same principle to heating drying rooms and stores. In front of the wire guard of a slow moving fan is placed a set of radiant elements so that a slow moving draught of hot air emanates from the fan and acts as a drying and warming agent. There seem to be distinct possibilities for the further development and exploitation of this method of electric heating, particularly in connection with industrial stores and in manufacturing processes where drying operations take place

THE CARRON COMPANY'S STAND AT GLASGOW.

This old-established Corporation, founded in the reign of George II., with works at Carron and branch works at Sheffield and having showrooms in Buchanan-street, as well as Edinburgh and other large cities, manufacture practically everything, which can be made of cast-iron, as well as a wide range of ships' fittings in brass, gun-metal, malleable iron and steel. But of special importance on their stand at the Glasgow Shipbuilding, Engineering and Machinery Exhibition is the electrical cooking and heating apparatus for ships, including an electric galley range with two ovens and hot plate. This equipment has a number of independently controlled heated sections, an independent hot plate, hot press for warming plates and keeping food hot, double salamander for grilling and toasting, independent fish frying pan and a large selection of electric heaters for staterooms, saloons, &c.

Solving the Transport Problem.

ENTHUSIASTIC WELCOME TO THE "TRANSPORT WORLD."

Three weeks ago we announced the publication on January 5th of a new weekly paper to be called the "Transport World," having as its main object the solution of the problem of the return load. We do not remember any journalistic announcement which has been received with greater enthusiasm. The offices of Benn Brothers, Ltd., have been besieged with inquiries, and the traders of the country have never expressed in a more definite form their approval and support of a publishing enterprise. The idea of a motor freight exchange in the form of a weekly journal, has caught and gripped the attention of not only the big but the small people in trade and industry, and it is therefore possible even at this early stage to claim success for this new enterprise.

HIGH RAILWAY RATES ON ROAD TRANSPORT.

The announcement this week of the big surplus which the Government have secured from the increase in railway rates may be very satisfactory from the point of view of the Chancellor of the Exchequer, but to the trader it is merely proof of the millions that have been added to the already excessive burdens upon industry in the form of extra railway charges. Whether railway rates had increased or not, the road transport industry would, of course, have gone ahead, but the outlook for road transport since railway costs became so prohibitive has brightened and widened, and the "Transport World" comes upon the scene at the very moment when the motor industry has determined to assume the leading position as providers of transport for the service of the community.

THE "TRANSPORT WORLD" AND TRADERS.

So many of our readers have written to Benn Brothers, Ltd., for particulars of the motor freight exchange, that it may save others trouble if we give rather more details than was possible in our article of three weeks ago. It may be said at once that the motor freight exchange section of the "Transport World" will be useless to those who are not able to plan their journeys and their transport requirements at least a few days ahead. The "Transport World" will give each week complete and comprehensive lists of owners of freight requiring transport and of transport owners requiring freight. Both these lists will be published under towns in alphabetical order, and both will give such essential details as tonnage or capacity of vehicles. Thus, if a trader has a load of goods to transport from Brighton to Chatham, his requirements will appear under the heading "Transport Wanted," as follows :—

> Brighton-Chatham, 3 ton 6 cwt. January 15.—BRADSHAW. Tel. 293, Brighton. T.A.: "Brad., Brighton."

This advertisement will be seen by haulage contractors and motor owners both in Brighton and Chatham, and also in neighbouring districts. It is to be presumed that among them will be found a motor owner who, on or about the date given, is engaged to cart goods from Chatham to Brighton, or, at all events, along part of that road. The transport owner will proceed to get into touch with Bradshaw of Brighton, and a bargain which should save money to both would promptly be made. Similar information will be given with regard to "Freight Wanted," published in the same way.

In addition to these two sections, there will be a directory of road carriers appearing each week with their telegraphic addresses, and in these three ways it is obvious that the facilities for arranging road transport will be much greater after January 5th than they are to-day. It is particularly pleasing to know that the "Transport World" has found its most enthusiastic welcome among those who are interested in the various freight exchanges which are now being established all over the country. Motor owners who have already come together in this way recognise in the new journal a powerful support which should much improve their chances of successful organisation.

Greater London Electricity Supply.

In a report issued this week the Special Committee of the London County Council outline a scheme for the reorganisation of electricity supply in Greater London and for the establishment of a joint electricity authority. The Committee, which was authorised in November, 1919, to confer with other municipal electricity undertakers, issued an interim report in March last and announced that Mr. J. H. Rider had been retained as consulting engineer for the Council in order to investigate and report upon the engineering aspects of the supply of electricity for a Greater London area. Mr. Rider was associated in the preparation of the scheme with engineers representing the local authorities in Greater London owning electricity undertakings and nine of the London electricity supply companies, and this committee of technical experts is now closely engaged in drawing up proposals covering the technical side of the question. Simultaneously with the preparation of a technical scheme the Committee have been giving constant consideration to the question of the formulation of a scheme for the establishment of a Joint Electricity Authority. It is stated that "from the point of view of the settlement of a satisfactory and workable scheme it would appear to be essential that the clauses in this year's Electricity Bill dealing with finance should become law before the time arrives for the submission of a scheme to the Electricity Commissioners. In view of the urgency of the matter it was felt that the proper course to adopt would be to proceed with the preparation of a scheme on the assumption that it is the intention of the Government to obtain Parliamentary sanction as regards these financial matters before the time arrives for schemes to be considered by the Commissioners."

In regard to the procedure with respect to the submission of schemes, it is pointed out that the greater London provisional district conforms generally with the area proposed in connection with the Council's scheme of 1914-15, but it is somewhat more extensive. It has a total area of 1,660 square miles, a population of over 7,900,000 and a total assessable value of £68,663,477. The merits of the area suggested are being considered by the Committee of technical experts in its bearing upon the technical scheme which they are drawing up. In view of the comparatively short time available before proposed schemes are required to be deposited, it is important that without further delay the general heads of a scheme should be adopted by the Council. The fact that it has been found possible to secure co-operation between such important interests as the Council, the local authority undertakers, and so many of the principal London companies in the preparation of a joint technical scheme constitutes a very material factor in arriving at a satisfactory and agreed solution of many of the problems involved. The question of the administrative and financial basis of the scheme to be laid down for the Greater London area, however, is one in which co-operation and joint action by the different interests affected are not so readily secured.

The Committee state that they have gathered from the discussions which they have had with representatives of the local authorities and the principal London companies in connection with the joint opposition to the proposed Barking station and the work of the committee of technical experts, that both the local authorities and the companies have made considerable progress in the preparation of schemes dealing with the administrative and financial sides of the question. In all the circumstances and having regard to the importance of expediting the preparations for the submission of schemes to the Commissioners, it is felt that the most satisfactory course is for the Council also to frame its own administrative and financial proposals, while keeping closely in touch both with the local authorities and the companies on the matter.

GENERAL PRINCIPLES.

The following is a summary of the general lines on which the Committee recommend the Council's scheme should be based :—

(i) The embodiment of a technical scheme for the improvement of the organisation of the supply of electricity in the electricity district ; (ii) The constitution of a Joint Electricity Authority with powers of supervision and control necessary to secure the carrying out of the technical scheme referred to above ; (iii) All new stations to be provided by the Joint Authority ; (iv) In order to consolidate the generation and transmission side of electricity supply in the hands of the Joint Authority, provision to be made for the acquisition, based upon the outstanding life of existing plant, by the Joint Authority of the generating stations and main transmission lines of the existing individual undertakers either—(*a*) By agreement, or (*b*) By compulsory purchase under the existing Electric Lighting Acts, or any Act or Acts which may be passed hereafter ; (v) Provision to be made for the possible ultimate acquisition at the discretion of the Joint Authority of distribution systems—(*a*) By agreement, or (*b*) By compulsory purchase under the existing Electric Lighting Acts or any Act or Acts which may be passed hereafter ; (vi) Financial arrangements to be such as to provide that the undertaking of the Joint Authority shall be conducted on a self-supporting basis ; (vii) Regulation of charges to ensure that the benefits and economies resulting from the concentration of generation shall accrue to the consumers.

CONSTITUTION OF JOINT AUTHORITY.

In some explanatory notes the Committee point out that to comply with the provisions of the Act of 1919, the Council and the outside purchasing authorities will have to be given adequate representation on the Authority. As regards the Council, apart from its position as a purchasing authority, it has a status as representing the London consumers as a whole and also as an undertaker in respect of the Greenwich generating station. Other interests to be represented will include local authority and company undertakers and railway companies and other large consumers. While it is essential, in order to secure unity of control and concentration of generation facilities, that the Authority should from the outset possess certain general powers of direction over all means of generation, any arrangement which involved the immediate acquisition of the whole of the generation and transmission side of electricity supply in the area would handicap the Authority. Not only would this involve a very large capital outlay for purchase which might place a heavy financial burden on the new undertaking, but any such sudden transfer of control from the existing undertakers would possibly militate against administrative and technical efficiency. On the other hand, if the companies' undertakings were acquired under the Electric Lighting Act, 1888, purchase would be postponed as regards London company undertakings, until 1931, and as regards extra-London company undertakings to various dates extending beyond 1931. The whole of the undertakings affected would have to be acquired, including distribution systems, and during the intervening period the position with respect to control and supervision would be extremely complicated, and it would be difficult for the Authority to proceed with a scheme for development and extension on unified lines for which it will be responsible. Apart from these drawbacks, we understand that no legal interpretation has yet been placed on the terms of purchase contained in the 1888 Act. There is a possibility that acquisition on these terms of the whole of the undertakings might operate in such a way as to counterbalance much of the advantage sought to be secured by the setting up of a unified system of electricity supply. With the present difficulties in finding capital for the many purposes of post-war reconstruction, the Committee feel strongly that all capital financial resources that are available should be utilised directly on the development of the electricity undertaking.

With due regard to these points, the Committee state that they have considered most carefully what will be the most satisfactory way of dealing with the problem so that, while avoiding financial obligations that might hinder and delay progressive development, the Authority may, nevertheless, be placed in a position in which it will be enabled to exercise that degree of central control which is essential to any effective discharge of the responsibilities placed upon it. To achieve this object, it is proposed in the first instance, that the Authority should gradually replace plant in suitable existing stations as it becomes worn out or obsolete, put down new plant in existing stations or in new stations as may prove to be most advantageous, and provide also any necessary new transmission mains; also that the Joint Authority shall in the meantime control the operation of existing undertakings so as to secure that effect shall be given to any technical scheme of development that may be decided upon. The terms of purchase proposed with regard are the original cost, less appropriate depreciation. It is important that this complete transfer of the ownership of the generation sides of electricity undertakings should be effected simultaneously throughout the whole area.

So far as regards satisfactory public control of electricity supply, the Committee are convinced that the key to the situation lies in the unification and centralised direction by a public authority of the means of generation. To facilitate a settlement by agreement on the lines indicated, for the acquisition of the generating systems, the possibility is suggested of granting to existing company undertakers an extension of time as regards the distribution side of the enterprise, provided that reasonable purchase terms can be secured. It is proposed that the Joint Authority should as far as possible arrange to discharge its capital liabilities arising out of the purchase of undertakings by payment in electricity stock, and thus reserve the bulk of the new money which may be raised for the provision of new stations, the extension of existing stations and the replacement of worn out and obsolete plant therein.

Summary of Recommendations.

The Committee recommended the Council to approve the undermentioned heads as the basis of a scheme for the improvement of the organisation of electricity supply in the London and Home Counties :—

(i) The technical scheme to provide for (*a*) development and extension of existing stations, where this can be done economically; (*b*) elimination as far as possible of uneconomical stations and plant; (*c*) the supplementing of the supplies which can be obtained under (*a*) by the erection of a large station or stations, equipped with the most modern and economical plant available.

(ii) The Joint Electricity Authority to consist of a small number of members, *e.g.*, not exceeding say, 30, representative of the various interests concerned, viz.: (*a*) London County Council, (*b*) extra-London local authorities other than undertakers, (*c*) local authority undertakers, (*d*) company undertakers, and (*e*) railway companies and other large consumers.

(iii) The Joint Authority to control the use, development and extension of existing undertakings so as to secure that effect shall be given to the technical scheme.

(iv) The Joint Authority to be responsible for the provision of new generating stations and main transmission lines.

(v) The Joint Authority to have power to give a bulk supply to existing undertakers within the electricity district, and, subject to limitations laid down in Sec. 12 of the Electricity (Supply) Act, 1919, to supply electricity to railway, tramway, canal, or inland navigation companies or authorities.

(vi) The Joint Authority to have power to provide a distributed supply in areas for which there is at present no authorised distributor and elsewhere, subject to agreement with the authorised undertaker concerned, or, failing agreement, with the consent of the Electricity Commissioners.

(vii) The Joint Authority to have power to establish and work subsidiary works, or arrange for their establishment and working.

(viii) The Joint Authority to have power to create and issue stock, bills or bonds, and borrow money on the assets of the undertaking, and to use for capital purposes money standing to the credit of sinking and other funds.

(ix) The Joint Authority, county councils and other local authorities and authorised undertakers to have power to give mutual financial assistance by means of loans, advances, guarantees, or otherwise.

(x) Capital expenditure of undertakers to be made subject to consideration by the Joint Authority.

(xi) The charges to be made by the Joint Authority to be such as, over a period of years, will render the undertaking self-supporting and will cover all its expenses including debt charges and any necessary reserve.

(xii) The charges of authorised undertakers to be so adjusted as to ensure that any saving effected as the result of authorised undertakers obtaining their energy wholly or partly from the Joint Authority shall be passed on to the consumer.

(xiii) Any deficiency in the revenue of the Joint Authority to be made good out of future revenue and, if necessary, by means of a revision of charges.

(xiv) Existing powers of purchase of company undertakings to be transferred to the Joint Authority.

(xv) Generating stations and main transmission lines to be acquired, if possible, by agreement. Date of acquisition of distribution systems may be extended, if so desired by the undertaker concerned, provided that such undertaker is prepared to enter into an agreement for the purchase of the generation side of its undertaking on the lines laid down.

(xvi) Approval of Electricity Commissioners to be obtained to standard heads of agreement for the acquisition of generating stations and main transmission lines, subject to it being ascertained that such heads are likely to meet with the substantial approval of the undertakers concerned, so as to facilitate the execution of agreements, when the Joint Authority is established.

(xvii) The standard heads of agreement to provide as follows :— (*a*) Existing generating stations (so far as they are needed for the time being for supply purposes) to be retained and operated by owning undertakers until the bulk of existing plant is no longer worked, subject to powers of regulation as to user, &c., being vested in the Joint Authority. (*b*) The plant in such stations then to pass, without payment, apart from scrap value, to the Joint Authority, except in the case of plant, if any, thereafter continued in use for which payment to be made on the basis of capital properly standing in the books less depreciation. In the alternative the scrap plant to be retained and disposed of by the undertakers if they think fit. (*c*) Simultaneously rest of generating sides of existing undertakings (land, buildings and main transmission lines) to pass to the Joint Authority on payment of capital properly standing in books, less appropriate depreciation. (*d*) During the period referred to in (*a*) above all necessary extensions or replacements of generating plant to be made under the control and at the cost of the Joint Authority. (*e*) Distribution systems to remain in possession of present undertakers for further period beyond that provided for by existing compulsory purchase clauses.

Finance Committee's Report.

Reporting on the scheme, the Finance Committee state that a guarantee by the Council of the stock of the London Joint Authority might involve payments by the Council during the earlier years of the Authority's operations, but it would be open to the Council to attach such conditions to any guarantee as might appear reasonable to safeguard its financial position. There is no absolute certainty that the undertaking will be self-supporting, notwithstanding the provision that the charges for current are to be fixed on that basis. There would, therefore, be an element of risk in the advance or guarantee of loans by the Council, but in view of the size and nature of the projected undertaking, it appears that, provided the terms of purchase of existing undertakings are agreed to, the risk would be small. No specific provision is proposed to be made for the increase of the number of representatives to be appointed by the Council or any other body in consideration of their rendering financial assistance to the authority. Any assistance of this kind would, however, be granted on such terms as might be agreed, and it would be open to the Council to make it a condition of giving financial assistance to the authority, or of guaranteeing stock, that the number of the Council's representatives should be increased or that the Council should in some other way be given increased power in the management of the authority's undertaking.

Report Approved.

At the meeting of the County Council on Tuesday, the report was approved and the Committee was empowered to draw up a scheme on the lines indicated.

Recently a dispute between the Electrical Trades Union and Colchester Corporation in regard to the wages paid to the men engaged in the electricity works was referred to the Industrial Court for arbitration. The Union claimed that the agreed schedule of rates fixed by the District Council No. 9 (Home Counties) of the Joint Industrial Council for the Electricity Supply Industry should be paid. The Council urged their inability, from the financial point of view, to pay the rates claimed, as on the last five years' working of the electricity undertaking there had been a total deficit of £7,656, and as the charges for energy for lighting and power had been greatly increased it was impossible to increase the tariff without incurring further financial embarrassments. We learn that the Court has awarded that the rates in the District Councils schedule are to be paid to the respective grades of workpeople concerned.

Labour Movements.

By ARTIFEX.

Discussion is still proceeding between the Engineering Employers' Federation and the Amalgamated Engineering Union, regarding the men's claim for 6d. per hour increase in wages with an equivalent increase in piece-rates. A further conference will take place between the two organisations on December 8.

The Electrical Trades' Union has postponed the threatened strike against the London County Council, regarding the classification as skilled operatives of 900 controller repairers and power attendants. A settlement of the dispute by negotiation is now anticipated.

Proposals are being considered for the amalgamation of the Central Ironmoulders' Association and the National Union of Foundry Workers.

The first International Conference of Railwaymen held in this country met in London on Monday. The Internationalisation of Railways will be discussed.

The Wages and Conditions of Service Committee of the Glasgow Corporation are recommending an increase of 8s. per week to labourers employed by the Corporation.

The North Midlands District of the National Union of Vehicle Workers, are negotiating with the employers regarding a basis for a national rate of wages.

The claim of the employees in the engineering and shipbuilding trades at the ports of Cardiff, Newport, Swansea, &c., for increased wages, was not established before the Industrial Court.

Mr. J. H. Thomas, M.P., has been elected President of the International Federation of Trades Unions, in succession to Mr. W. A. Appleton, who resigned rather than continue in an office which, he believed, involved an acceptance of Socialism.

At the International Trade Union Congress, in London last week, M. Jouhaux, the French trade-union leader, advocated socialising the means of production and distribution, with the breakdown of capitalism, as the only means of re-establishing the world upon principles of solidarity.

Commercial Topics.

American Capital for Germany.

There appears to be a great influx of American capital into German industrial concerns, and this accounts for some of the activity of certain branches of the German export trade. U.S.A. syndicates have formed combinations which sometimes aim at domination . For example, the Amstea Company, which has headquarters in Berlin, with branches in Hamburg, Dresden, Cologne, Bremen, Munich, Danzig, Essen, Vienna, Warsaw, Reval, and Helsingfors. It was founded by the American Steel Export Company, and it seeks to control the markets in steel and steel products throughout Germany, Austria, the Balkans and elsewhere in Europe. Much American money has been invested in the textile and oil industries, in shipping, &c., and no doubt keen competition with British manufacturers will arise very soon.

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Cuba as a Market for Electric Supplies.

In a recent report on the trade of Cuba it is stated that extended credits are necessary in order to do business. While the United States, owing to its proximity, is the natural market for Cuba, the great wealth and enterprise of the people enable them to purchase in any part of the world. British manufacturers and shippers enjoy opportunities for extending their trade with this State, especially in connection with electrical supplies, which are at present in active demand. Electric lighting plants are being increased, and in this connection opportunities may arise for the introduction of British manufactures. Importers have a good opinion of British electrical goods, and as similarly priced manufactures from the United States are frequently several months in transit and in some cases prove, when delivered, to be not according to specification, there should be an excellent opening for the products of other nationalities. Cuba offers a particularly attractive field for small motors suitable for medium-sized factories, of which a considerable number have been commenced during the last few months, when large sums of money had been gained through successful sugar speculation and general trade prosperity.

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Electrical Machinery Requirements of Roumania,

A good deal of electrical plant (including motors, transformers, cables, &c.) is urgently required in connection with the reconstruction of the Roumanian oil industry. Some particulars of the country's requirements have been supplied by H.M. Commercial Secretary at Bucharest, who has also forwarded to the Department of Overseas Trade a list of the principal firms engaged in the industry, together with a list of the goods required. Names of the undertakings will be furnished by the Department to United Kingdom firms.

Most of the plant hitherto used has been of German manufacture, but British firms have now an opportunity of capturing some of the orders for the new plant. In addition to the plant and machinery mentioned above, a turbo-generating set of 10,000 kw., tubes, pumps, tanks, hardware, tools, &c., are required.

The Commercial Secretary to H.M. Legation at Bucarest reports that an important company, called the "Societatea Refacerea Industriala" (Industrial Reconstruction Company), was recently formed under Government auspices for the following purposes :—To provide industry with machines, tools, raw materials, means of transport, &c. : to distribute the raw materials that the State brings in as capital ; to make advances to industrialists for short terms ; and to participate in the creation of industries of utility to the national economy, &c.

Electricity Supply.

The Mountain Ash Council has been authorised to borrow £5,700 (balance of a sum of £31,000) for the electricity undertaking.

The £3,000 authorised for electricity services at Burnley a year ago has been spent, and application is to be made for sanction to borrow a further sum of £5,000.

Hebden Bridge Council has accepted the terms of Halifax Corporation for a further supply of electricity in bulk. The tariff for electricity has been increased to 8d. per unit for lighting and 4d. for power.

The Ministry of Shipping has agreed to accept the offer made on behalf of the West of England Joint Electricity Authority to purchase the Electricity Generating Station at Beachley (Glos.) at £163,200.

It was stated at the meeting of the Edinburgh Electricity Committee last week that the scheme for the Supply of Electricity in Greater Edinburgh was now completed. The total cost, including Portobello and the subsidiary power stations, would be £1,497,801.

Harpenden Urban Council is anxious to get a supply of electricity as soon as possible, and, as the negotiations with Luton Corporation have fallen through, it has been decided to co-operate with other local authorities in connection with the scheme for the formation of a joint electricity authority for the Greater London area.

Blackburn Corporation has made provisional arrangements with the Great Harwood and Rishton Urban Councils for the supply and distribution of electricity to those townships, and an application has been made to the Electricity Commissioners for an order permitting Blackburn to supply electricity in bulk to Darwen.

A serious accident occurred at the Woolwich Borough Council electricity works on the 29th ult., resulting in damage estimated at £30,000. It appears that a 3,750 kw. turbo-alternator was being placed on load when, for some reason, the overspeed governor failed to act, and the alternator raced away at a terrific speed and burst. Pieces of machinery were hurled in all directions, some falling into the river, others striking houses in the vicinity. One piece of metal was thrown right across the Thames, a distance of quite half a mile, and struck a boy named Pettitt, who was sitting on an omnibus. He was instantly killed. Three workmen at the power station also received injuries. One of the pieces of the burst alternator struck the rotor of the next largest generator set, severely damaging it. As a result of the accident the generating capacity of the station is reduced from 8,400 to 4,500 kw., and the authorities have been obliged to ask consumers to use as little electricity as possible during the next few days.

Representatives of the electricity undertakers (about 30) in the Merseyside and West Lancashire electricity district met at Liverpool last week in order to consider the question of forming a Joint Electricity Authority. One of the principal topics of discussion was the method of meeting a deficit on the year's working of the authority, whether it should be covered by a levy on the rates or on the consumers in the districts of the respective local bodies. Wallasey Corporation object to the area and desire a separate scheme for Wirral.

The Runcorn Urban and Rural Councils have also lodged objections to inclusion in the scheme. It is suggested that a separate area should be made to consist of the present area of supply covered by the Mersey Power Company from their generating station at Runcorn, which extends from Runcorn and Widnes to the important industrial district of Ellesmere Port.

Electric Traction.

The tramway fares on the routes of the Dublin United Tramways Company have been increased, the average increase being about 50 per cent.

As there was a deficit of £10,000 on the working of the Burnley tramways for the last half year, application has been made to authorise an increase of 50 per cent. in the fares.

An inquiry was held at Bootle on the 25th ult., into the application to borrow money for the purchase of electric vehicles for the collection of house refuse, &c.

The Corporations of Aberdeen, Ayr, Dundee, Edinburgh and Glasgow have decided to associate themselves with other municipal tramway undertakings in Scotland in resisting the men's demand for a 12s. per week advance in wages. The tramway companies have already refused to accede to the demand.

Sir William Forbes, general manager of the London, Brighton & South Coast Railway Company, states that his directors had submitted to the Ministry of Transport a comprehensive scheme for the electrification of the main line between London and Brighton. After twenty-two years in the company he was now hopeful, in the near future, of seeing an electrified service between London & Brighton. The time had arrived when, in spite of economies forced by the Ministry, the trains between London and Brighton should be better than ever before.

At the annual dinner of the Sunderland Corporation Tramways staff last week there were about 140 present. Mr. A. R. Dayson, general manager presided, and amongst those present were the Mayor (Councillor Walter Raine), Alderman Geo. New, chairman of the Tramways Committee ; Mr. J. C. Whiteley, general manager of the South Shields Tramways ; Mr. Hugh Lynas and Mr. J. Davison.

The Tramways Committee recommend the Council to abolish the existing workmen's fares and also to accept advertisements for the outside of the cars, as there was a deficit of £968 on the last half-year's working.

Institution Notes.

The Annual Prize Distribution and Students' Conversazione of the Northampton Polytechnic Institute will be held to-day, Dr. Sydney Russell Wells distributing the prizes and certificates. A conversazione will be also held on Dec. 4, for members, students and their friends.

The Festival Dinner of the Electrical Trades Benevolent Institution will be held on Wednesday, Dec. 15, at 7.30 p.m., at the Connaught Rooms. The dinner will be presided over by Mr. E. Manville, M.P., who is well known in the electrical industry. It will be the first occasion on which the chair at this function has been taken by a Member of Parliament.

The members of the council of the Rontgen Society for the ensuin year are as follows: *President:* Dr. R. Knox; *Vice-Presidents:* Prof. A. W. Porter, Prof. J. W. Nicholson and Dr. G. H. Rodman; *Hon. Secretaries:* Dr. R. W. A. Salmond and Dr. E. Owen; *Hon. Treasurer:* Mr. Geoffrey Pearce; *Hon. Editor:* Major G. W. C. Kaye; *Members of Council:* Mr. Cuthbert Andrews, Dr. A. E. Barclay, Mr. E. P. Cumberbatch, Mr. A. E. Dean, Mr. F. J. Harlow, Dr. W. Makower, Dr. J. Metcalfe, Dr. R. Morton, Major C. E. S. Phillips, Prof. A. O. Rankine, Sir A. Reid, and Mr. J. Russell Reynolds.

We have received from the British Electrical & Allied Manufacturers' Association a pamphlet containing the terms of the research studentships and scholarships in mechanical and electrical engineering which they are proposing to endow. The general terms on which these studentships and scholarships will be granted have already been given in the columns of The Electrician and we need only add that having regard to the importance of promoting the development of electrical and mechanical engineering the members of the Association have been, not only doing the generous, but the long-sighted, act in the setting aside a sum not exceeding £8,000 for this purpose.

A Paper on "Industrial Lighting, with suggestions for its Application to Collieries" was read by Mr. H. Girdlestone at the meeting of the Midland branch of the Association of Mining Electrical Engineers at Mansfield, on Saturday. The metal filament and the gas-filled lamps had, he said, entirely changed the conditions of industrial lighting. After referring to the economy and efficiency of the modern electric lamp, he pointed out that scientific illumination increased output from 8 to 15 per cent., and a saving of a few minutes per day to the workmen would more than pay the entire cost of operating a modern lighting equipment. Statistics also showed that improved lighting reduced accidents; and, as accidents were becoming more expensive every year, improved lighting was a good investment, apart from the human side of the question. That was in the case of collieries of first importance.

Educational.

In an appeal which is being made for funds for the University of Edinburgh it is stated that there is an urgent need of about half a million sterling for new buildings, &c. The number of students has enormously increased, and the requirements of practical teaching cannot be met without large additions to the existing laboratories Donations may be sent to the secretary of the University, Mr. William Wilson.

In the 1920 Mayoral Statement it is stated that the resources of the Huddersfield Technical College have been strained to the utmost. Ex-Army students were enrolled in large numbers and it was found impossible to accommodate many applicants. The number of students during the session was 3,248, an increase of 876 over last year. Of these students 658 were enrolled in day classes (an increase of 139) and 2,590 in evening classes (an increase of 737). The enrolment at the afternoon classes for apprentices continues to be very satisfactory, over 300 students being in attendance. Under the schemes for the education and training of ex-Service men 413 students in receipt of Government maintenance allowances were enrolled. The Board of Education grants amounted to £6,238 and the tuition fees were £3,577. A research laboratory has been added to the Chemistry Department, and in the engineering department new laboratories have been equipped.

Personal and Appointments.

Dr. Alexander Graham Bell, who was on a visit to this country, and left for the United States on Wednesday, has been presented with the Freedom of his native city of Edinburgh.

Mr. T. C. Joyce, B.Sc., has been appointed lecturer in electrical engineering at Sheffield University, and Mr. A. Glyn Robley, B.Sc., lecturer in electro-metallurgy.

Mr. Wm. Steventon has been appointed assistant manager of the Commercial Cable Company in London. Mr. J. W. Simpson succeeds Mr. Steventon as manager at Liverpool.

Mr. H. V. Pointon, who has been connected with the Metropolitan Electric Supply Company, Ltd., for the past seven years is relinquishing his position in order to join the staff of the Swedish General Electric Ltd., 5, Chancery-lane, W.C.2., as Technical Representative.

Mr. W. Holmans, who for several years was employed at the Edison Swan Electric Company, Ltd., Ponders End, and who went to Australia about nine years ago as their representative, has now returned to this country and was married at St. Mary's, Brighton, on the 23rd ult.

His Majesty has given orders for the following appointments to the rank of Commander of the Order of the British Empire to date from June 5 last: Dr. A. C. Jordan, for work in connection with radiology at Queen Alexandra's Hospital; Mr. H. A. Madge, principal technical adviser on the Wireless Telegraphy Staff of His Majesty's Signal School; and Dr. F. Mollwo Perkin, for valuable services rendered in various Departments of State.

Imperial and Foreign Notes.

The work of laying supply mains in Waratah (N.S.W.) is progressing and will be continued until the whole district is lighted electrically. Current will be supplied from the Newcastle power station.

The net profit of the Automatic Telephones (Australasia), Ltd., for the year ended June 30 was £3,[illegible], after providing £3,156 for taxation. A dividend of 1s. per share was declared.

The South African Advisory Board of Industry and Science has been reconstituted, and its present members are: Prof. Young (Transvaal, chairman), Prof. Anderson (T.U.C.), Col. Arnott (Natal), Prof. Sir J. C. Beattie (Cape), Dr. Caldecott (Transvaal), Mr. E. Chappell (Transvaal), Mr. A. Crawford (Transvaal), Mr. G. A. Kolbe (O.F.S.), Mr. W. J. Laite (Transvaal), Mr. K. B. Quinan (Cape), Prof. Van der Riet (Cape), Prof. Stanley (Transvaal), and the President of the Royal Society of South Africa.

An illustration of the principal drawback of hydro-electric power is given by Switzerland, where at present water-power is scarce, owing to the fact that there has been no rain for many weeks, and that the mountain lakes are frozen. Berne Municipal Council has been compelled to notify that electricity must not be used for heating purposes from 6 a.m. to 10 p.m.

Owing to the controversy between the U.S.A. Government and the Western Union Telegraph Company a committee of the Senate will investigate the whole question of cable landings in the United States. Senator Kellog proposes to introduce a bill empowering the State Department to regulate the cable connections with this country.

H.M. Secretary at Buenos Aires reports that the Argentine Ministry of Public Works has directed all departments of the Ministry to compile registers of local firms of importers or makers of, or dealers in, materials of the kind usually required by the various departments, so that each firm may be invited to present offers in cases of private calls for tenders. As regards public invitations for tenders, it will be necessary for each offer to be accompanied by a public document proving the right to represent the firm concerned in any case where the firm itself does not directly make an offer. This step has been taken owing to cases having occurred of two parties offering goods manufactured by the same principals.

Catalogues, Price Lists, &c.

A leaflet recently issued by the British Insulated & Helsby Cables, Ltd., sets out the special features and advantages of the Prescot armourclad Reactances.

Messrs. Scholey & Company, Ltd., have issued an illustrated booklet which gives particulars of the design and construction of the Scholey Fractional h.p. Motors for a.c. and d.c. These motors were described and illustrated in our last issue.

The Midland Electric Manufacturing Company, Ltd., Barford-street, Birmingham, have issued a leaflet giving particulars and prices of their "Pyramid" cable sockets. They are made of the best high conductivity seamless copper tube, of substantial strength and correct temper. It is claimed that they possess and maintain all the qualities which go to make a perfect cable socket.

The recent trade literature of the Metropolitan-Vickers Electrical Company, Ltd., included a leaflet (No. 461/4) which gives an illustrated description of the Metropolitan-Vickers Leblanc surface condensing plant; a leaflet (No. 459/2-3) showing some good illustrations of Metropolitan-Vickers marine turbines and double reduction gearing; and a pamphlet (No. 7,450/1) containing an illustrated description of the Metropolitan-Vickers Rateau reducing pressure steam turbine.

An attractively produced catalogue and compendium devoted to N.K.A. Bearings has been issued by the Northern Ball Bearings, Ltd. Its pages contain an interesting survey of bearing requirements, and gives a description of the principles of N.K.A. bearings, their patented feature and manufacture. The calculations forming the basis of the design of the bearings are also thoroughly described, and a special chapter is devoted to the method of self-alignment. A load-speed graph accompanies each of the many types of bearings dealt with, whilst dimensions and maximum loads are also included.

The use of drawn or extruded sections in place of laboriously fashioned bar or strip is too widely recognised to need advocacy. Aluminium as a material for such sections finds many openings owing to its 60 per cent. weight economy and low first cost, as well as its rustlessness and effective appearance. The range of Aluminium sections for which the British Aluminium Company have tools is so large and so continuously increasing that they find it impracticable to issue their exhaustive list. The company have, however, added to their series of "Hints on Working Aluminium" a booklet on aluminium sections which gives illustrations and sizes of a few representative shapes.

No electrical engineer whose pastime is motoring, needs to be reminded of the unsurpassed qualities of Mazda Motor Car Lamp Bulbs. A folder recently issued by the British Thomson-Houston Company will be a useful reminder to motorists of the important benefits, such as steady brilliance, immunity from vibration and general reliability which ensue from the use of Mazda lamp bulbs. This folder (No. L-173) is attractively printed in three colours and contains illustrations and full particulars of all the various types of Mazda motor car bulbs for headlights, side, tail and dash lights and interior lighting. Headlights of both the vacuum and gas-filled types are shown. Copies (overprinted with name and address) will be supplied to any contractor or dealer who applies to the Company at 77, Upper Thames-street, E.C. 4.

Miscellaneous.

The death is announced of Mr. Thomas C. Jenkin, a director and formerly general manager of the City & South London Railway. Mr. Jenkin occupied various positions in the railway world, and in 1890 he became general manager of the City & South London Railway, the pioneer of the electric tube lines. He held this position until 1912, when he became a director of the Company on its coming under the control of the Underground Electric Railways Company of London.

It is announced that at the War Office wireless station at Aldershot, messages are being received from Cologne Headquarters at a regular speed of 100 words a minute. At a recent demonstration at Aldershot the messages were automatically printed in the usual characters of a typewriter, all transcriptions of Morse characters being eliminated. The instruments used were of Army pattern, with the exception of the Morse recording and typing apparatus, which were of the well-known Creed design.

The Pocket Diary of the "Hardware Trade Journal" for 1921 is now ready. In addition to being a useful diary, it contains a number of tables, costs data and other trade information. The tables include some useful data for wiring contractors and electric light consumers. Over 130 pages are devoted to a Buyers' Guide, which contains an alphabetical list of goods, together with manufacturers' names and addresses, and a special list of trade names. All the information has been carefully revised, and as the Diary is only 3s. 6d. net, it should be a cheap investment for wiring contractors, dealers in electrical supplies, hardware, &c. It is published by Messrs. Benn Brothers, Ltd., 8, Bouverie-street, E.C. 4.

The First National Conference of Works Magazine Editors will be held on Dec. 8 in the Council Room of the Industrial Welfare Society, 51, Palace-street, S.W. 1. During the morning session Mr. Ernest J. P. Benn will deliver an address on "The Mission of the Works Magazine," and in the afternoon Mr. L. Pendred, editor of the "Engineer," will give an address on "The Art of Editing." Mr. Robert R. Hyde, Director of the I.W.S., will preside. As the purpose of the conference is to assist editors to co-operate in overcoming their common difficulties and in evolving a constructive policy, most of the time available will be devoted to discussion.

The Industrial Court has issued its award in the dispute between the Electrical Trades Union and the Negotiating Committee of Railway General Managers in respect of a claim that the Wages of Electrical Fitters, Electricians, wiremen, plumbers, jointers, and armature winders, and the mates of the first three, should be increased on the railways in London to correspond with the district rates agreed upon by the National Federated Electrical Association and the E.T.U. for the London district. The Court held that the workpeople referred to (other than mates), who were engaged on the installation of new plant and other work ordinarily done by electrical contractors, should be paid 2s. 3½d. per hour. The wages of mates are to be those provided by an agreement of January last, and as enhanced by advances since granted. The award takes effect from October 31.

Business Items, &c.

Messrs. Claremont, Johnson & Company, electrical fittings and accessory manufacturers, have removed to 66, Chancery-lane, London, W.C. 2. Telephone: Holborn 6581.

Mr. A. Hugh Seabrook, M.I.Mech.E., M.I.E.E., Consulting Engineer, has removed to larger offices at 44, Devonshire Chambers, 146, Bishopsgate, E.C.2. Telephone: Central 256.

Mr. L. Hermes, late manager of the Manchester branch of the "Z" Electric Lamp Manufacturing Company, Ltd., has joined the staff of the General Electric Company, Ltd., Victoria Bridge, Manchester.

The Z Electric Lamp & Supplies Company, Ltd., is removing this week-end to 73, Newman-street, London, W. 1. Telegrams: Zedellam Phone London; Telephone: Museum 4,650/3 (4 lines).

The London office of Messrs. Mirrlees, Bickerton & Day, Ltd., has been removed to Mirrlees House, 7, Grosvenor-gardens, Westminster, S.W.1. Telephone: Victoria 9123; telegrams: Crudoil Sowest London.

Messrs. A. Verey & Company, Ltd., have removed to 67, Borough-road, London, S.E.1, where they have acquired an entire building with ample office and stores accommodation. Telephone: Hop 5318; Telegrams: "Velelecco Sedist, London."

Bankruptcies and Liquidations.

Claims against Oswald Carr, electrical engineer, Oak Works, Headingley, Leeds, are to be sent by Dec. 8 to Mr. H. Clifford, Official Receiver, 24, Bond-street, Leeds.

The Electric Supply Company of Western Australia, Ltd., is being wound up voluntarily, and Mr. G. Saies, 21, Waterloo-street, Birmingham, has been appointed liquidator.

The discharge of Geo. Edwd. Bonner, electrical agent, 105, Fox-lane, Palmer's Green, Middlesex, has been suspended for six months from Oct. 22, 1920.

Claims against Ivor James Hodson and Basil Howard Newman, trading as Hodson & Newman, electrical engineers, 85, Queen-street, Exeter, are to be sent by Dec. 14 to Mr. A. H. Ward, Official Receiver, 9, Bedford-circus, Exeter.

Tenders Invited and Accepted.

Littleborough Urban Council invite tenders for the supply and laying of h.t. cables and roadwork. Tenders to the Clerk by Dec. 20.

Marylebone (London) Borough Council invite tenders for the supply of l.t. and e.h.t. lead-covered paper-insulated cables. Tenders by Dec. 6.

The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels, invite tenders by December 20 for a 10-ton electric crane.

Pontypridd Guardians require tenders by December 14 for three months' supply of electrical material, ironmongery, &c. Forms of tender from the Clerk.

Canterbury Corporation invite tenders for extra-high-pressure three-phase and medium-pressure d.c. switchgear and cable connections. Tenders to the Town Clerk, Mr. Henry Fielding, by 4 p.m. Dec. 6.

Tenders are required by December 11 for the supply of stores, including vulcanised wire and wiring sundries, carbon brushes, &c., to Birmingham Electric Supply Department. Schedules, &c., from the Secretary, 14, Dale End, Birmingham.

Southampton Corporation invite tenders for the supply and erection of steel work for extensions to boiler-house; also extensions to boiler-house equipment. Specifications from the borough electrical engineer, Mr. W. G. Turner. Tenders to the Town Clerk, by noon, Dec. 17.

Leeds City Council invite tenders for the supply and erection of three-phase switchgear for their generating station. Specifications from the manager of the Electricity Department, Mr. C. Nelson Hefford. Tenders to the Town Clerk, 26, Gt. George-street, Leeds, by December 13.

The Netherlands Government has placed an order with the Norddentsche Seekabelwerke for about 1,800 nautical miles of submarine telegraph cable for connecting up various islands of the Dutch East Indies.

Stepney (London) Electricity Supply Committee have accepted the following tenders: W. T. Henley's Telegraph Works Company, Ltd. (lowest tender), for 440 yds. 0·2 sq. in lead-covered cable (three tenders received; highest, £475); Sloan Electrical Company, Ltd. (lowest tender), for steel tubing and fittings, £63. 14s. 3d. (three tenders received; highest, £73. 12s. 6d.).

Directories.

One of the most useful annual publications relating to the electrical industry is Garcke's Manuel of Electrical Undertakings and Directory of Officials. The twenty-third annual issue of this well-known and valuable work, which was published some time ago, contains complete particulars of the financial position and technical equipment of all British electric-supply, tramway, telegraph and telephone undertakings, &c. There are also sections devoted to legislation, Parliamentary Bills, statistics, and the progress of the industry, to manufacturing and miscellaneous companies and to Colonial undertakings. In addition there is a directory of chief officials, electricity committees and electrical contractors, &c. The whole of the manual (over 1,600 pages) has been carefully revised, and the analyses of the last published accounts of trading companies are included. The Canadian section has been re-written and extended, and now provides a complete survey of the central-station industry of Canada. There are a number of useful maps of tramway systems, electrified railways, power undertakings, &c. The statistical and general information relates to about 2,600 electrical undertakings. It is impossible to give an idea of the ground covered by the manual in a brief notice, but is sufficient to say that it is an invaluable work of reference for the electrical industry. It is published at 27s. 6d. net by the Electrical Press, 13-16, Fisher-street, W.C.1.

Another valuable book of reference is the Engineers' Iron, Metal and Electrical Trades Directory, published by Messrs. Kelly's Directories, Ltd. As in previous editions, the 1920 (14th) issue is divided into the following sections:—(1) Every ascertainable name in the towns and villages, alphabetically arranged under each county; (2) the names under each particular trade, in London and its suburbs; (3) the names for the rest of England, Scotland and Wales; (4) the names for Ireland; (5) the names for the Channel Islands and Isle of Man; and (6) lists of the manufacturers of iron and steel sections, indicating the sections and sizes rolled, also the brands on iron and steel work. In each case the arrangement is alphabetical, and the whole seems to have been carefully prepared. The last-named section, which is on coloured paper, is an addition to the directory, and gives complete lists of all the various trades connected with every kind of metal or having any relation to engineering, from the raising of ores from the mines in this country or their importation here, throughout the various processes to which the metals are subjected, until the immense variety of articles manufactured therefrom have been produced in their finished forms. The book, which has increased in size by over 100 pages, has been compiled with the usual care bestowed on their directories by Messrs. Kelly. The published price is 45s. net.

For those interested in the South African market Saunders' South African Engineers' Electrical and Allied Trades Directory will also prove a useful work of reference. The book is divided into alphabetical, overseas, geographical and mining sections, and there is besides a separate buyers' guide to engineers' specialities. Lists are given of consulting engineers, officials of mines, ports and railways, local authorities, power-supply stations and tramways, factories, &c. The directory is published by the "South African Mining and Engineering Journal," of Johannesburg, and the price is 30s. net.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1916 Specifications.

152,153 Brantom, Bitton, Dransfield & Boyce. Apparatus for use in connection with telegraphy and telephony, and in connection with the control of electrically actuated or controlled apparatus situated at a distance. (24/7/19.) (Cognate Application, 31,511/19.)

Comprises the combination with a body of magnetic material constituting a make-and-break device in a secondary or receiving circuit and consisting of a group of magnetic diaphragms or the like, all having the same natural frequency of vibration and assembled face to face, but spaced far enough apart to permit of their free vibration, of means to produce a varying magnetic field in the neighbourhood of the said diaphragms to cause them to vibrate so that when they vibrate in synchronism with the magnetic field they control the said secondary or receiving circuit.

152,155 Cole. Electric switch lock. (24/7/19.)
152,157 B. T.-H. Co. (G. E. Co.) Induction electric furnaces. (8/8/19.)
152,162 Hill. Electric-heaters. (12/8/19.)
152,176 Heyen. Electric-arc furnaces. (30/8/19.)
152,190 Smart & Tucker. Telegraphic recorders, relays, telephonic receivers or the like (23/9/19).
152,210 Wilcox. Junction or like device for use in electrical wiring systems. (27/10/19)
152,216 Haddan. (Regan.) Electrically-controlled application valves for pneumatic brakes. (7/11/19.)
152,230 Merz & McLellan and Redman. Conductor rails for electric railways or the like. (24/11/19.)
152,234 Sargent. Electric lamp shade holder. (1/12/19.)

APPLICATIONS FOR PATENTS.

Jnue 12, 1920.

15,935 Taylor. Electrical transmission systems.
15,947 Schroeder. Transformers.
15,957 Rees. Tuning instruments for wireless telegraphy, &c.
15,986 B. T.-H. Co. & Jewett. Electric ship propulsion.
15,987 B. T.-H. Co. & Taylor. Electric machines.
16,003 British Insulated & Helsby Cables, Ltd., & Bolton. Multiple twin cables.

June 14, 1920.

16,034 Ateliers de Constructions Electriques du Nord et de l'Est. Arrangement for coupling alternating-current systems in parallel. (22/1/14, France.)
16,049 Edison Swan Electric Co. & Wrightson. Intercommunication telephones.
16,050 Edison Swan Electric Co. & Wrightson. Switch devices for telephones.
16,051 Edison Swan Electric Co. & Wrightson. Telephone apparatus.
16,064 Siemens-Schuckertwerke. Production of unidirectional voltages from alternating voltage. (15/5/18, Germany.)
16,066 Siemens & Halske A.G. Reduction of inductive effect of telegraph currents. (27/9/18, Germany.)
16,094 Marconi's Wireless Telegraph Co. Vacuum tube apparatus. (14/6/19, U.S.)
16,095 Marconi's Wireless Telegraph Co. Radio transmitters.
16,070 Western Electric Co. Telephone systems. (14/6/19, U.S.)
16,106 Mettalurgique Electrique. Suspension of electric traction wires. (19/2/14, France.)

June 15, 1920.

16,128 Griffin. Switches.
16,148 Goodman. Electrical energy distributing systems.
16,154 Western Electric Co. High frequency electric signalling systems.
16,164 Westinghouse Cooper-Hewitt Co. Vapour electric apparatus. (20/6/19, Switzerland.)
16,170 B.T.-H. Co. (G.E. Co.) Electrical distribution systems.
16,177 Macrorie. Transmitting and receiving circuits for wireless telegraphy and telephony.
16,183 Bellini. Apparatus for directed wireless telegraphy and telephony. (4/11/16, France.)

June 16, 1920.

16,232 Midland Electric Mfg. Co. Electric fuses.
16,257 Hosgood. Electric bed warmers, &c.
16,261 Breil. Electric fuses for explosives.
16,266 Western Electric Co. Signalling systems. (31/8/15, U.S.)
16,274 Automatic Telephone Mfg. Co., Mercer & Bates. Telephone systems.
16,294 Sokal. (Suftfahrzengbau Schutte Lanz.) Electric water heating.
16,310 Siemens Schuckertwerke. Suppression of sparking at interruption of conductors. (29/7/15, Germany.)
16,311 Siemens Schuckertwerke. Sparkless disconnection of conductors. (9/10/15, Germany.)
16,314 Akt.-Ges. Kummler & Matter. Electric heating elements. (16/6/19, Switzerland.)
16,328 Kimura. Slip rings for induction motors.

June 17, 1920.

16,369 Brecknell, Munro & Rogers & Willis. Bow current collectors in overhead wire systems of electric traction.
16,389 Aoyagi. Electro-metallurgical processes for making ductile bodies of high fusing metals, &c.
16,399 Alkan. Interrupter switch. (19/8/19, France.)
16,403 Meissner Inventions Corporation. Telephone transmitters. (23/6/19, U.S.)
16,404 de Forest. Electric signalling system. (13/3/20, U.S.)
16,407 Payne. Lamp-holders.
16,415 B.T.-H. Co. Generation of electrical oscillations.
16,430 Siemens & Halske A.G. Vacuum intensifier with glow cathode and auxiliary electrode. (31/5/16, Germany.)
16,431 Siemens & Halske A.G. Starting of electric arcs. (21/7/19, Germany.)
16,432 Siemens Schuckertwerke. Arc lamps for searchlights, &c. (20/8/17, Germany.)
16,433 Siemens Schuckertwerke. Vacuum rectifiers with rotating electric arc. (23/10/15, Germany.)
16,457 Stone & Co. Brush gear for electric machines. (16/2/17, U.S.)

June 18, 1920.

16,468 Oates. Automatic electrical magnetic cut-out.
16,499 Malermo & Raynaud. Electromechanical change-speed gear. (20/6/19, France.)
16,501 Siemens-Schuckertwerke. Alternating-current systems. (20/12/15, Germany.)
16,485 Booth. Controllers for multiple electric circuits.
16,514 Lazarus. Telephone instruments.
16,572 Igranic Electric Co. (Cutler-Hammer Mfg. Co.) Charging apparatus for storage batteries.
16,576 Forshu. Electrodes. (18/3/20, U.S.)
16,585 Taylor. Interrupting powerful currents.

June 19, 1920.

16,606 Radio Communication Co. & Lea. Production of electrical oscillations by thermionic valves.
16,618 Ohrstrom. Push-button switches.
16,630 Siemens-Schuckertwerke. Balancing device for commutators. (27/6/14, Germany.)
16,631 Siemens-Schuckertwerke. Electrical machines. (10/11/14, Germany.)
16,636 Lea. Electric cables.
16,632 Siemens-Schuckertwerke. Electric driving of ship propellers. (1/8/16, (Germany.)
16,633 Siemens-Schuckertwerke. Self-starting induction motor. ([illegible], Germany.)
16,642 Soc. Française Radio-Electrique. [illegible] comprising thermionic valves.

June 21, 1920.

16,650 Wallace. Automatic electrical adjusting device.
16,672 Stockwell. Method of [illegible] continuity between unscrewed tubes, &c.
16,680 Roe. Electric contact makers and [illegible] for railways, &c.
16,682 Roe. Electric contact breaker for railways.
16,692 Jacquot. Radio-telephony. (2/6/19, France.)
16,695 Street. Testing electric cables.
16,701 Skinningrove Iron Co. & Smith. Electrostatic plant for precipitating dust, &c., from gases.
16,705 Yellin. Support for telephone receivers.
16,726 Metallbank u. Metallurgische Ges. & Lilienfeld. Process for electrical gas purification. (8/8/18, Germany.)
16,736 Siemens & Halske A.G. Apparatus for registering rapidly varying pressures, &c. (23/5/18, Germany.)
16,745 Igranic Electric Co. (Cutler-Hammer Mfg. Co.) Lifting magnets.
16,747 Igranic Electric Co. (Cutler-Hammer Mfg. Co.) Electrical distribution and power transmission systems.
16,806 Austin Motor Co. Automatic switches for relay circuits, &c.
16,808 Walker. Automatic switches for relay circuits, &c.
16,818 Spreadbury. Two-way rectifying crystal receiver for radiotelegraphy.
16,834 Siemens-Schuckertwerke. Electric switches or [illegible]. ([illegible], Germany.)
16,835 Hollingsworth. Means for suspending electric lighting bowls.
16,838 Thomas. Electrical contacts of plug and socket type.
16,847 Gunn. Electric burglar alarms.
16,860 B.T.-H. Co. & Young. Magneto-electric machines.
16,862 Biro. Electric generating sets (3/2/19, Hungary.) 16888 Gerrard. Incandescent lamps for polyphase currents. (26/11/13, Belgium.)
16,918 Sullivan. Telegraph cables.
16,944 & 16,945 Metropolitan-Vickers Elec. Co. & Coates & Davies. Switchgear.

June 23, 1920.

16,950 Rowlands. Commutator for dynamos, &c.
16,977 White. Switches.
16,980 Latour. Two-phase high-frequency alternating-current generators.
16,999 Automatic Telephone Mfg. Co. & Newell. Controlling length of telephone conversations.
17,000 Automatic Telephone Mfg. Co., & Mercer & Savin. Telephone Systems.
17,003 Baissbarth. Switch. (31/1/19, Germany.)
17,005 Werner. Electromagnetic feeding devices for machine tools. (26/2/16, Germany.)

Companies' Reports, &c.

Major Ralph G. C. Glyn, M.P., and Mr. W. S. Eyre (of Grace Bros., Ltd.) have joined the board of the Still Engine Company, Ltd.

The accounts of the Constantinople Telephone Company for the period from Jan. 1, 1914, to Dec. 31, 1919, show a debit balance of £T55,594.

The Rees Roturbo Manufacturing Company, Ltd., has declared a dividend of 5 per cent. on the preference shares for the years 1912, 1913 and 1914.

The Globe Telegraph & Trust Company, Ltd., has declared a quarterly dividend of 3s. per share on the preference (less tax), and 5s. per share on the ordinary shares, payable Dec. 18.

The directors of Callender's Share & Investment Trust Company, Ltd., have declared a dividend of 4 per cent. (less tax) for the past half-year, making 8 per cent. for year. A sum of £500 has been placed to reserve, £741 written off preliminary expenses, and cost of debenture stock issue, and £6,218 carried forward

The profit of the Venezuela Telephone & Electrical Appliances Company, Ltd., for the year ended June 30, was £20,806, less £7,505 interest on debentures and loans, £1,620 income-tax, £488 excess profits duty, £350 corporation profits tax, leaving £10,841. After paying a dividend of 8 per cent. on the cumulative preference shares for year, and making provision for debenture sinking fund, &c., a sum of £2,667 has been carried forward. Demands of new subscribers necessitated capital expenditure of £15,156, making it impossible to pay a dividend on the ordinary shares.

Subscriptions are invited for £1,250,000 eight per cent. six-year notes at 98 per cent. by the English Electric Company, Ltd. The company owns the share capital of the Coventry Ordnance Works, Dick, Kerr & Company, the Phœnix Dynamo Manufacturing Company, the United Electric Car Company and Willans & Robinson. The company's position has been further strengthened through the acquisition of the well-equipped works at Stafford, formerly owned by Siemens Bros. Dynamo Works. The company has on hand uncompleted orders for over £5,000,000. The proceeds of the present issue will be used to replace expenditure incurred in the purchase of the Stafford Works and for other trade purposes.

The 20th and 22nd annual reports of Chadburn's (Ship) Telegraph Company, Ltd., have been issued. The former states that the credit balance for the year ended March 31, 1918, was £32,021, and after deducting managing directors' remuneration, directors' expenses, depreciation, &c. (£21,155) and adding £3,586 brought forward, the total was £14,452. After paying 6 per cent. on the preference and 8 per cent. on the ordinary shares, the balance of £6,052 was carried forward.

The 22nd report states that the annual general meeting will be held on the 7th inst., but owing to the exceptional circumstances prevailing, it is impossible to submit a balance sheet and profit and loss account for the year ended March 31 last. The directors recommend payment of a dividend of 6 per cent. on the ordinary shares, and the usual dividends on the preference shares, for the year.

New Companies.

HALSTEAD ELECTRIC SUPPLY COMPANY, LTD. (171,527).—Reg. Nov. 19. Capital £12,000 in £1 shares. To carry on at Halstead and elsewhere in Essex the business of an electric supply company and to adopt agreements with Mr. C. C. Pudney and Crompton & Company, Ltd. First directors are: R. E. Minter, S. Moger, C. C. Pudney and H. H. Portury, J.P. Secretary: R. Sargent.

HARRISON BROTHERS (ELECTRICAL ENGINEERS), LTD. (170,754).—Private company. Reg. Oct. 11. Capital £6,000 in £1 shares. To carry on the business of electrical, telephone, hydraulic and general engineers, &c. First directors are: A. Edwards (permanent) and A. Anderson. Solicitor: H. Outhwaite, Prudential-chambers, Middlesbrough.

HAWES ELECTRIC LIGHTING COMPANY, LTD. (170,842).—Reg. Oct. 15. Capital £3,000 in £1 shares. To carry on at Hawes (Yorks) the business of an electric light company, &c. Directors are: E. Allen, T. Allen, S. W. Bowness, G. Coates, J. A. Dinsdale, A. T. Iveson, W. T. Metcalfe and W. Raw. Secretary: H. F. Martland. Reg. office: Gayle Mill, Hawes, Yorks.

D. & J. HILL, LTD. (171,108.)—Private company, reg. Oct. 29, capital £3,000 in £1 shares (1,500 8 per cent. preference), to carry on the business of manufacturers of and dealers in appliances for the deaf, and of electrical, surgical and scientific apparatuss, &c. P. Skinner is permanent governing director. Reg. office, 267, Gray's Inn-road, W.C.1.

INDUSTRIAL ELECTRICAL, LTD. (171,507).—Private company, reg. Nov. 19. Capital £3,000 in £1 shares. To carry on the business of electricians, electrical engineers and manufacturers of and dealers in railway, tramway, electric, and other apparatus, &c. First directors are: H. J. Kennedy (permanent managing director and chairman) and S. Kennedy. Reg. office: 10, Southwark Bridge-road, S.E.

INSTITUTE OF PATENTEES (INCORPORATED).—(The word "Limited" is omitted from title by licence of Board of Trade).—(170,887). Reg. October 18, as a company limited by guarantee. The management is vested in a Council, the first members of which are: I. Darby, H. E. Dakin, Capt. E. T. Elias, A. G. Hardcastle, S. M. Johnson, M. Morgan and G. H. Skinner. Organising secretary: G. D. Coleman. Reg. office: 6, Holborn Viaduct, E.C.

LEES BROTHERS (HOVE), LTD. (170,847).—Private company. Reg. October 15. Capital £1,500 in £1 shares. To carry on the business of motor, electric and general engineers, &c., and to adopt an agreement with the Westbourne Motor and Engineering Company. First directors are: E. R. Lees and H. W. Lees. Reg. office: 10, Westbourne-place, Hove.

LOWTH & SMITH, LTD. (170,977.)—Private company, reg. Oct. 22, capital £5,000 in £10 shares, to take over the business carried on as Lowth & Smith, and to carry on the business of electrical and mechanical engineers, &c. Permanent directors are W. H. Lowth and T. Smith. Reg. office, 3, Hanging-ditch, Manchester.

NELSON ENGINEERING COMPANY, LTD. (170,500).—Private company. Reg. Sept. Capital £2,000 in £1 shares. To carry on the business of electrical and mechanical engineers, millwrights, &c. Directors: C. H. Kay (Secretary), C. E. A. Young, A. E. Adams, and A. Roberts. Reg. office: 13, Market-square, Nelson.

NORRIE, CLARK & COMPANY. LTD. (171,511).—Private company, reg. Nov. 19th. Capital £2,000 in £1 shares. To acquire business carried on by J. R. D. Norie and J. Clare as "Norie, Clare and Company," and to carry on the business of electrical, mechanical and general engineers, manufacturers of and dealers in motor accessories, &c. The permanent joint managing directors are: J. R. D. Norie and J. W. Clare. Reg. office: 7, Tottenham-street, Tottenham Court-road, W.1.

Forty Years Ago.

(THE ELECTRICIAN, DECEMBER 4, 1880.)

SWANSEA.—The Swansea Corporation are using the Gower-Bell loud-speaking telephone between their offices and their waterworks, a distance of about 14 miles.

THE CONGRESS OF ELECTRICIANS.—The several Governments of the States comprised within the Telegraphic Union have already received diplomatic invitations to take part in the Congress and Exhibition at Paris next year.—"Journal Telegraphique."

THE SOCIETY OF TELEGRAPH ENGINEERS.—The next meeting will be held at the Institution of Civil Engineers, 25, Great George-street, Westminster, S.W., on Wednesday, Dec. 8, when a Paper on "The Photophone and the Conversion of Radiant Energy into Sound" will be read by Mr. W. H. Preece, President.

AN IMPROVED TELEPHONE.—Mr. John P. M'Dermott, of Galveston, Texas, has patented an arrangement by which the telephone receivers are held, by means of a spring passing over the head, at each of the operator's ears, whilst the sending instrument is held by supports from the head-piece against the mouth. The whole gives the operator very much the appearance of being in harness.

HELENSBURGH.—Is the borough to supply gas? Not long since the resolution was favourable, now there is a little hesitation. The mover of the resolution has withdrawn his support. He believes the electric light is making great strides towards perfection—indeed, he thinks it may be the light of the future. Another gentleman, while desirous that the ratepayers should control the gas supply, was also troubled with the bugbear of the electric light. Why should they give £30,000 for gas works which in a few years might be useless? Why indeed?

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics."—"Air Mails and Airships"; "The Transverse Wiring of the Rigid Airship," by E. H. Newitt, B.Sc.; and "Atmospheric Data."

"Cabinet Maker."—"The Use of Glass in Furniture Manufacture"; "The Science and Art of Advertising"; and "Concerning the Nature of Material," by M. McLeish.

"Chemical Age."—"Direct Recovery of Sulphate of Ammonia," by G. H. Cheal; "British Chemical Glass Industry," by S. N. Jenkinson; and "The Dyestuffs Controversy."

"Farm and Home."—"The Historic Smithfield"; "Prominent Winners at Norwich Show" (illustrated); and "Championship Winners at Smithfield."

"Fruit-Grower."—"Developments at Rothamsted Station"; "The Agriculture Bill"; and "Marketing of Fruit," by E. L. Vinden.

"Hardware Trade Journal."—"Hardware in the Making (II.): The Manufacture of Scissors"; "A Classification of Sheet Steel Enamels"; and "The Mass Production of Hardware."

"Gardening Illustrated."—"Flowers and Flowering Shrubs in Winter"; "Growing Ferns in Pots"; and "Bulb Growing in the Home."

"Gas World."—"The Construction and Fixing of Gas Furnaces"; "The Performance of the Hot-plates of Gas Cookers"; and "A Special By-Product Coking Section."

"Transport World."—First issue, Jan. 5, 1921.

Arrangements for the Week.

FRIDAY, December 3rd.

INSTITUTION OF MECHANICAL ENGINEERS

6 p.m. At Storey's Gate, London, S.W. Paper on "The Human Factor in Industry," by Mr. A. Ramsay. Adjourned Discussion.

INSTITUTION OF ELECTRICAL ENGINEERS.—STUDENTS' SECTION.

6.30 p.m. At King's College, Strand, London, W.C. Discussion on "The Modern Tendency to Trusts. Is it Beneficial?" opened by Mr. A. Serner.

JUNIOR INSTITUTION OF ENGINEERS.

8 p.m. At Caxton Hall, London, S.W. Lecturette on "Electrolysis as Applied to the Measurement of Water," by Mr. G. F. Shotter.

TUESDAY, December 7th.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.

4 p.m. At Queen's-chambers, 5, John Dalton-street, Manchester. Paper on "The Organisation of a Coal Research Association," by Messrs. R. A. Burrows and F. S. Sinnatt.

INSTITUTION OF ELECTRICAL ENGINEERS.—NORTH-WESTERN CENTRE.

7 p.m. At the Engineers' Club, 17, Albert-square, Manchester. Discussion of Report on the Heating of Buried Cables.

WEDNESDAY, December 8th.

ASSOCIATION OF ENGINEERS-IN-CHARGE.

7.30 p.m. At St. Bride's Institute, Fleet-street, E.C. Informal talk by Mr. W. H. Patchell relating to his American tour.

THURSDAY, December 9th.

INSTITUTION OF ELECTRICAL ENGINEERS.

6 p.m. At the Institution of Civil Engineers, Great George-street, London, S.W. Adjourned discussion on "The Distribution of Electricity," by Mr. W. B. Woodhouse, and "Some Economic Aspects of E.H.T. Distribution by Underground Cables," by Mr. R. O. Kapp.

FRIDAY, December 10th.

INSTITUTION OF ELECTRICAL ENGINEERS.—SCOTTISH CENTRE STUDENTS' SECTION.

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "Static Transformers," by Mr. R. Dickson.

PHYSICAL SOCIETY.

5 p.m. At the Imperial College of Science, S. Kensington, London, S.W. Papers on "Some Slide Rule Improvements," by Mr. J. St. Vincent Pletts; "Absorption of Gases in the Electric Discharge Tube," by Mr. F. H. Newman; "A Sodium Vapour Electric Discharge Tube," by Mr. F. H. Newman; and "The Current Density in the Crater of the Carbon Arc," by Mr. N. A. Allen.

SATURDAY, December 11th.

INSTITUTION OF ELECTRICAL ENGINEERS.—SCOTTISH CENTRE.

7.30 p.m. At the Institution of Engineers and Shipbuilders, Glasgow. Smoking Concert.

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Notes.

The E.P.E.A. Dispute.

SECRET diplomacy has for the past fortnight enveloped the negotiations in the E.P.E.A. dispute. It, however, appears that the Association have at last modified their "thorough" policy in so far that should any stoppage unfortunately take place it will be confined to those undertakings who have either definitely refused the agreed increases or have failed, by putting forward reservations or by not replying to correspondence, to make clear exactly what their position is. We are glad that this change of heart has taken place. For the E.P.E.A have a good case, and had they insisted on a national stoppage it is not unlikely that their demands would have been universally acceded. But they would have suffered in public opinion. If local stoppages should unfortunately be considered necessary they will lose a certain power in enforcing their demands, it is true, but we feel sure that they will not detract from the support which is now being generally given them by the electrical industry.

The Localisation of the Dispute.

IT is interesting to note that should the strike take place it will be confined to London, Lancashire and Scotland, and would cut off only 30 per cent. of the power now being supplied. For 101 undertakings have accepted the recommendations of the National Joint Board in their entirety, about 20 have accepted with reservations, 28 have declined to have anything to do with them, and 90 have not answered Ald. WALKER's letter. The three groups of recalcitrants include most of the London companies, who question the competence of the Board—(this is rather like objecting to the type of fire engine in use when the conflagration is well alight)—and the Provincial Electric Supply group, who contend that they cannot pay higher wages, unless they are allowed to charge more for energy. In all the undertakings except the 101 that have accepted the scheme in its entirety, and these include most of the largest undertakings in the country, a strike will take place next week unless an agreement can be come to. This can mean nothing else than a closing down of the undertakings affected with results obvious to all. This matter is important to both engineers and the public, and we hope that the negotiations which are now taking place will be brought to a satisfactory conclusion.

Wireless Progress.

THE address which Dr. ECCLES recently delivered to the Wireless Section of the Institution of Electrical Engineers forms a much-needed contribution to the literature of radio science. There are now so many wireless investigators working eagerly over so wide a field and the variety of problems is so great that no sooner is one problem elucidated than another is waiting to be taken up. This state of things has its disadvantages. There is insufficient consideration by independent expert observers of what has been done, not enough sifting of the results, and an almost entire lack of useful deduction and ordered criticism. To adopt an agricultural metaphor the ground is turned over, but not properly ploughed. This rapidity of advance and absence of criticism grew to its height during the war period for obvious reasons, but the time has now come when we must have a thorough stocktaking to find out exactly how we stand. The task is made easier, as Dr. ECCLES pointed out, by the excellent series of Papers which have been read at the meetings of the Wireless Section during the last two sessions.

How Do We Stand?

How do we stand? The introduction of the triode has almost revolutionised both wireless transmission and reception, and has opened up an immense field for the measurement of its qualities and characteristics, so that a proper theory may be built up. We want to know more about the voltage factor, about the relationships of the filament and grid, about the maintenance of constant wave length and about tuning and methods for energy saving generally. Directive reception is a matter about which we know a little practically, but hardly anything theoretically. Yet it is a subject upon which a full knowledge of which much future progress must depend, and to the theoretical worker it offers a series of most suggestive problems. In all these matters Dr. ECCLES' address provides a convenient dividing line. It shows what has been done and what should be done in the future. It is the fashion to sneer at signposts, but there are the two duties which they are designed to perform, and they are not the less useful because they generally perform them efficiently. And as a signpost Dr. ECCLES' address is distinctly useful.

The Severn Barrage Scheme.

The seismological disturbances caused by the Ministry of Transport's Severn Barrage scheme are still having their effects on recording instruments of various qualities and sensitiveness. A secondary disturbance from the Ministry is partly responsible for this. This document permits us to know some of the electrical engineering details of this formidable project. Mixed flow turbines are to be used to obtain the maximum overall efficiency, the generators being driven through helical gearing. It is rather astonishing to learn that "a direct current dynamo of special design with vertical axis" is to be used. This is evidently the Thury system raising its head again, and it would be interesting to know exactly what considerations led those responsible to adopt this arrangement. We are further told that the 1,300 kw. machines with a constant voltage of 525 volts are to be employed. The floor space required will therefore be considerable. Rotary convertors will transform this current to alternating current at 330 and transformers step it up to 6,000 volts for transmission. Probably this scheme has been decided upon after due consideration, but is obvious it is not going to make the capital account any less heavy, especially as the units being so small will have to be very numerous. It is interesting to note, as pointed out by Mr. S. E. Brittain in our correspondence columns, that the proposed installation closely follows that already successfully in use at Chester.

Transmission Details.

The pumping motors for the subsidiary power-house are apparently to have an aggregate capacity of no less than 13,000 kw. Ninety per cent. of these motors will be of the induction type and the remainder of the synchronous type, to allow of power factor correction. We are now permitted to know that the transmission line conveying 500,000 kw. at 120,000 volts to London (115 miles) with a 10 per cent. loss will cost approximately £1,250,000, and will only, it is said, add a fraction to the generating costs, though that is an intelligent anticipation which may or may not be fulfilled. To this sum must, of course, be added the cost of the transmission lines to South Wales (50 miles), Birmingham (70 miles), and Stoke-on-Trent (100 miles), which are also proposed as parts of the scheme. The latter arrangements will, it is said, obviate the erection of steam power stations in a district where little condensing water is available, and working the Severn scheme in conjunction with the existing steam stations would raise the load factor of the latter to 70 or 80 per cent.

Finance Still the Bogey.

These technical details, which it is curious to note have been issued "unofficially," have the advantage of making the electrical position clearer. The civil engineering features of the scheme are, however, still camouflaged, and as the capital spent on these will not be directly productive, the relation of these amounts to that spent on the productive electricity scheme is therefore of interest. The price at which electricity can be supplied economically must depend on the capital cost of the scheme. Is that capital cost merely to include what is spent on the electrical portion of the undertaking or is it also to comprise the cost of the bridges, the roads and the docks? It will make all the difference to the financial success or failure. We regret, therefore, that we cannot share the general enthusiasm which has been shown towards the Ministry of Transport's ideas, the more so as we wish to see the development of electricity supply carried through to the greatest possible extent. But there is a right way and a wrong way of doing most things, and from past experience the Ministry of Transport seems to be unfailingly accurate in choosing the wrong way. We want no Sloughs and Beachleys in the electrical industry.

Misleading Trade Names.

A dispute about the sale of some electric lamps, though it recently caused amusement at the Shoreditch County Court, reflects little credit upon the business capacity and technical skill of one or two of the parties concerned. We are not surprised that ambiguous, if not misleading, terms used in business transaction, sometimes lead to misunderstandings and litigation, but a combination of these with the employment of an unskilled salesman who is expected to use these terms is certain to cause trouble. In the present case a firm of electric lamp manufacturers received an order for gasfilled lamps through a salesman "who did a little travelling in lamps," and, as might be expected, the result was a visit to the County Court by the sellers and buyers. The buyers alleged that they bought gasfilled lamps taking half a watt per candle-power, and counter-claimed for misrepresentation; but the sellers maintained that they had only sold half-watt *type* lamps. In the course of his evidence the plaintiff's salesman provided the comic element necessary to all drama by admitting that he did not even know what a half-watt was. The judge ultimately found that there was no misrepresentation, that the defendants should have returned the lamps if they were dissatisfied with them, and gave judgment for the plaintiffs. The moral of it all is to employ trained salesmen, use unambiguous terms, and thus avoid litigation. The situation is not made the less Gilbertian by the fact that there is no such thing as a half-watt lamp in the plaintiffs' meaning of the term.

Some Legal Points.

From a perusal of the evidence we have gained the impression that the case is one in which the well-known rule of *caveat emptor* applies. Both parties must be presumed to be skilled men; they were either manufacturers of or dealers in electrical supplies, then how could it be alleged that one was relying upon the skill of the other? They were bargaining about an article in common use in the electrical industry and the buyer should have protected himself by a careful examination and by insisting upon getting an express and definite warranty at the time of the sale. When there is any doubt about the capacity or performance of a lamp or a piece of apparatus this is the safest course to adopt, and in order to succeed upon a warranty it must have been made at the actual time of the sale. As the judge found there was no misrepresentation, and as the defendants retained the lamps for investigation purposes, instead of returning them, we are not surprised that judgment was given against them.

Joint Electricity Authorities.

The movement towards the formation of Joint Electricity Authorities in those areas which have been provisionally determined by the Electricity Commissioners is now becoming a little more rapid, though the progress is disappointingly slow. In the single case, that of the Severn Valley area, where a definite scheme has been submitted, we have seen that the obstacles created by the petty parochialism of a Corporation have been successful in maintaining the old order for the present, though not, we hope, permanently. There is evidence, however, that in the majority of the areas schemes for the reorganisation of electricity supply and for the creation of Joint Authorities are under serious consideration. Last week we were able to give the general outlines of a scheme proposed by the London County Council for the important and complicated Greater London area, and this week we learn that the Chester Corporation has not only prepared but has submitted a scheme to the Commissioners for the establishment of a Joint Authority for the North Wales and Chester District. The City Council intended to prepare the scheme in consultation with all the local authorities and undertakers concerned, but the necessity for completing it before November 30th, the appointed day for the submission of schemes, rendered such a course impracticable. However, the Chester Council intend at an early date to call a conference to discuss their proposals, and they have suggested to the Commissioners that they should appoint someone, if possible one of their number, to preside over the conference. The suggestion to have an impartial chairman, not connected with local affairs, is a good one, and will tend to aloofness in the discussion of the details of a scheme which, however excellent it may be, may arouse suspicion because it has been prepared by the largest municipal electricity undertaking in the district.

The Chester Proposals.

Though the Chester scheme has not yet been published and we therefore cannot give details we learn that it includes a definite proposal for the constitution of a Joint Electricity Authority for the whole of the area as defined by the Commissioners. It provides for the proper representation of the various interests affected and it lays down rules for the administration and working of the authority. At present there are 20 municipal authorities and companies supplying in the North Wales area, but it is proposed to discard the great majority of these when a bulk supply is available, retaining only four hydro-electric stations. It is further proposed to erect a steam power station at Chester, with a capacity of 150,000kw., and the water power resources, capable of providing 200,000,000 units per annum, will be utilised as required. Therefore, as the demand increases it will be necessary to construct additional water power stations. The system of supply proposed is 3-phase, 50 periods, at 60,000 and 33,000 volts by main overhead transmission lines of 0·1 sq. inch and 0·2 sq. inch section and local secondary transmission on the 3-phase systems 50 periods and 6,600 volts. We shall look forward with interest to the outcome of the conference, for it is becoming more and more clear that what is wanted in electricity supply at the moment, as in other branches of human activity, is a clear and definite lead. There is always a complacent majority. There is always a fractious minority. But yeast to turn them into something useful is too often lacking.

Wireless Problem.

In spite of the extraordinary theoretical and practical developments that have taken place in wireless telegraphy during recent years it would hardly be going too far to say that it has not become a branch of engineering. Like all other movements of a similar kind its growth began in the laboratory, and although it has now become an important factor in international communication it has not altogether freed itself from the trammels of its early surroundings. Much of the apparatus is too "scientific" in design and construction, it fulfils few of the laws imposed on engineering mechanisms, it is often makeshift when it might be permanent, it is indeed a bit too Heath Robinsonian to last. These are all matters to which attention must be given in wireless work, the more so as they have, in mast design and construction, an excellent example of the application of true engineering methods to what is a very difficult problem.

All may be Well that Ends Well.

The old text connecting what a man sows with what he reaps is peculiarly applicable to an agreement entered into some years ago between the Carmarthen Electric Supply Company, Ltd., and the Corporation of that town, and, as the harvest is a more than usually bad one, the company are to be congratulated on not having to conduct the gathering to the bitter end. For in the days when it was considered that any movement in the price of electricity would be down rather than up, the company entered into an agreement with the Corporation not to charge their consumers more than a certain price per unit. This maximum, considered in the light of present conditions, is, however, ruinously low, and the company, therefore, took their courage in both hands and put their prices up to the figures permitted by the Electricity Commissioners, the agreement notwithstanding. Naturally the Corporation objected, and, being among other things Welsh, went to law to enforce their presumed rights. But while the County Court gave a decision in their favour, the Court of Appeal upheld the company, their view being that the Corporation had no trust towards their individual purchasers which empowered them to make such agreements, and that when the company charged the consumer a price which was enforceable by statute, the consumer could not set up a plea based on an agreement to which he was not a party. If there are any other supply companies which have entered into similar agreements, they should thank the Carmarthen Electric Supply Company for their public-spirited action in this matter unless, or until, the decision is reversed by the House of Lords.

1921 Private Bills.

Judging by the list of notices given on another page of this issue, the Private Bill Legislation work of the 1921 Session of Parliament will be comparatively light. Neither in numbers nor in importance do the Bills promise to be up to the average pre-war year. So far as Electricity Supply and Traction are concerned twenty-three Bills are being promoted, but only three of them relate to new schemes, the remainder being omnibus measures containing clauses for supplementary powers.

There are three reasons for this paucity of interesting projects: In the first place, the Electricity (Supply) Act, 1919, substituted Special Orders for the old Provisional Orders, and as these can now be applied for at any time there are no Special Orders to swell the list on this occasion. In the second place, the position in regard to the formation of Joint Electricity authorities is not yet very clear, and many of the Urban and Rural Councils hope to be able to obtain a supply of electricity through these authorities, without going to the expense of acquiring Special Orders. In the third place, the final report of the Water Power Resources Committee has not yet been published, and as there is a feeling of uncertainty, in view of the promised Government legislation on water power, some promising hydro-electric projects have been hung up until the position is clearer.

New Powers Required.

It is, however, a striking commentary upon the piecemeal and inadequate character of the legislation connected with electricity supply and tramways that it is necessary for so many local authorities to go to the expense and trouble of promoting Bills to obtain adequate powers to carry on their undertakings on modern business lines. There are five principal Acts governing electricity supply in this country, one of which was only passed last year, and yet year after year Parliament is asked to grant some additional authority to anything up to fifteen or twenty electricity undertakings.

A Galaxy of Wants.

But if we look at the character of the powers demanded it cannot be denied that the majority of them are essential for the requirements of an up-to-date electricity supply authority. For instance, on this occasion four wish to be able to provide and maintain show-rooms, to give exhibitions of electrical appliances and to promote the use of electricity by advertising or otherwise; four want to make a special charge to "stand-by" consumers, *i.e.*, those with independent plants who only desire to take energy in cases of emergency; and in four additional instances authority is sought to increase the maximum price charged for electric current. There are also four authorities who desire to be able to refuse a supply to persons in debt for electricity or gas already consumed, and to cut off supply from those who use electricity contrary to the terms of their agreements. Four others wish to lay mains in private streets; three require additional powers of entry into premises to ascertain the amount of energy consumed, or to remove fittings, &c. Nelson Corporation also seek authority to provide, *sell*, let for hire, fix and maintain motors, lamps and electrical fittings; Burnley Corporation wish to obtain additional borrowing powers, including the suspension of payments to the sinking fund; and Liverpool Corporation are anxious to be empowered to make by-laws as to wires, apparatus and fittings, to require notice of the discontinuance of supply, and to be able to recover charges for re-connection, &c. It all shows a commendable desire to push electricity supply, but we wish it could be done in some cheaper and simpler way.

Necessity for New Powers.

For anyone who is acquainted with the business of electricity supply will agree that, with two or three exceptions, the powers enumerated above are necessary for the proper conduct of an undertaking. In fact, many supply authorities already possess and use them with great advantage. For instance, there are an increasing number of local authorities who maintain showrooms, let motors and fittings on hire, and they have by these methods provided an excellent means of advertising the uses of electricity for power and domestic purposes. If, therefore, the powers are useful for some undertakings, why not place all authorities on an equal footing and enable each and all to develop their electricity undertakings on the most modern lines to the utmost advantage for the general good of the community? Private Bill legislation is an expensive luxury and we think the Electricity Commissioners would do the industry a very good turn if they prepared a few clauses dealing with these special powers and inserted them in the Electricity Supply Bill which it is proposed to pass in order to supplement last year's Act. Alternatively, a clause might be inserted in the Bill giving the Commissioners power to grant such power as occasion required. In this way the powers of supply authorities would be standardised, and the expense and trouble of promoting special Bills obviated.

Scottish Hydro-Electric Schemes.

The only new project of the Session is the Provisional Order promoted by a syndicate under the Private Legislation Procedure (Scotland) Act, of 1899, for the incorporation of a company for utilising the water-power in the Perthshire Highlands for generating electric power. The water powers to be developed are those of the Lochs Ericht and Garry and certain streams including the Truim, Bruar Water, Banavie Burn and the Tarf Water. Several reservoirs and other works are to be constructed, and the company seek power to supply and distribute electricity in the counties of Perth, Kinross and Forfar, and in parts of Inverness, Argyll and Stirlingshire. It will be noticed that the water power of Lochs Rannoch and Tummel, which formed part of last year's comprehensive project of the Dundee Corporation, are not included in the scheme. It is, however, an interesting enterprise and we hope the promoters will be successful in obtaining their Provisional Order. If so, there is no reason why they should not establish a successful undertaking in the Highlands. Already Dundee Corporation and other local authorities are contemplating taking supplies of electricity in bulk from them. Electrical energy may also be required for electric traction, for agricultural and industrial purposes, so that the company would start out with a fair prospect of success in a district where electricity has not hitherto been used to any considerable extent.

The British Aluminium Company seek additional powers, including the right to develop the water power of Lochaber, and the Town Councils of Airdrie and Coatbridge are applying for a Provisional Order to constitute a Tramway Trust, and for vesting in the Trust the undertaking of the Airdrie and Coatbridge Tramways Company.

London Projects.

The County of London Electric Supply Company want to revise and amplify the powers granted in 1918 for the erection of a generating station in Barking, and the Bill for the construction of a deep-water wharf and railways in Canvey Island will be introduced again next year.

Traction Bills.

There is also only one Traction Bill relating to a new project, viz., that of the Durham County Council, who are promoting an ambitious scheme for the construction and working of several tramway and trolley vehicle routes in the county and for working motor omnibuses, &c. Already many of the local authorities affected have decided to oppose the Bill, and it is doubtful if it will survive the serious opposition it will encounter.

Miscellaneous Powers.

A sign of the trend of events is the number of Bills which confer powers to run motor omnibuses as auxiliaries to tramways. There are nine of these measures, but there are also five which confer authority to run trolley vehicles. Of late there has been a revival of faith in this form of traction. The war, it is true, interfered with its development and tramway managers are watching with keen interest the results of the experiments which are being made at Bradford and other places in Yorkshire to popularise its use. Four Bills confer powers to construct new tramway lines, including in one case authority to construct the track on land other than the highway, as suggested by Mr. John Brodie, and two Bills will enable trailer cars to be employed.

Dormant Powers.

Though the number of original projects is disappointingly small, it must be remembered that there are a great number of undeveloped Provisional Orders and Acts from pre-war days, and there is, therefore, no fear of a slump in orders for electric generating plant from lack of new schemes. Extensions of existing stations, the relaying of tramway tracks and the modernisation of rolling stock, &c., apart from export orders, would be sufficient to keep electrical manufacturers busy for a long time to come. As the Joint Electricity Authorities are formed, however, and when a start is made with the electrification of the railways, further demands will be made on the capacity of their factories. In fact, it may truly be said that the only thing that will bring about a slump will be the attitude of labour. The excessive demands of the workers for higher wages and shorter hours, the fear of strikes, &c., have created such a feeling of doubt and uncertainty, especially in connection with the undertaking of big contracts, that many valuable foreign orders have already been lost to this country. However, given moderately stable labour conditions and goodwill between employers and employed the electrical industry need have no fear of lack of orders or of want of employment for years to come.

Omar Khayyam at Westminster.

With only three dissentients a largely attended, but not crowded, Special Meeting of the Institution of Electrical Engineers, on Thursday, December 2nd, passed a resolution increasing the subscriptions of the various classes of members on lines which have already been published in The Electrician. Listening to the speeches both for and against the proposal we were reminded of the oriental student who, having heard great argument from seers and philosophers, came out by the same door at which he had entered. But while it is true there was great peregrination on Thursday, a good deal of the ground covered was not of a simple character. If we may both modernise and adapt the tour which took place, it was more like that of a man who, visiting one of those two-storey maisonettes, which are to be found in the suburbs of large towns, enters by the front door of the lower flat, traverses every exiguous room in the crowded apartment, ascends by the service lift to the upper one, makes a similar tour of the rooms in that, and finally emerges at the adjacent front door to that by which he entered, having made a little real progress, but not much.

No Real Opposition.

For we are not exaggerating when we say that opposition in the true sense of the word there was none. Even the most hardened and diffuse critic that spoke admitted that if the Institution is to represent the electrical profession and industry in the way it should represent it then the subscriptions must be raised. The only difficulty in the minds of the doubters was how best to determine the exact amount of the increase and whether, if it were decided to make the increase less than the Council proposed, revenue and expenditure could be made to meet by saving on certain items of the present expenditure. The one exception to this rule was Mr. Joseph, who, in an almost tearful appeal *ad misericordiam*, pointed out that large numbers of members could afford no increase at all. There we think he was mistaken. Even if it be so, however, the Council are willing to consider individual cases for relief, and on the broader aspect of the question the time has surely come when the deduction of subscriptions to learned societies from taxable income should be pressed on the Government.

A Chinese Attack.

We are told that the ancient Chinese used to sally forth to meet their enemies disguised in horrible masks and making still more horrible noises. Mr. F. W. Purse, the leader of the "opposition" on Thursday, adopted the same policy. His criticism would have been more striking, however, if the President had not answered it in advance—a real but perhaps necessary unkindness. In great detail Mr. Purse exposed the hollowness of the estimates on which the suggested increases were based, advocated certain economies in expenditure, especially on that whipping boy, the "Journal," and wound up, when a reference back had been stated to be inadmissible, by suggesting a flat rate increase of twelve shillings and sixpence to the subscriptions now paid by each class of member. In cross-examination he admitted, however, that this increase would bring in *practically* the same amount of revenue as the Council's scheme, which might be accounted to him for righteousness, while it would have the undoubted disadvantage of throwing an increased burden on those least able to bear it, *i.e.*, the students and graduates, which is certainly not a policy that would receive general support. For, as Mr. Llewelyn Atkinson had previously pointed out, it is for every reason desirable to increase the flow of students into the Institution, and to do this the cold winds of finance must be tempered with discretion. But then discretion is not one of Mr. Purse's strong points.

The Institution and Finance.

Still dealing with this speaker, as in him was epitomised all the rest of the opposition, in a preliminary skirmish, Mr. F. W. Purse raised four objections to the procedure followed by the Council in bringing this matter before members, to two of which we may briefly refer. He said that the approval of the Territorial Centres to the proposals for increase had been greatly exaggerated. The answer to this surely is that if the opposition in the provinces was no greater than it was in London exaggeration is a mild term to apply to his own statement. It has been amply demonstrated that the large majority of members agree to higher subscriptions, not because they like paying more or because they wish to encourage spendthriftiness by the Council, but because without more money the Institution must decline in usefulness and prestige at the very time when an increase in those qualities is urgently necessary for the good of the electrical profession and industry.

A Genuine Criticism.

The other point Mr. Purse made was better conceived. He complained that the case for an increase in subscription had not been laid by the Council before the members in more detail. The official reply that it was all in the last Annual Report is not a full answer to this contention. This is a busy age and peptonisation of information is becoming a necessity, while to avoid the appearance of evil is as necessary to Councils as to private individuals. It may not have been possible to circulate to members beforehand the interesting figures given at the meeting, but something of the sort would have been very useful and would have stifled much of the undigested criticism which wasted the time of those present and with which the President might have dealt with a great deal less leniently than he did.

We might say a good deal about the other points that were raised in the course of the debate, but perhaps the kindest thing is to ignore them. Most of them were based on false information and the rest were merely captious. But one remark may be made. The Council need no longer deplore that they receive no constructive criticism; whether what they received was as sound as it was constructive is, however, open to question.

The Essentials of the Question.

The proceedings on Thursday night for a time tended to obscure the essentials of the question. But these were finally stated with admirable clearness by the President. "Is," he said, "the Institution to continue its great work? Is the present expenditure reasonable? Is the method of making the increases reasonable?" To these questions the meeting gave an overwhelming affirmative. We are sure they were right. The Institution has reached a turning point in its career. It can either go forward or go back. By their vote the other night the members showed that they wish it to go forward, and by their support of the Council endorsed the policy which is now being followed in a way that can be nothing less than gratifying to that body. With this assurance that the lines they have been following are generally acceptable, the Council are therefore relieved of one anxiety. But they are also invested with the fresh responsibility of ensuring the Institution shall worthily represent the electrical profession and industry. The virtue is in the word worthily. It is a great task and must be nobly undertaken not only by the Council, but also by the members.

Mathematical Analysis of the Mechanical Forces Acting on Switches and Busbars.

By L. B. W. JOLLEY. B.A. (Cantab.).

(*Concluded from page* 647.)

SAFE MAXIMUM FIGURES.

From Table II. it is at once manifest that values of the torque for low values of L are much too high and as in each case the values tend to a minimum, it is evident that in all cases figures will be obtained which are at least a safe maximum if the values of T for L infinite are found. If then in (3) L is put equal to infinity the exceedingly simple formula for the torque is found to be

$$T = 0{\cdot}187 \times 10^{-8} AI^2 \log \frac{A}{0{\cdot}53B}.$$

TABLE II.—*Formula* (3) "*Change of Energy*" *Method.*

B	L				
	5	10	20	30	40
1·0	38·5	32·0	30·0	29·5	29·5
0·5	44·0	36·5	35·0	34·5	34·2
0·25	50·0	43·5	41·5	40·7	40·6

The figures in the Table represent torque in lb. feet.

If values for B are inserted corresponding to $A = 12$, $I = 20{,}000$ and $B = 1{\cdot}0$, 0·5 and ·25. $T = 28$, 34·2 and 40·5 ft. lb., which compare favourably with those in the Table II above.

It is useful to draw a set of curves connecting T, A and B, and these are depicted in Fig. 3. From these curves it is at once apparent that the torque for a given current is (1) very much reduced with decreased values for A the blade length, and (2) is slightly reduced by increasing the blade width. It is certainly a consideration, for instance, to be able to reduce the torque from 28 ft. lb. to 16 ft. lb. by decreasing the blade length from 12 in. to 8 in. This is an important point to be considered in design. No curves have been plotted connecting torque and current, as this is obviously a parabolic relation, the torque varying as the square of the current. In practice, however, in large stations the short-circuit current is usually limited by reactances in circuit and if the voltage and the per centage reactance is settled the value of the current can be ascertained.

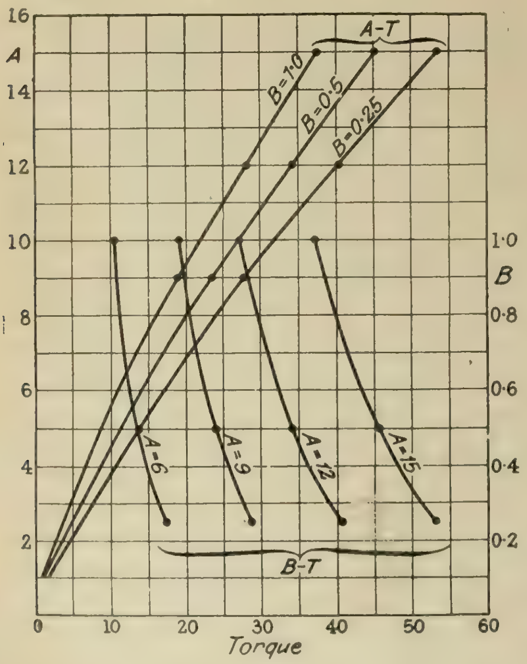


FIG. 3.

CALCULATIONS AND TESTS COMPARED.

It is interesting to compare the above calculations with the tests which have been made by Loebinstein, which are quoted in his original article in the "Electrical World" (*loc. cit.*):—

Mechanical torque required to open 600-ampere switch, 16·25 ft. lb.

Mechanical torque required to open 1,200-ampere switch, 32·5 ft. lb.

In the article quoted a curve is given (Fig. 4) connecting rated capacity in amperes of G.E. switches (America), and the maximum current in amperes permissible without the use of safety catches. The following values are obtained: 600-ampere switch, 15,000 amperes; 1,200-ampere switch, 20,000 amperes. If these switches are assumed to have a blade width of 1 in., *i.e.*, $B = 0{\cdot}5$, and the values of the torque are worked out for $I = 15{,}000$ and 20,000, the torque $= 19{\cdot}2$ ft. lb. for 15,000 amperes, and 34·2 ft. lb. for 20,000 amperes. These figures compare very favourably with the actual test figures of mechanical torque required to pull out the switch given by Loebinstein of 16·25 ft. lb. for the 600-ampere switch, and 32·5 ft. lb. for the 1,200-ampere switch, and hence if the G.E. curve for maximum permissible current flowing without the use of safety catches is assumed to have been calculated from actual results a very fair check is obtained on the application of the principle enunciated above.

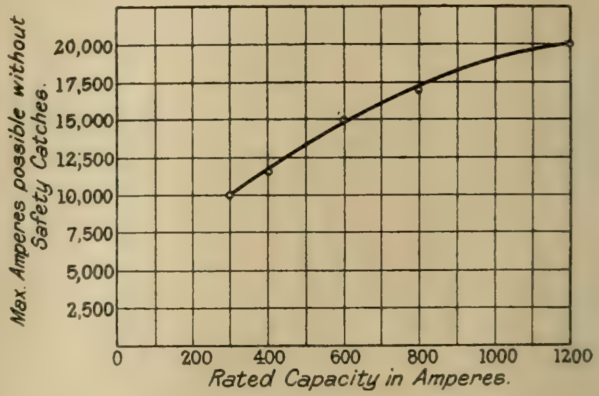


FIG. 4.

It should be stated that as the term I^2 appears in the formula the mechanical force is proportional to the average value of the instantaneous square of the currents and hence in this and all similar problems the R.M.S. value of the currents may be taken.

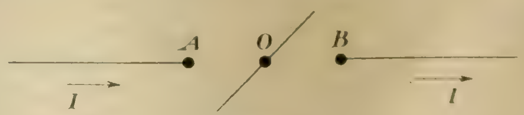


FIG. 5.

Before finally leaving this particular problem it is worth while mentioning that the form of rotary switch depicted in Fig. 5, the blade rotates about the point O and makes contact at A and B, entirely overcomes the difficulty of the switch opening itself on short circuit.

SHORT-CIRCUIT FORCES ON BUS BARS.

It is possible to proceed in similar fashion to that of the previous calculations to calculate mechanical forces on bus bars. Let the two bars be separated by a distance "r." The energy residing in the medium is: $\frac{1}{2}Li^2$

and the rate of change of energy is

$$\frac{1}{2}\frac{dx}{dr}i^2.$$

In Liven's "Electricity," p. 387, the inductance of two long parallel wires where current is flowing in opposite directions is given as

$$x=2l\left(\log\frac{r^2}{ab}+\tfrac{1}{2}\right)$$

$$\frac{dx}{dr}=\frac{4l}{r}.$$

A formula is given in Nottage's "Calculation of Inductance and Capacity," p. 12, for the inductance of two wires carrying alternating current of low frequency as

$$x=4l\left(\log\frac{d}{r}-\frac{d}{l}+y\right).$$

The term $\left(\frac{d}{l}+y\right)$ reduces to $\frac{1}{4}$, and the formula becomes

$$x=4l\left(\log\frac{d}{r}+\tfrac{1}{4}\right)$$

$$\frac{dx}{dr}=\frac{4l}{r},$$

which is the same result as obtained from Liven's formula. Hence the force

$$F=\frac{2I^2l}{r}\text{ C.G.S. units.}$$

If "l" is in feet, "r" in inches and I is in amperes

$$F=5{\cdot}4\times10^{-7}\frac{lI^2}{r}\text{ lb.}$$

According to Nottage, this formula applies to direct and alternating single-phase problems.

THREE-PHASE BUS BARS.

Let us consider the case of three-phase bars each spaced "r" apart, and ascertain the force in the two following cases: (1) The short-circuit current which preserves its phase relationship in each phase; and (2) assume that the phase relationship is destroyed and the maximum current is flowing from phases (2) and (3) to (1).

As regards (1), the three currents are

$$i_1=I_M\sin\omega t,$$

$$i_2=I_M\sin\left(\omega t+\frac{2\pi}{3}\right),$$

$$i_3=I_M\sin\left(\omega t+\frac{4\pi}{3}\right),$$

where I_M is the peak value of the current.

The forces per unit length of bars 2 and 3 on bar 1 are

$$\frac{2i_1i_2}{r}\text{ and }\frac{2i_1i_3}{2r},$$

and the total force due to the instantaneous currents is

$$\frac{2}{r}\left(i_1i_2+\tfrac{1}{2}i_1i_3\right).$$

Now, the force exerted on the bar (1) will follow the instantaneous value of the current flowing in the bars, and will be the compounded force of each force due to each phase.

The average force is therefore

$$\frac{\omega}{2\pi}\cdot\frac{2I_M{}^2}{r}\int_0^{\frac{2\pi}{\omega}}\sin\omega t\left\{\sin\left(\omega t+\frac{2\pi}{3}\right)+\sin\left(\omega t+\frac{4\pi}{3}\right)\right\}d(\omega t).$$

This reduces to

$$F=\tfrac{3}{4}\cdot\frac{I_M{}^2}{r}$$

$$=\frac{3}{2}\cdot\frac{I^2}{r}\text{ C.G.S. units per unit length,}$$

where I is the root mean square value of the current.

If the instantaneous values of the currents in 1, 2 and 3 are plotted, it will be seen that when the currents in 1 and 2 are positive, and approaching their maximum values, there is a large negative current in 3, and similarly when 2 and 3 are approaching their positive maximum there is a large negative current in 1. Hence the force on 2 is compounded, firstly, of an attraction to 1 and a repulsion by 3, and later by an attraction to 3 and a repulsion by 1. If this force is calculated it will be found to oscillate with a frequency twice that of the supply, but if this value is integrated over a cycle it will be found to be zero.

As regards (2), if the short-circuit does not preserve its phase relationship, the total force exerted is obviously

$$\frac{2I^2}{r}+\frac{2I^2}{2r}=\frac{3I^2}{r}.$$

It is believed that it is generally admitted that this latter condition rarely if ever exists, and the force may, therefore, be taken as

$$\frac{3}{2}\cdot\frac{I^2}{r}$$

for all cases of three-phase circuits where the bus bars are in the same straight line.

Hence $$F=\frac{4{\cdot}05\times10^{-7}I^2}{r}\text{ lbs. per foot run,}$$

where I is in amperes and r is in inches in the case of three-phase circuits.

As an illustration of the application of this formula to a three-phase set of bars supported by insulators cylindrical in shape and "d" inches in diameter, the force per insulator is $\frac{4{\cdot}05\times10^{-7}I^2l}{r}$, where the insulators are "l" feet apart.

If "p" is the maximum permissible stress in the porcelain, and "AG^2" is the moment of inertia of the insulator section, the bending moment at the base of the insulator is

$$2p\,.\,\frac{AG^2}{d}.$$

Now, the bending moment is also $\frac{4{\cdot}05\times10^{-7}lhI^2}{r}$, where "$h$" is the height of the support in inches above the base of the insulator, and hence

$$I^2=\frac{2p\,.\,AG^2r}{lhd\times4{\cdot}05\times10^{-7}}.$$

To take a practical example: $p=0{\cdot}435\times10^4$ lbs. per square inch for porcelain. $h=5$ in. (height of insulator). $d=3$ in. (diameter of insulator). $l=4$ ft. (distance apart of insulators).

$$AG^2=\frac{\pi d^2}{4}\cdot\frac{d^2}{16}=\frac{\pi d^4}{64},$$

$r=12$ in. (distance between bars).

The value for the current to cause a breakdown works out at 13,000 amperes. This, of course, takes no account of the fact that insulators are hollow and often corrugated, but is only given as an illustration of the use of the method.

It is hoped that the above calculation will serve a dual purpose: (1) To ensure a correct fundamental view of the method of dealing with problems of this nature; and (2) to present such a view in a practical form which will be of some slight assistance to designers of switchgear and station equipment, and which will enable them to feel some sort of security in installing equipment against the worst effects of short circuit.

CURRENT ON SHORT CIRCUIT.

When all of this, however, is taken into consideration, there still remains the very uncertain feature of the maximum current which will flow into a short, and practice in the United States has appeared to follow the lines of definitely limiting the current by reactors, &c., and then so to design the apparatus as to withstand all shock due to short-circuit. This appears to be essentially sound practice.

The effect of breaking short-circuit currents and the devices suitable for quenching the destructive arc may be dealt with in some later Paper, as a totally different problem is involved which is beyond the scope of the present article.

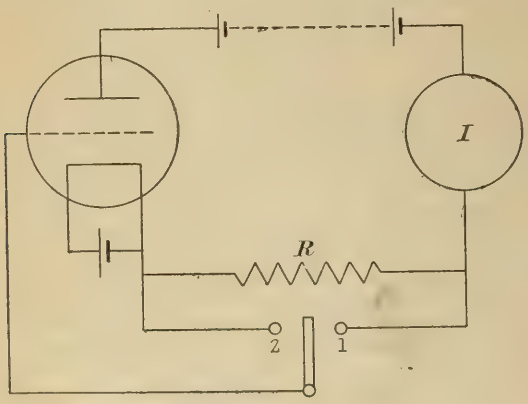
Dr. W. H. Eccles on Wireless Progress.*

In 1916 a movement was started for founding a professional society of wireless engineers on the lines of the American Institute of Radio Engineers, the lack of such an organisation in this country being very marked, especially as the progress of wireless service during the war was so great that all existing textbooks on the subject were out of date. The inauguration of such a society was beset with a number of financial difficulties, and when Mr. Wordingham, then President of the Institution of Electrical Engineers, suggested that the Institution should form a wireless section before which Papers might be read and discussed and subsequently printed in the Institution "Journal," the offer was accepted. The result has been the bringing into the "Journal" of many Papers which might otherwise never have reached it, and a considerable number of new members have been enrolled on the books of the Institution.

A WIRELESS STOCKTAKING.

During the last session the Committee of the Section endeavoured to secure that the principal advances made in wireless communication during the war should be described by the men who played so large a part in making them, and from the material thus collected a sort of stocktaking may be made and some of the more striking improvements achieved briefly set forth.

In 1913 the musical spark method of transmission was still in use at some of the largest stations in the world, with the arc, the timed spark and the various forms of alternator as formidable rivals. Signals from spark stations were received by crystal detectors, by Fleming valves or by audions with two electrodes and continuous wave signals by the ticker and the tone wheel. Continuous wave circuits did not show outstanding advantages over spark circuits, for the heterodyne method of reception was cumbersome in practice and lacked many of the features which have made modern methods so successful. While in spite of the apparatus of de Forest and Lieben Reiss there seemed no imminent likelihood of continuous wave telegraphy completely ousting the spark for long-range work. During 1913, however, the possibility of generating oscillations of very high frequency was realised and the heterodyne method of reception then sprang on to a different plane. For the three-electrode vacuum-tube aerial not only magnifies the signals at the same time as it generates the oscillations, but is so simple, perfect and manageable that it realises the highest ideals of the wireless engineer. Combined with its positive retro-action between the



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rent can be ascertained.

THE VOLTAGE FACTOR.

One of the first inquiries provoked by the study of this apparatus is in respect of such a fundamental parameter as the voltage factor, as in some modes of using the tube the value of the voltage factor is disappointing with certain adjustments. Fig. 1 shows the diagram of connections used in tests that have been taken with the anode connected in series with a battery E and instrument I, resistance R and the filament. The operation consists first in giving R any convenient value, say R_1, putting the grid circuit switch on the point marked 1, secondly in putting the switch to 2 and adjusting the resistance to bring the anode current to its previous value. If this second value of the resistance be R_2, then the voltage factor is $R_2 - R_1/R_1$. For equal measurements it is very convenient to make R equal 1,000. Thus the final reading of the resistance box minus 1,000 gives the voltage factor by the movement of the decimal point. The same method can be applied to the measurement of the internal resistance of the triode by keeping the switch on the point marked 2. All operations consist in first observing the current when $R=O$ and in then observing the changed value of the current when R is any convenient value. If S be the resistance of the shunt galvanometer, and i_1 and i_2 the observed currents, the internal resistance of the tube is $\frac{Ri_2}{i_1 - i_2} - S$. A quick way of using this method is to read R_1, take ten-elevenths of its value and adjust the resistance to bring the current reading to this value, then the internal resistance is 10 times the figure given by the resistance box. The results of measurements made by this method are shown in Fig. 2, in which the ordinates give the voltage factor and the abscissæ are the voltages of the battery permanently connected in the grid circuit. the filament current being constant.

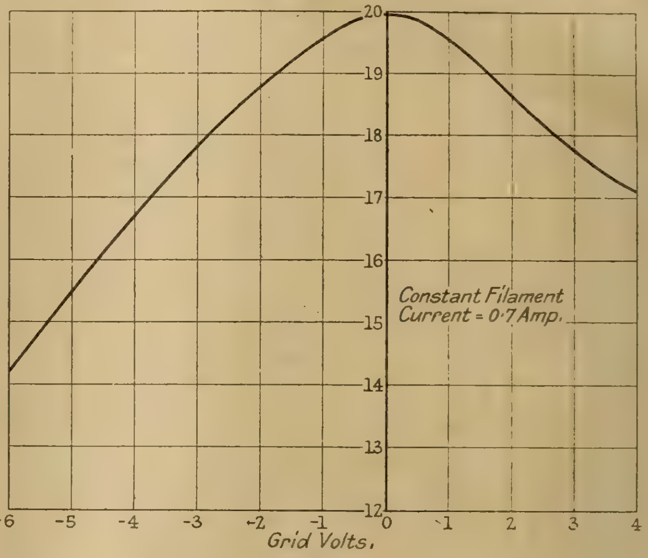

FIG. 2.

SOME ANOMALIES OF TRIODE WORKING.

It is found that the voltage factor undergoes great variation when tubes are used for magnifying rather larger changes of voltages than are applied to them in the bulk of wireless telegraph experiments. The reason for this variation is partly due to the unevenness of the temperature of the filament, but chiefly to the drop of voltage along the filament. This can be experimentally demonstrated by connecting the grid to the negative terminal of the filament, applying a rather large negative voltage and thus putting this end into action, with a consequent lowering of the voltage factor. By increasing the filament current the difference of potential between the grid and the positive end of the filament is increased and the voltage factor lowered, while if the filament current be considerably reduced the ends of the filament become saturated and the voltage factor again drops. These matters all lead to apparent anomalies when triodes are used for other purposes than the reception of faint wireless signals. It is possible that the changes usually occurring in the wave-lengths generated as the filament battery runs down owe their origin to the variations in the average value of the voltage factor, but by using the flat part of the curve the filament currents may be set so that this alteration will for a long time produce no change in the wave-length. The constancy of wave-length will become of growing importance as the world becomes crowded with wireless stations, and methods of transmitting within very narrow ranges of wave-length may have to be devised in combination with receiving antenna and apparatus with sharp tuning. The increased cost of low-resistance antenna and apparatus will have to be compared with a possible saving of energy and other advantages of precise tuning.

CHARACTERISTIC SURFACES OF THE TRIODE.

Among other insufficiently investigated properties of the triode are those associated with certain operations of the characteristic surfaces which may be used to represent all the principal properties of the tube. When the filament current and voltage are kept constant there remain four principal variables, the anode current i_a, the grid current i_g, the anode voltage e_a, and the grid voltage e_g. Fig. 3 shows three lines at right angles. The horizontal line marked l_a is the axis of the anode voltage, that marked l_g represents the grid voltage, while i represents either grid or anode current. Upon these axes we may erect surfaces to represent the current flowing in a triode for any assigned values of the two voltages and erecting at the points so determined a vertical with two ordinates equal to the observed currents. When this is done we obtained for the anode current a surface such as that shown in Fig. 4. Here the flat top represents the saturation values, the concave sloping surface at the right-hand side follows the three-halves power law, only a small part of this area on the extreme right hand being normally utilised. On the left hand, where the surface descends in a kind of cliff to the axis of the grid voltage, there is a little investigated region. The rapid rise of anode current and the accompanying fall of grid current in the region of low anode voltage requires an explanation.

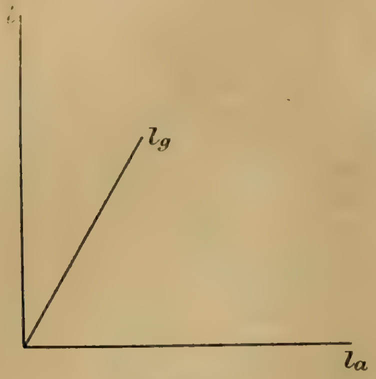

FIG 3.

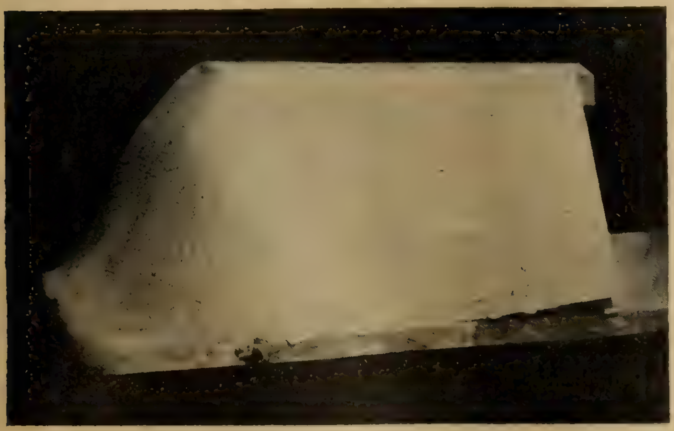

FIG. 4.

In Fig. 5 the diagram on the left indicates possible paths of electrons when the grid is slightly positive and the anode at zero voltage, A being the anode, G the grid wire in section, and F the cathode. It may be shown that the grid current has the value

$$i_g = A'(e_a + ve_g)^{\frac{3}{2}} \exp\{-\alpha\nu(e_a/e_g)\}$$

and the anode current is given by

$$\log(1 + i_a/i_g) = \alpha\nu(e_a/e_g)$$

at low voltages when ν is the voltage factor and A' and α are constants that are different for each tube. For ordinary reception triodes α has the value of approximately 1·3. From this it appears that the grid in a triode may exert two influences. That just described which is characterised by having the bulk of the grid current contributed by electrons that have been laterally reflected and the other which accelerates or decelerates the motion of the electrons from the cathode to the anode. The former "snatching" action is illustrated in the steep surfaces shown in Fig. 4. In Fig. 6 is shown the surface whose ordinates represent both the grid and anode currents of an ordinary form of triode. It will be noticed that the "snatching" action between the grid and the anode at low anode voltages produces a gully separating the two surfaces. Investigations into this gully and surrounding surface enable Fig. 7, which represents most of the properties of ordinary triodes, to be obtained. It will be noticed that in this case the gully in the previous figure takes a sharp turn and this section is a characteristic curve of the grid and anode currents as the grid voltage varies. It will also be seen that the anode current rises from zero to a maximum as the grid current voltage rises and remains nearly constant until the gully is reached, when it descends suddenly. During this descent the grid current rises and becomes greater than the anode current.

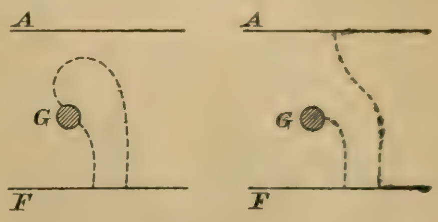

FIG. 5.

THE PROBLEMS OF DIRECTIVE RECEPTION.

The perfecting of high-power amplifiers has had the important result of making possible the directive reception of distant stations by small antenna. For instance, it has been possible to receive transatlantic signals in England with a small frame aerial a yard square and to determine its direction by rotating the frame about a vertical axis. False directions are, however, obtained during the sunrise and sunset periods, and it has been suggested that much of the directional error might arise from the rotation of the plane of polarisation of the signal-bearing waves by reflection at the non-level portion of the Heaviside layer between the sending and receiving stations. It has, moreover, been abundantly proved that rays bending round the globe follow a curved trajectory resembling that of a projectile. In the daytime these magnetic rays have their force horizontal, but if at night the plane of polarisation is rotated in any manner the apparent direction of the source of radiation would become erroneous.

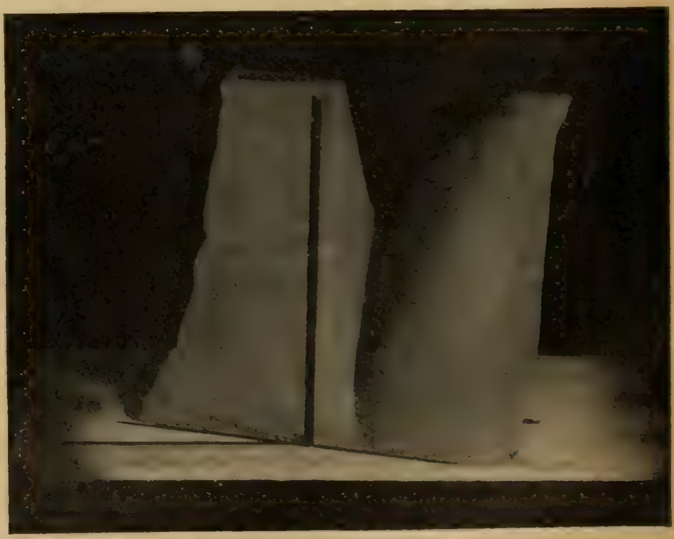

FIG. 6.

The cause of the rotation of the plane of polarisation is still a problem. It is evident that the earth's magnetic field will introduce obliquity into the motions of ions propelled by the electric force of the waves. Waves passing over any particular ion impart to it a to-and-fro motion of the same period as that of the waves, but lagging behind their electric force by about a quarter of a period. An ion moving in the earth's magnetic field is deflected by that field and acquires an oblique component of velocity, while a calculation shows that a rotation such as is demanded by the observed facts of directive wireless telegraphy might be furnished by the passage of the waves through a space containing free electrons.

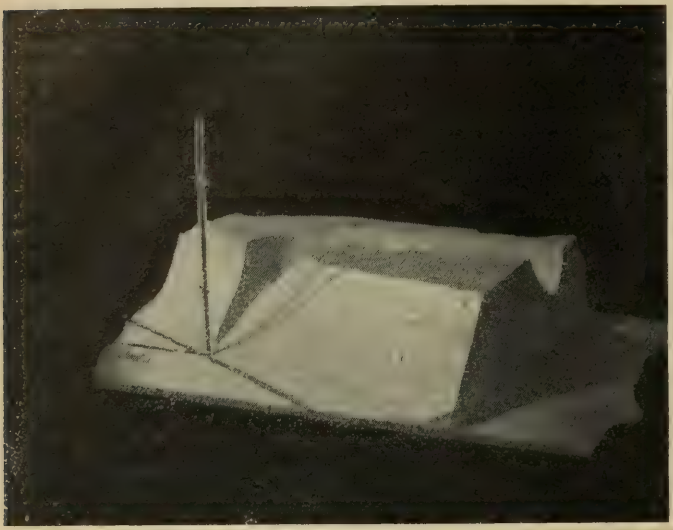

Fig. 7.

This affects reception of the waves in the following way: The accumulated effect of the simultaneous oscillations of a whole cloud of electrons may produce an effect at the receiver as if the cloud itself were a source. The plane of polarisation of this secondary radiation is the same as that of the motion of the electrons. Hence in this country a cloud of such electrons will arrive at a receiving station due north of the cloud with the magnetic field dipping from east to west, and these dipping magnetic fields will cause errors of direction and, if part of the primary wave from the sending station get through as well, the minimum will be ill marked; and the combined effect will be equivalent to reception of elliptically polarised waves. It ought to be possible to test these conclusions by observation.

Further, the longer the wave the greater the directional error should be, and if a station transmits a group of slightly differing wave-lengths a kind of spectrum analysis could be performed by a radio-goniometer. The information gained from observations made with directive aerials must be combined with the knowledge furnished by an analysis of the records of magnetic variations and magnetic storms. It would seem that the diurnal variations of the range of wireless signals must be due to the kind of ionisation of gases familiar in laboratory work with X-rays and the γ-rays from radium. It is suggested that this diurnally-ionised layer below about 50 km. is ionised by the γ-rays and other ultra-violet rays from the sun and involves the splitting of electrons from molecules to make positive ions, and at the gas pressures in fairly low levels, many of the electrons will combine with neutral molecules to form negative ions. Both positive and negative ions of molecular size give rise to ionic reflection, to the arched trajectory of the Hertzian rays and incidentally to absorption. Watson's solution of the daylight propagation problem takes account at least partially of such a layer of conducting gas, and from his result we may deduce that if the ionisation is effective down to 25 km. the conductivity would not be a quarter as great as that of sea water to obtain results such as those summarised in the Austin-Cohen empirical formula.

Mr. C. J. Jewell on Electric Welding.*

The powers granted under the Electricity (Supply) Act 1919 will, it is hoped, ensure that all future developments will be considered as part of a general scheme and that the elimination of non-standard frequencies will make it possible for stations to be linked up profitably and will save considerable capital expenditure and stand-by plant by ensuring that only the most economical plant is kept on load.

The question of coal saving has been closely considered just recently and whatever may be done in the generating station to reduce the coal consumption it will be agreed that the very high percentage of dirt present in small coal to-day is very deplorable. More and better coal washing plant should be put down at collieries to ensure that the consumer gets what he pays for. At the present time, though oil has many advantages as a fuel, financial considerations prevent it being a serious competitor with coal in stations of the type and magnitude we shall have to consider in the near future. It is interesting to note that high coal prices are increasing the demand for electricity from manufacturers while the benefits derivable from the use of this form of energy made evident during the war are also having a similar effect. As the cost of running services to factories is a serious item of capital expenditure, other things being equal, it will be to the advantage of the consumer to build his works as close to the supply authorities main routes as possible.

Problems of Domestic Supply

The question raised by Mr. Wordingham as to the supply pressure for distributors is a topic worthy of careful thought if the use of electricity for domestic purposes increases in proportion to the demand for lighting, as the present low tension distributors will be quite inadequate to carrry the current without excessive losses, and it may, therefore, be necessary to go back to some modified form of house-to-house distribution to avoid expense of running heavy section low tension mains.

As regards the tramways, it is interesting to note that while the percentage of costs to revenue fell from 62·5 to 60·3 per cent. between 1908 and 1911, it increased to 66·5 per cent. in 1917, and to 82 per cent. in 1919. Nevertheless, the tramways remain the cheapest method of street passenger-carrying transport and it is unfair that they should be forced to maintain the surface of the roadway. The railless traction system has possibilities for less densely populated routes. For transporting goods within a short range the battery vehicle has a great future and if more accommodation could be provided by electricity supply undertakings for charging purposes a very remunerative night load could be built up to the benefit of the industry as a whole.

Electric Welding.

During the past 10 years electric welding has developed in a remarkable degree, broadly there being three processes of electric fusion welding:—(1) The carbon arc, (2) The metal arc, and (3) The quasi-arc.

The difference in practice between an arc and a quasi-arc is the factor which has produced the developments mentioned. These developments may best be visualised by comparing the work of repairing a ship's fractured stem or stern frame and the building throughout of a steel sea-going ship by electric welding—the former being the maximum achievement by electric arc welding up to 1910, whilst the latter was achieved by electric quasi-arc welding in 1920.

The differences between an arc and a quasi or partial arc may be noted. The arc is produced between the metal rod—in some instances covered with a flux and in some instances bare—and the work, by using a high current density and drawing an arc to obtain the heat required. At the same time a drop of molten metal is added from the steel electrode, and sometimes the material is hammered to close up the spaces; whilst the quasi-arc is produced between a metal rod coated with an indestructible permanent slag, which, in acting as a non-conductor, allows the electrode to be used close up to the work, thus calling for a lower current density to bring about the requisite fusion of the metal. The covering when in a molten state produces an acid slag, which not only cleanses the metal of the weld from all oxide, but acts as a secondary conductor of electricity, enabling the operator to maintain a continuous flow of molten metal into the weld. The weld thus produced requires no subsequent hammering, and therefore the work is continuous and much more speedy. It is interesting to note that, so far as is at present known, the only covering substance which produces these results is blue asbestos.

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* Abstract of an address delivered to the North-Midland Centre of the Institution of Electrical Engineers.

The Reason for Progress.

It may be inquired why electric welding, after virtually standing still for a matter of 10 years, should suddenly emerge and be employed by every Naval Dockyard and every important shipbuilder and engineer in the country. This is probably traceable to the improved metallurgical conditions brought about by using the quasi-arc instead of the true arc. One certain reason for this is the ease with which the knowledge of applying the process can be acquired. This was proved during the war by many hundreds of operators—both male and female—who were taught in the various works (notably Messrs. Ruston & Hornsby, Messrs. Clayton & Shuttleworth, Messrs. West's Gas Improvements Company, etc.) to operate the quasi-arc in the electric welding of trench warfare bombs, Admiralty mines, &c. The severity of the tests imposed upon these articles bears evidence of the perfection of welding. Hydraulic pressure at 1,250 lb. per square inch was applied upon the cylindrical bombs, which were composed of $\frac{3}{8}$-inch steel plate 9 inches in diameter, with a longitudinal weld to form the barrel, and circumferential welds to attach the pressed ends. When it is taken into consideration that upwards of half a million of these trench warfare bombs, and practically the whole of the mines used in the North Sea, were welded by the electric quasi-arc, it will enable one to estimate the enormous service rendered to this country by the use of this improved process.

Current Consumption.

The perfect fusion of the blue asbestos slag-covered electrode calls for a pressure of at least 90 volts, and although the voltage between the electrode and the work, if measured with an ordinary voltmeter will be found to average about 35 volts, it is, nevertheless, important to remember that the voltmeter gives no indication of the maximum and minimum voltage during an interval of time, say a fraction of a second. But an oscillograph record of the drop in volts across a quasi-arc will indicate peaks rising to 90 volts.

With the object of attaining the pressure required for these high peaks an exhaustive investigation was undertaken with a view to the discovery of some means whereby a lower terminal voltage might be adopted as a standard, under conditions which would nevertheless instantaneously provide the increased pressure required from time to time in the course of making a weld. There has now been designed a special reactance coil which fulfils the necessary conditions when used on a direct-current supply of 60 volts having a straight-line voltage characteristic.

It is found that as the resistance of the quasi-arc increases before the arc is actually broken, there is an available pressure of over 100 volts, although the pressure of the line is only 60 volts. When, therefore, this special reactance coil is used in series with each welding circuit, a pressure of 60 volts (direct current) will give results in every way equal to those obtained with 100-110 volts without this reactance, with a corresponding economy in electrical energy.

The sizes of electrode mostly used in engineering works range between No. 10 S.W.G. and No. 6 S.W.G., and the usual current consumption on these and the intervening sizes would range from 60 to 120 amps. Assuming an average consumption of 90 amperes at 60 volts, this would call for 5·4 kw. per welder where a number of welders were employed; but in smaller installations where only one welder was employed, 10 kw. should be provided, or for three welders, 20 kw.

The Institution of Electrical Engineers' Subscriptions.

The Critics' Night Out.

Judging by the opinions that have been expressed, both verbally and in print, there was widespread opposition to the Council of the Institution of Electrical Engineers' proposal to raise the subscriptions of the various classes of members, as from the beginning of next year. Soon after the opening of the meeting held on Thursday, December 2nd, to decide this momentous question, it became evident, however, that the opposition was more vocal than numerous, and that the large majority of the members realised that it was no good kicking against the inevitable. It was for this reason no doubt that the meeting was not overcrowded, and that most of those present came to see the fun, and to do nothing more active than vote in favour of the Council's proposals rather than to criticise or to put up any really vital opposition.

The President on the Need for the Increases.

The **President** (Mr. **Llewelyn Atkinson**) opened the proceedings by giving reasons why an increase in the present subscriptions was necessary. He had an easy brief; and a good case. So good, in fact, that it seems a pity it was not more widely circulated beforehand. To follow this procedure would have neutralised all real opposition, and saved the time of the meeting.

His argument may be briefly summarised as follows: In spite of general rise of prices, economy in administering the affairs of the Institution had actually been possible, owing to the income received for their own building from the Government exceeding the rent of the Albemarle-street premises, and because paper, being practically unprocurable, it was not possible to issue the "Journal" during the war. Since the war, on the other hand, expenditure had risen enormously, till, with 8,400 members, it was now 74·5 shillings per member, as against 41·6 shillings per member in 1912, with a membership of 6,600. Next year the cost would rise to 75·5 shillings per member, assuming the membership remained the same as it was now, and there would, therefore, be a deficit of £5,425, unless subscriptions were raised. The proposed increases would just meet that deficit. This budget took into account no "increased activities." The policy followed had been to raise the subscriptions of most of those classes who could bear it most. Thus students and graduates' contributions had hardly been touched. This is very wise.

An Analysis of the Opposition.

Mr. **Atkinson** then turned to the actual and presumed opposition which would be raised to the proposals. It had been contended, he said, that the Institution was of more use to London than to country members, and that, therefore, some differentiation should be made between the two classes as regards subscription. Facts and figures however, showed the opposite to be the case. The building had been called a white elephant. But the Institution must live somewhere and must meet somewhere. To hire other administrative offices and premises for all the necessary meetings would save about £1,800 a year, but then the Institution would have no home of its own. (We rather expected someone to suggest that the "Civils" should continue their hospitality, but this was the one point on which some diffidence was shown.) The large increase in the cost of the building was due to the enormous rise in the rates.

The "club" idea received short shrift. Theoretically it is attractive to everyone. Practically it would mean a large increase in income tax, apart from other obvious difficulties. The definiteness (or is it definitiveness?) with which the President made this announcement evidently impressed the meeting; and, in spite of its fitful appearance during the discussion, one felt that the club idea was dead, at any rate as an appanage of the Institution. 'Tis a pity, but 'tis so.

The Redress of Grievances.

The case of the "scattered" member and his subscription, continued the **President**, would receive close consideration. Indeed, the Council wished it to be known that they were sympathetic to members' troubles and desires, and, with all due thanks to the technical Press for the way in which they had opened their columns to a discussion of the subscription and other questions, members would really do well to deal direct with the Governing Body. This is a statement of a more liberal policy which we feel sure is not realised by most members, and might well receive wider publicity.

The **President** concluded by making some remarks on the proxy question, which were hardly needed, though we might lightly criticise the lack of clarity in the arrangements made for carrying out this side of the election, and ascribe what was really little more than a misunderstanding to that cause. He hoped the discussion would be confined to the point at issue—a hope that was not fulfilled—and summarised his case in the following questions: Is the Institution of Electrical Engineers to continue its great work? Is the expense of doing this work reasonable? Is the method of meeting the expense reasonable? Is there any alternative method?

Mr. W. B. Esson, one of the elder brethren of the Institution, seconded the resolution proposed by the President. He, to a certain extent, covered the ground again and, as not his best friend would call him an attractive speaker, we were not surprised to find the meeting becoming impatient before he had finished. He, however, made one important point. The increased rate of progress means more expense. A variant of the old saw that you can't make an omelette without breaking eggs, which some of the later speakers might have taken to heart.

The Opposition at Work.

The debate now being open we were not surprised to find that "official opposer" to all resolutions, Mr. F. W. Purse, on his feet. He wanted to refer the whole matter back, and have done with it. But as the President would not see eye to eye with him in this procedure he momentarily subsided.

Mr. E. L. Joseph next took the floor. He is both a tearful and a constructive critic. The increases, he said, were a burden on the brains of the Institution. This, it appeared, meant that there were certain members, belonging to the teaching profession, who really could not afford to pay more. Mr. Joseph's remedy for present discontent was, therefore, to abandon the Annual Dinner, the Conversazione, turn the library into a sort of Mudie's by lending out the books to all and sundry at a small fee, hire the Institution hall to other bodies (such as E.T.U., presumably) for meetings, and publish the "Journal" in the technical Papers, and so get both them and the Institution fresh advertisements, or alternatively, get advertisements for the "Journal." Constructive criticism is, however, not without its destructive side, and supposing Mr. Joseph had his way we might well ask *cui bono*.

Mr. Purse's Main Attack.

Mr. F. W. Purse then returned to the charge. Like a good general he despatched his skirmishers in advance. What did the Council mean by sending out stamped addressed envelopes with the proxy papers (Perhaps they were afraid members would return them without any stamps on). There was nothing to show that the proxy papers should be sent in 48 hours beforehand (Mr. Purse had evidently not read the notice convening the meeting). The support given by the territorial centres had been much exaggerated, and, finally, the information given by the President that evening should have been in the hands of the members sooner. (Mr. Purse has a just grumble here, as the statement took a good deal of wind out of his sails.)

Launching his main attack, Mr. Purse thought the increases proposed by the Council would bring in nearer £7,000 than £5,425 needed, if the membership remained the same. Members who had compounded escaped scot free, and a much fairer way would be to make everyone pay 12s. 6d. a year more without fear or favour.

Among other things, he had a tilt at the "Journal," and before sitting down was unwise enough to threaten all sorts of pains and penalties if the suggestions of his little Cave of Adullam (how small it was appeared later on) were not accepted by the meeting. The resentment at this attitude became evident before the meeting closed.

Some Supporters and Some Critics.

Mr. A. H. Dykes and Mr. J. E. Kingsbury supported the Council's proposals. The latter, in a happy speech, pleaded for unanimity. It was the good of the Institution, not of individual members, that was at stake. Increased activities must require more money. It was a pity that his plea fell on deaf ears.

Mr. L. Wolf also had a go at the "Journal," and advocated the club idea. He had to make a hurried retraction when the President pointed out that this would involve an increase of £9,000 in income tax.

Mr. W. R. Cooper suggested a time limit to the increases, and that the new subscriptions should come up for review on December 31st, 1922. This compromise was evidently acceptable to the meeting, and had the distinction of being added to the original resolution as a proviso.

Sir Charles Bright, Mr. Adams, Mr. Bothwell and Mr. Jockel objected to the "Journal" in one form or another and to the Conversazione, but Mr. Adams thought some addition to the social side desirable, so that consistency is not his strong point.

After this, saturation set in, and the proceedings became rather muddled, but from the welter "emerged" a second proposal that the whole matter should be referred back, and a seconder for Mr. Cooper's amendment. These critics were, however, implicitly unanimous in one thing, and that is that some increase is a necessity.

The Hon. Treasurer Replies to the Critics.

The Hon. Treasurer (Sir James Devonshire, K.B.E.) gave the critics short shrift. In his opinion there was very little difference between the Council's proposals and Mr. Purse's. He accepted Mr. Cooper's suggestion as a proviso to the resolution.

Mr. Purse thereupon moved that there should be a flat rate increase of 10s. 6d. to all subscriptions, and that the remaining sum necessary to cover the deficit should be obtained from the compounded members and by reductions in expenditure.

The President pointed out that the "compounded" members could not be interfered with, and that Mr. Purse's suggestion would throw a heavy burden on the younger members of the Institution. (A curious policy surely for so democratic a reformer!)

Before putting the resolution to the meeting, the President also said that the dinner was an act of hospitality due from such a body as the Institution, but as regards that and the Conversazione the decision whether they should continue remained with the majority of members. More democracy!

Mr. Purse's resolution was then put to the meeting, and found nine supporters. Then that comic relief which had not been entirely absent throughout the proceedings reasserted itself in ful vigour. Mr. Purse demanded a poll, received the very small necessary support for this action; in spite of cajoleries from the chair and protests from the meeting persisted in his obduracy; scrutineers were appointed; the provision of refreshment for all and sundry suggested; the futility of the opposition pointed out, and then Mr. Purse's spirit failed him—he withdrew his demand for a poll. The resolution was carried with three dissentients, and we all went home, after nearly three hours' talk.

Quite an amusing, if rather a lengthy, entertainment!

The Influence of Traffic on Automatic Exchange Design.*

By G. F. O'DELL.

Traffic conditions have an important influence on the operation of automatic exchanges. In none but the smallest system is it possible for the exchange to enable all subscribers to engage in conversations simultaneously; there are not enough connecting circuits and the cost would be prohibitive. In fact, only a certain proportion of subscribers desire to speak at the same time, and it is this percentage that should determine the number of connecting circuits. As is well known, the percentage varies greatly, not only in different areas but at different times of the day. Traffic generally reaches a maximum in the morning.

In considering the influence of traffic on automatic exchanges the author quotes, as an example, an exchange built by the Automatic Telephone Manufacturing Company, Ltd. Each unit, with its group of selectors must be self-sufficing, and the first problem is to distribute the total traffic amongst the various groups. Next we have to determine how many switches are needed to carry the assigned traffic. A further problem is the determination of the number of second selectors required; having decided the number of switches, we must arrange them so as to allow for growth. Finally, we must arrange that calls shall be as easy to trace through as possible.

The problem can be treated by applying the theory of probabilities, but consistent results can only be reached by taking into consideration not one, but a large number of busy hours. As the effect of restriction of the number of switches is to cause some calls to be lost it is important to set a limit to this number. Thus a grade of service of 1 in 1,000 means that 1 call in 1,000 may be lost during the busy hour. Attempts have been made by various investigators to treat the problem empirically, one of the best known devices being Erlang's formula. Two curves were exhibited showing the proportion of time during which 0, 1, 2 switches are engaged for Erlang's theory and a modification. Actual records showed that the latter approached practical conditions the more closely. As illustrating the closeness between calculated and actual conditions some experiments were mentioned in which the theoretical loss was 25 per 1,000 and the actual loss (Erlang) 25·5 per 1,000 and (Siemens) 22·5 per 1,000. With full availability the loss would have been only 10 per 1,000; if interconnecting were not made use of, 40 per 1,000.

It may be concluded that for the "full availability" case Erlang's theory will serve to determine the number of switches required to carry a given traffic.

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* Abstract of a Paper read before the Institution of Post Office Electrical Engineers.

The Effect of Shunted Resistance, or Plug Leakage, on the Sparking Performance of an Electrical Ignition System.*

By G. E. BAIRSTO, D.Sc., D.Eng.

The work described in the following Paper was carried out at the Royal Aircraft Establishment, Farnborough, during the years 1917-1918. A series of tests was made to determine the effect of shunted resistance on the spark voltage of most of the leading types of electrical ignition systems. One of the most serious limitations imposed on an electric ignition system by the engine, is that after a sparking plug has run for some time it becomes a fairly good electrical conductor, due principally to the deposition of carbonised oil on the surface of the insulation and infiltration into the body of the insulation if of mica, and to burning-in of the glaze of porcelain insulation. A resistance of one megohm in parallel with a spark plug causes a falling off of the spark voltage of the magneto, and a resistance of 200,000 ohms—a marked fall in voltage. These results were obtained on magnetos of the rotating armature and sleeve inductor types. A more extended investigation on the sparking performance of electrical ignition systems in general is now given.

Apparatus and Methods.

It is necessary to make a sharp distinction between "regular sparking voltage" and the voltage which only occasionally will give a spark (the "maximum sparking voltage"). In comparing two magnetos for spark voltages, it is the former quantity that matters.

A cylinder fitted with a spark plug and pressure gauge was connected to a source of compressed air, kept at constant pressure by means of a suitable stop-valve on the intake. The sparking plug was a K.L.G., C.B. type, having two crossed circular bars as spark points. The spark gap was kept constant at 0·015 in. The air pressure was adjusted until the plug just ceased to miss sparking, the spark being viewed through a small window. In some cases maximum voltage and corresponding air pressure were also taken. The peak voltage across the plug was measured by a thermionic valve and a series electrostatic voltmeter in parallel with a highly insulated condenser. The variable leak consisted of a water resistance in the form of a U-tube, with adjustable electrodes.

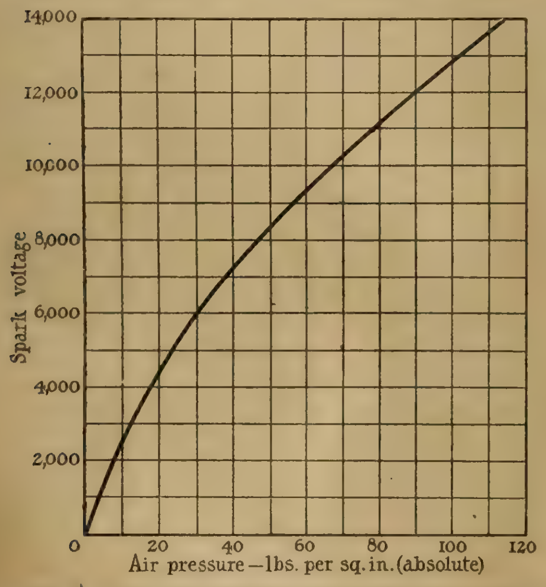

FIG. 1.—RELATION BETWEEN SPARK VOLTAGE OF SPARK PLUG USED IN THE TESTS AND CORRESPONDING AIR PRESSURE FOR REGULAR SPARKING.

The relation between the spark voltage and air pressure is not quite the same for all types of ignition systems, and the magnitude of the leak also affects the relationship. Fig. 1, a mean for various systems and leaks, gives a typical relation.

Comparative Tests on Various Ignition Systems.

All the experimental results given in this section were taken at a constant magneto shaft speed of 1,800 revs. per min., except in the cases of the battery and coil sets, which were driven at a cam-shaft speed of 900 revs. per min.

The author, in the original Paper, then proceeds to give detailed results for a series of nine different types of magnetos, including rotating-armature, sleeve inductor, and polar inductor types, and two coil and battery sets. Diagrams connecting air-pressure and resistance of leak are given for each. Fig. 2 gives the assembled data for the series of tests.

Summary of Results.

We may compare the various systems in either of two ways: (1) the actual air pressure for some particular value of the resistance shunting the spark plug; (2) the ratio of the air pressure with some particular leak, to the air pressure with no leakage.

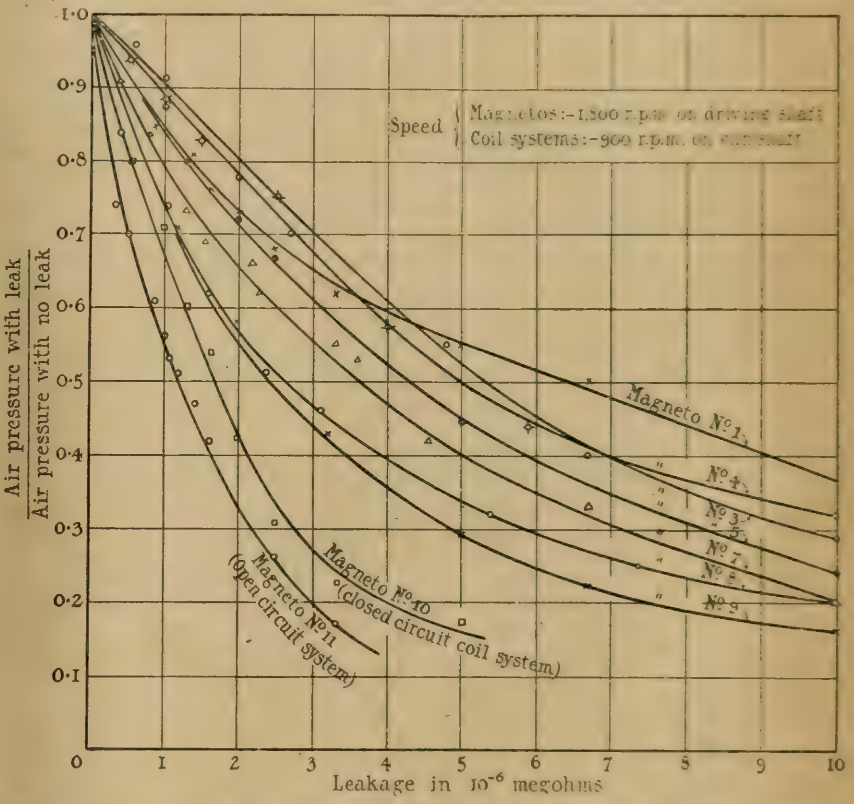

FIG. 2.—RELATION BETWEEN DROP OF AIR PRESSURE AND LEAKAGE FOR VARIOUS IGNITION SYSTEMS.

Table I. gives a comparison made by method No. 1, the magnetos being arranged in their order of merit for a shunt resistance of 500,000 ohms.

Table 1.

Magneto.	Type of Magneto.	Air pressure (with 500,000 ohms in parallel with plug)
		lb.
4	Rotating armature	92
3	Rotating armature	87
1	Rotating armature (movable pole-shoes)	77
2	Rotating armature (movable pole-shoes)	74
6	Rotating armature (light type with jump spark distributor)	72
8	Polar inductor	70·5
7	Sleeve inductor	70 and 81
5	Rotating armature (light type)	62
9	Polar inductor	58
10	Coil and battery	46
11	Coil and battery	41

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* Abstract of a Paper read before the Institution of Electrical Engineers.

Fig. 2 shows the results for the various magnetos compared on the basis of the ratio of air pressure with leakage, to the air pressure with no leak, the ordinates giving this ratio and the abscissæ the leakance, or the reciprocal of the shunted resistance. Some of the curves cross one another. One striking feature is the very indifferent performance of the battery and coil ignition systems.

It will be seen that the magnetos group themselves in their main types of designs and in the following order: Rotating armature, sleeve inductor, polar inductor, and coil and battery. Machines with the movable pole-shoes are better than the others, while the heavy types of ordinary rotating-armature machines are slightly better than the lighter types. The performance of the polar inductor machine is only roughly 50 per cent. of that of the rotating-armature type, while coil and battery sets show up badly.

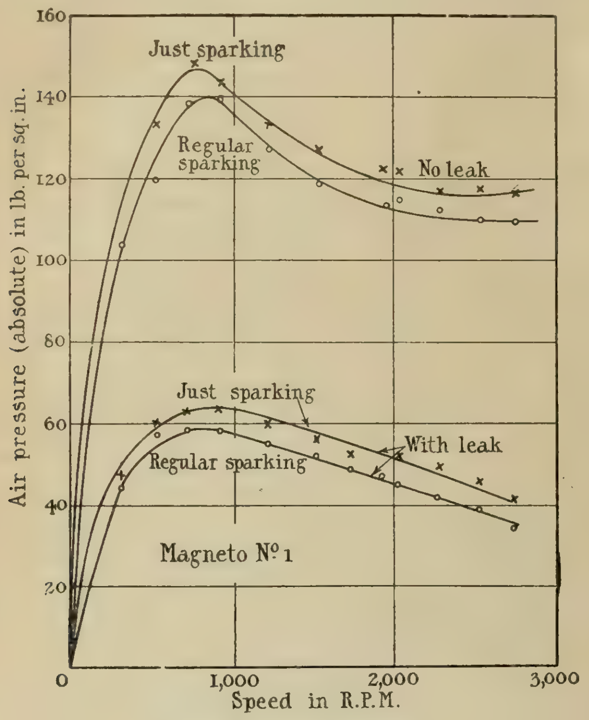

Fig. 3.—Effect of Speed.
Leak = 100,000 ohms.

Alteration of Magneto Electrical Constants.

Effect of Alteration of Speed of Magneto.—A series of tests were taken on a No. 1 magneto at various speeds for both no leak and for a leak of 100,000 ohms. Tests were made for the plug just sparking and also for perfectly regular sparking. The curves, which are shown in Fig. 3, are very similar.

A similar set of results was obtained from a No. 9 magneto with 500,000 ohms in parallel with the plug. In this case the pressure ratio rose from 49 per cent. at low speeds, to a maximum of 60 per cent., and then fell away again at top speeds to about 50 per cent.

Effect of Alteration of Primary Capacity.—The effects will vary greatly with the electrical constants of the various machines, and a series of observations were taken in which one of these factors was varied over a fairly wide range and all the others were kept constant, the magneto speed being 1,800 revs. per min. throughout.

To show how the spark voltage of a No. 9 magneto varies with the primary capacity, the author gave a series of curves for various leaks. The no-leak curve, except for a tendency to form a hump near 0·2 mfd., gradually falls as the capacity increases. This result is similar to that shown by an induction coil. In the case of the 500,000-ohm leak, the fall of voltage is not at all as great and a definite hump shows itself at 0·21 mfd. With the 200,000-ohm leak, the curve becomes practically flat except for a slight hump at the beginning. In the two lower curves, the initial hump also appears and each curve consists of a gentle rise at the beginning, next a flat portion, and then the curve tends to fall again.

It is of interest to see whether the condenser actually fitted to the magneto gives the best possible results. Its value is 0·096 mfd. The no-leak curve shows that a slightly better performance is obtained with smaller capacities, but such smaller capacities are not permissible, as sparking occurred at the contact-breaker points. The 100,000-ohm curve shows that with 0·2 mfd. an improvement of about 7 per cent. can be effected. With the other curves the increase is not so apparent, but the whole tendency is for the best value of the capacity to be rather higher with a leak on the system, than it is for no leakage.

Effect of Alteration of Secondary Capacity.—Some tests were made on a No. 9 magneto with various capacities shunted across the plug. The condensers were air-plate condensers of negligible power factor. All the curves were gradually drooping ones. The percentage drop in voltage with a constant leak is practically independent of the value of the shunted capacity.

Effect of Alteration of Secondary Inductance.—In order to test the effect of altering the secondary inductance, a No. 9 magneto was used and the current from this was fed to the spark plug via one or more secondary windings of some other magnetos of the same time. With no leak there was only a slight fall in the voltage, but as the leakage increased the drop became more marked. With the leak of 0·1 megohm the voltage became practically inversely proportional to the inductance.

Effect of Alteration of Primary Resistance.—Inserting various amounts of resistance in series with the primary winding gives results showing that within moderate limits, say, 0 to 2 ohms, the primary resistance has little influence on the spark voltage. Beyond 2 ohms the effect is much more marked, as the resistance then becomes comparable with the reactance of the winding.

Theoretical Discussion.

The mathematical discussion of the secondary potential of an induction coil or magneto coil winding has been extensively developed by Oberbeck,[*] Rayleigh,[†] Dibberne,[‡] and Taylor-Jones,[§] but the case of a resistance in parallel with the spark gap does not seem to have been treated. It is a complex problem so involved as to be of very little use for the purpose of calculation. A very simple calculation will, however, give some idea of the order of magnitude of the effect of shunt leakage. Let R be the resistance in parallel with the spark, then during the whole time that the potential is rising, current is leaking via the leak and the total energy so wasted is equal to

$$\frac{E^2}{R}\int_0^{t_0}\sin^2\frac{\pi t}{2t_0}\,dt=\frac{E_0^2 t_0}{2R}$$

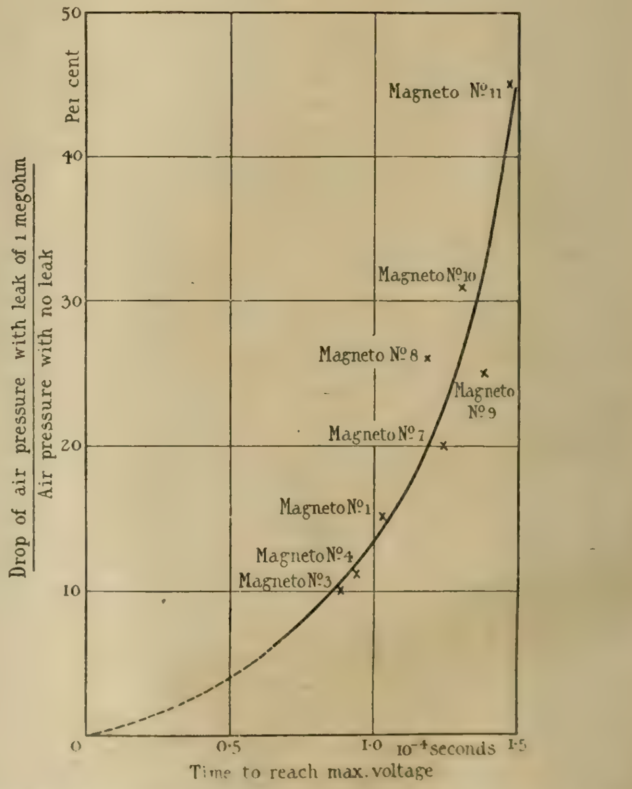

Fig. 4.—Relation between Rate of Rise of Potential and Percentage Drop in Air Pressure with a leak of 1 Megohm, for Various Types of Ignition Systems.

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[*] Oberbeck, "Wiedemann's Annalen," 1897, Vol. LXII., p. 109.

[†] Rayleigh, "Phil. Mag.," 1901, Vol. II., p. 581.

[‡] Dibberne, "Annalen der Physik," 1913, Vol. XL., p. 938.

[§] Taylor-Jones, "Phil. Mag.," 1909, Vol. XVII., p. 28; 1911, Vol. XXII., p. 706; 1914, Vol. XXVII., p. 565; 1915, Vol. XXIX., p. 1; and 1918, Vol. XXXVI., p. 145.

Now t_0 as found from rotary spark-gap tests is a quantity of the order of 10^{-4} seconds. Assuming, therefore, a spark potential of 10,000 volts and a shunt resistance of 100,000 ohms, the total energy wasted is equal to 0·05 joule. Now the whole energy in the spark discharge of even a very powerful magneto seldom exceeds 0·1 joule, hence a leak of the above magnitude would produce such a drain on the limited amount of energy available that the potential would never reach 10,000 volts. Hence the *rate of rise* of the secondary potential is of extreme importance when considering the efficiency of an ignition system as affected by plug leakage. The greater the rate of rise of potential the larger is the leakage the system will stand before missfiring.

It is therefore of interest to see how the effect of a small leak on the voltage is related to the rate of rise of potential of the various ignition systems under consideration (*see* Figs. 4 and 5). The gap was set for a pressure of 12,000 volts, and the reciprocal of this lag therefore gives a measure of the mean rate of rise of potential from zero time up to this voltage. The general nature of the results is quite clear. The shorter the time taken to reach the peak voltage, the less the drop of voltage from its value when no leak is present.

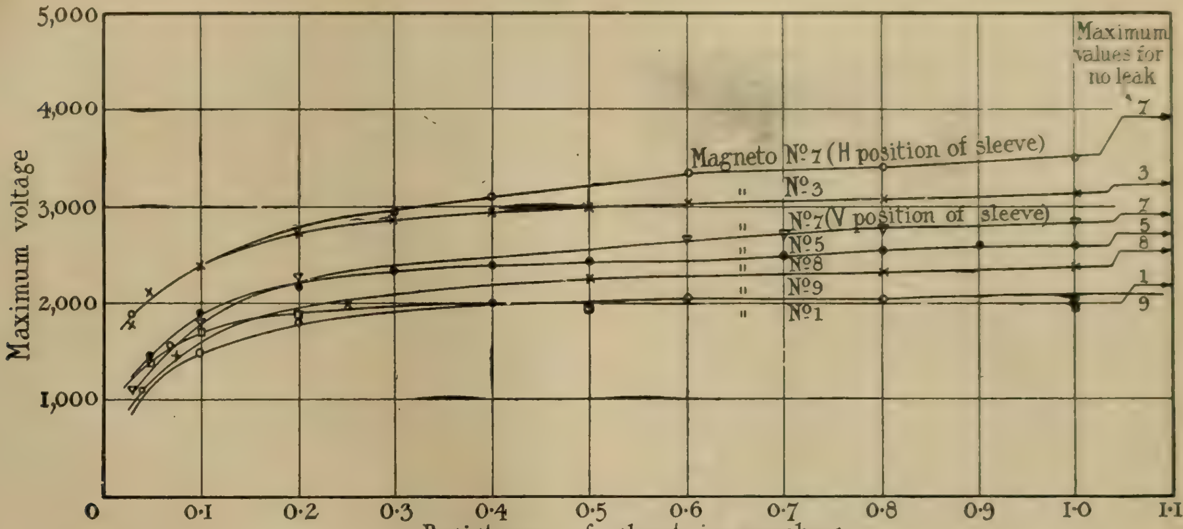


FIG. 5.—EFFECT OF LEAKAGE ON SECONDARY E.M.F. OF ROTATION. Speed = 1,800 revs. per min.

COMPARISON AND CALCULATED AND OBSERVED RESULTS.

In the original Paper the author then proceeds to work out a series of relations for the secondary potential when the leak is large. It is shown that the theoretical deductions are in general agreement with the experimental results. Both theory and experiment demonstrate the advantage of having as high a frequency as possible. Increase in capacity decreases the frequency, and hence diminishes the voltage.

Finally the author takes a typical machine (B.T.-H. AV.8) of the inductor type, and compares calculated performance with measured data. The machine had the following electrical constants: L_1 = 0·0078 henry at 3 amperes, L_2 = 28 henries at 50 milliamperes, M = 0·415 henry at 3 amperes in primary, $C_1 = 0{\cdot}20 \times 10^{-6}$ farads, R_2 = 16,500 ohms. Therefore $k^2 = 0{\cdot}78$; $q = 54{,}000$; also $I_0 = 3{\cdot}75$ amperes.

All the inductances were measured with " break " currents of the amounts stated.

Table II. gives the calculated and measured results.

Table II.

Resistance of Leak.	E_B Calculated	E_R Measured.	E_2 (calculated) E_B+E_R	E_2 Measured.	Difference.
Ohms.	Volts.	Volts.	Volts.	Volts.	Per cent.
100,000	7,400	720	8,120	5,650	31
75,000	6,050	650	6,700	4,700	30
50,000	4,350	520	4,870	3,650	25
25,000	2,350	360	2,710	2,250	17
10,000	970	210	1,180	1,050	11
5,000	500	140	640	580	9

With low resistances the agreement between the experimental and calculated figures is very good, the difference at 10,000 ohms being only 11 per cent.

In the final section of the Paper the author indicates how some of the results arrived at may be applied in the design of an ignition system. The total E.M.F. of a machine may be written $E_2 = E_B + E_R$, where E_B is due to the break of the primary current, and E_R to the secondary rotational E.M.F. It is shown that: E_B is directly proportional to the coupling, is inversely proportional to the number of secondary turns, and is independent of the number of primary turns. In coil and battery systems it is likewise important that N_2 should be as small as possible—a result in direct opposition to that applying when there is no leak on the system. The effect of altering N thus deserves fuller investigation.

In an appendix to the original Paper some tests of the surface dielectric resistance of leaky plugs that have been in use on an engine are summarised. These comprise " Megger," and hot high-voltage tests. The insulation resistance obtained by the former tests is in general much higher than that yielded by the latter. For a normal carbonised plug the insulation resistance at 300°C. is about one-third to one-half that at atmospheric temperatures. Missfiring on an engine occurs when the plug insulation resistance is between 10^4 and 10^5 ohms. The average resistance of a sparking plug after moderately long use is about 200,000 ohms, and accordingly missfiring is apt to occur early in the life of a plug.

The Sheffield Sub-Centre of the Institution of Electrical Engineers.

A meeting to inaugurate the Sheffield and District Sub-Centre of the North Midland Centre of the Institution of Electrical Engineers was held on November 30th, at the Royal Victoria Hotel, Sheffield. After some preliminary remarks by Mr. C. J. **JEWELL**, chairman of the North Midland Centre, the chair was taken by Mr. S. E. **FEDDEN**, who, in the course of a short address, mentioned that for every kilowatt of plant put down in the supply portion of the industry about 5 kw. of plant and accessories for the use of the electricity had to be provided. In Sheffield three times the number of services had been connected up in the past year than ever before, and at present the excess of demand over supply was something like 40,000 kw.

The high price of coal, strikes, uncertainty of labour and all the many evils which had effected industrial life in recent years had nevertheless been beneficial to electrical industry. He thought that with our present methods of transmission it was as economical to generate electricity in the heart of an industrial district as it was to transmit from a river-side station at a distance.

Points for consideration at the moment were further economies in the boiler house, the use of pulverised coal and the employment of higher temperatures and higher pressures of steam. Dissolved gases in feed water had a very harmful effect, which would be correspondingly increased by the use of higher pressures and temperatures. Preferential charges to large consumers were economically and equitably justified, the capital cost for the smallest service connected up being nearly 86 times as great per kilowatt as for a consumer taking, say, a 250 kilowatt supply. Means for cheapening the cost of these small services were urgently required.

Modern Methods of Manufacturing Electric Lamps.

The Willesden Works of Pope's Electric Lamp Co.

The manufacture of electric incandescent lamps is a process that has passed through several phases, each more interesting than the last. It is further notable in that while it has acquired it has relinquished no territory as is evidenced by the statement that carbon lamps are being turned out in ever increasing quantities alongside the new and more efficient metal filament vacuum and gasfilled types. Connected with all this development have been several well-known pioneers, among whom may be mentioned Mr. F. R. Pope, whose works at Willesden we had the pleasure of visiting on Monday last. These works were established in 1904, and as with many other important manufacturing concerns, their beginnings were small. It was not long, however, before other buildings had to be taken to accommodate fresh machinery and additions to the staff. Since that time the works have several times been extended, and at the moment once again the equipment is already taxed to its utmost capacity, so that arrangements have been completed for further extensions to be commenced in the immediate future.

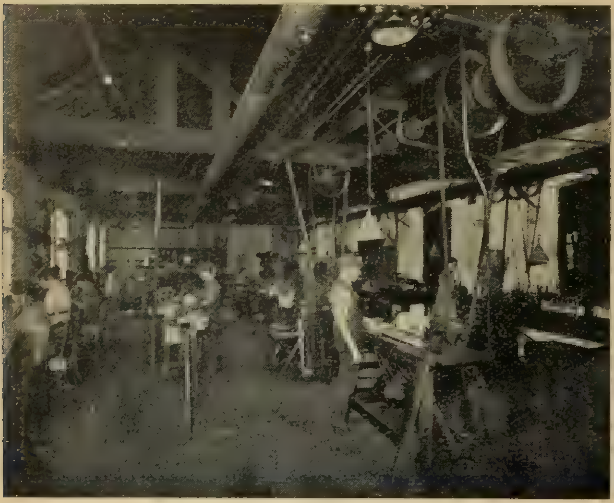


Fig. 1.—Section of Wire Drawing Department.

Accuracy and Uniformity.

Accuracy and uniformity are vital qualities in the production of the electric lamp of to-day, and a visit to the Pope Electric Lamp Works provides clear evidence of the care taken by a competent staff to obtain these qualities in the productions turned out. It may be mentioned that Elasta drawn-wire lamps, of both the vacuum and gasfilled types, and "Pope" carbon filament lamps are made at this factory, some of the processes of manufacture being common to all types. We shall, therefore, describe the making of the Elasta vacuum type lamp as representative, noting differences of treatment as they occur.

The molybdenum oxide, which is in due course to provide the supports for the filament, is first reduced to a grey powder in electric furnaces. A certain quantity is then placed in steel moulds, and under powerful hydraulic presses is transformed into square rods, which then go through the process of sintering, in a special department, in order to render them homogeneous and capable of being hammered and drawn. In the hammering machines these rods are reduced gradually, and can be gauged to any degree of fineness required. The drawn wire tungsten filaments are manufactured in a similar way.

The "Foot Building" Process.

The first stage in the manufacture of the lamp proper begins with the cutting of glass tubing by rapidly revolving miniature circular saws into short lengths as a preliminary to forming the flanges. Each piece is then heated and flanged by a single motion in a rotating machine, and becomes a part of the foot of the lamp. The copper and platinum leading-in wires are next prepared, and fixed in the glass foot. With the wires affixed, the foot then passes to a room where an examination for fitness is carried out. "Foot-building" is the next process. This consists in making the studs, and inserting the top and bottom supports ready for the mounting of the tungsten wire filament. Special machines known as "formers" give the filament its correct shape for mounting on the already prepared supports, and to this delicate process of attaching the filament a spacious department is allotted.

The bulbs, which are obtained from the glass works of the Company, are washed and dried by special and speedy methods, and sent to the "stemmers" who skilfully affix to each bulb a hollow stem of glass through which, at a later stage, the air is exhausted Trays of filaments (mounted as described) and bulbs, each containing a definite number, are then passed to the operatives known as "lamp makers." Here the mushroom neck of each bulb left by the glass-blowers is cracked off, and the filament with its support is sealed in, the process being effected with rapidity and precision on automatic machines, needing only supervision and feeding by the practised girl workers who attend them.

The lamp, having been made as far as its essentials are concerned, now goes to the examination department, where it is scrutinised and tested for possible defects, such as leaks, cracks, stems off, badly shaped filaments, &c. Its general appearance also receives criticism in this department, and by this precaution a faulty lamp is prevented from causing trouble at a later stage.

The Exhaustion Process.

The next operation is the important one of exhaustion. After the lamps reach the exhausting department the first process is to connect them to the pump. The actual vacuum is produced in two stages; first, by "rough" pumping, and secondly by mercury pumps of high efficiency, which remove the rarefied air that still remains in the bulb. A special preparation is applied during the process of exhaustion to assist in setting free any foreign matter which may be in the lamp, and which, if permitted to remain, would impair the perfection of the vacuum. A test for vacuum is, of course, imperative at this point; this is done by means of a powerful induction coil, the current from which, when sent through the lamp, produces easily recognisable signs if any trace of air is still left. A flashing test provides still further against imperfections, and then comes the delicate operation of sealing off. In this the stem is removed from the bulb.

Here it may be mentioned that the "rough" pumping plant and the air-compressing plant required for various purposes in conjunction with the lamp-making machinery forms a complete electrically-driven installation, self-contained and needing very little in the way of attention. The mercury pumps are situated on the same floor as the actual exhausting apparatus.

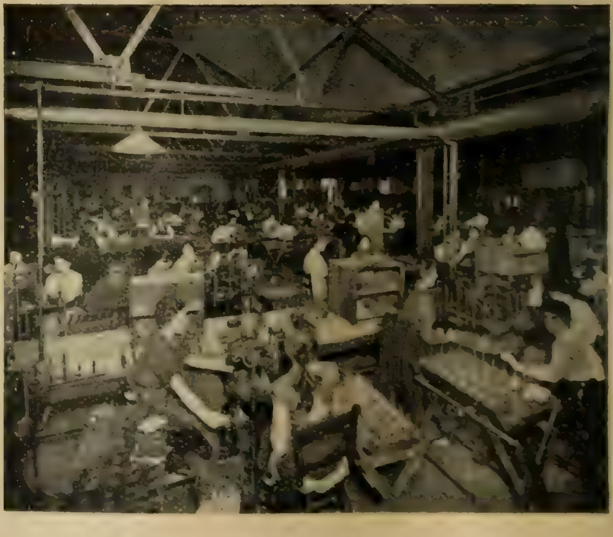


Fig. 2.—Section of Lamp Making Department.

From the exhausting department the lamps, now rapidly nearing their finishing stage, are dispatched for a preliminary test as complete lamps, previous tests having been incidental to the various individual processes.

Photometer Tests.

Having passed this preliminary trial, the real test by which each lamp is graded takes place in the photometer department, where it is compared with an ascertained standard lamp, photometrically measured and checked. Here the lamps fall into their proper categories of voltage and wattage.

The finishing department now takes the lamp in hand, and is concerned with extraneous matters—the capping of the lamp is the first operation in this concluding process, and for this specially prepared non-hygroscopic cement is used. The leads are then soldered or sweated in. Cleaning and examination for possible breakages or other suddenly developed defects follows, and the last stage in actual manufacture is the test for equality on the inspection screen, where we saw hundreds of lamps running under their correct voltage and being carefully scrutinised for uniformity.

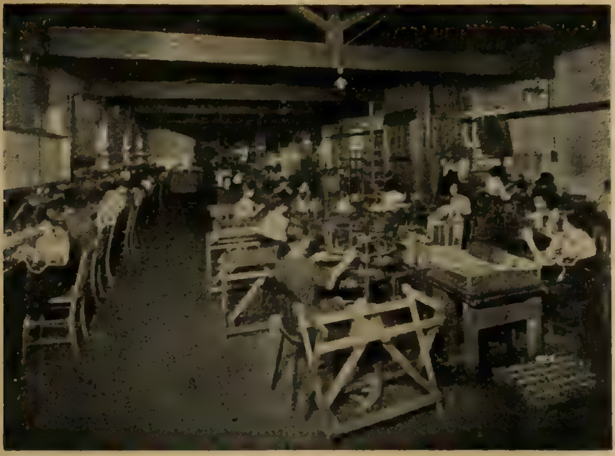


Fig. 3.—Section of Gasfilled Lamp Making Department.

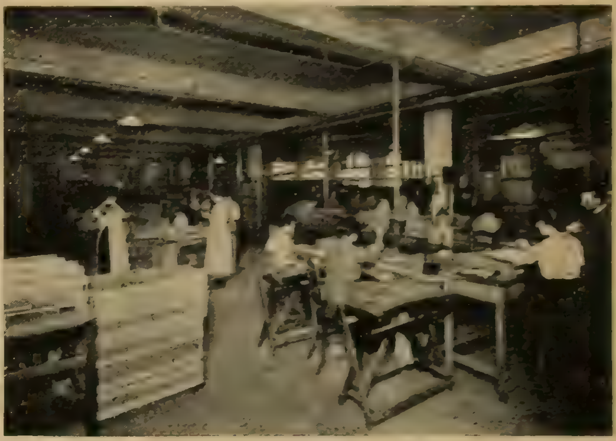


Fig. 4.—Section of Finishing Department.

A few moments under the fingers of a skilled girl worker suffices to etch the name of the firm and the usual details on the bulb, and the lamp is then ready for despatch to the spacious packing department, where it receives its protective coverings and awaits its journey to the customer.

The "Elasta" Gas-filled Lamp.

The various processes in the manufacture of the Elasta gas-filled lamp, though following the same general lines, differ in some respects from those obtaining in the vacuum type, one of the chief differences being in the preparation of the filament. The tungsten wire, after being drawn, is removed from its spools and spiralised on a special machine of the company's own design; its spiral form, after leaving this machine, is barely perceptible to the unaided eye. The construction of the lamp then follows the same routine as that of the vacuum type, with the exception of a slight variation in the method of mounting the filament, until it reaches the exhausting department, where, after being treated in a similar manner by the rough pump and mercury pump, and tested for perfection of vacuum, an inert gas is introduced. The lamp, now actually "gasfilled," is sealed off in the ordinary way before leaving the pump, the remaining operations being a repetition of those already described in dealing with the vacuum type. The construction adopted enables a high efficiency and high intrinsic brilliancy to be obtained.

The Carbon Filament Lamp.

In the manufacture of the carbon filament lamp, also carried on in the Pope factory, the method of mounting the filaments is slightly different. The bulbs are treated in the same way as before, but a large section is laid out for the purpose of flashing the carbon filament. In the exhaustion of the carbon filament lamp the process is varied slightly, and further vacuum tests are carried out before the final stage is reached. The lamps are photometered and graded according to power and performance as previously described, and their course to the packing department is also a matter of the same routine.

In conclusion, it may be mentioned that the firm has its own excellent mess rooms for the workers, and that a social club in connection with the works is a great success. In the repair shop attached to the factory every facility is provided for the quick repair of machinery, and the engineering staff are fully competent to construct many of the ingenious machines in use.

The Cost of Costing Systems

By ERNEST J. P. BENN.

Politics and most other things are upside down, and there are really very few of our actions to-day from which we are able to derive that old-time satisfaction which came from the knowledge of a good thing well done. During the war we scrapped all our experience and all our principles, especially in regard to business and industry, we repealed the laws of supply and demand, we forgot everything we had ever learnt of economics, and in the end we beat the Germans. Our present difficulties arise very largely from the fact that we cannot bring ourselves to believe that the war is over and that we continue in the endeavour to apply war-time expedients to peaceful conditions. Because we beat the Germans we are reluctant to admit that all the abortive experiments imposed upon industry by university professors were really very silly and very impracticable, and we do not like to confess that we really won the war in spite of all these obstructions, but prefer to think that they had something to do with the ultimate subjection of the enemy

A Government Costing Department.

It is announced that the Board of Trade are contemplating the establishment of a permanent Costings Department, empowered to conduct surveys of the trade of the country and to publish regularly statistical information on costs, profits and prices. The advocates of economy, who will probably not be given a hearing, will object to this proposal on the ground that there are already too many departments of the Board of Trade, and that the state of the public finances does not warrant the establishment of another. But the purpose of these notes is to put the objection to this latest bureaucratic aspiration on to the higher, stronger, and more practical ground that the Department, if established, will serve no useful purpose, that the Board of Trade does not understand what it is proposing to do and that the scheme outlined would merely perpetuate an abuse which has been largely responsible for the breakdown of our industries from which we are now suffering. There is no subject upon which the public is more woefully misinformed than on this question of costings. There is no better example of the way in which inexperienced theory has wrought havoc in practical affairs than is given by the history of costings as understood in Government circles.

In 1914, our industries were subjected to that healthy competition both at home and abroad which made for a spirit of economy, and which gave to the public a wonderful service at wonderful prices. The one idea of the business man was to serve his fellows and benefit himself (because the two things went together) by lowering the price or increasing the quantity of the article which it was his mission to make and market. In pursuance of this policy the best of our business men had begun to investigate the possibilities of costings as a means to economy; there are numerous instances on record to show how costing systems operated as a cheapening factor

It was found that an exact knowledge of costs enabled a manufacturer to discover items that might be eliminated, to put his finger on others that were excessive, and to search the markets for materials and processes which might lessen costs of production, and thus enable him to lower selling prices. The costing system in 1914 offered to the consumers the greatest hope of lower prices and better goods.

The Real Hand of Professor and Profits.

Then came the war and the sudden entry into positions of industrial authority of a whole gang of professors of literature, experts in the higher mathematics, classical "firsts" and students of theoretical economics. As soon as these persons got into their hands the industrial reins, they were attacked by the Trade Unions who, in return for pledges with regard to output and dilution, extracted pledges with regard to profits. The theoretical wreckers of practical wisdom thereupon divised means, as they foolishly thought, for the abolition of profit in connection with the manufacture of warlike material. It was decreed that instead of allowing a manufacturer to make a profit he should prepare a schedule of his costs and add an agreed percentage as his own remuneration. Needless to say, this cherubic scheme operated in exactly the opposite direction to that intended., Every incentive was given to everybody in industry to make wages and costs as high as possible, and all this was done in order that profits, which in many cases never existed, might be sacrificed on the altar of socialism. The costing system conceived, invented and designed as a means of reducing costs, became in the hands of the bureaucrats the most powerful lever for increasing them.

Four years of the operation of this topsy-turvy madness has had the effect of making not only the public, but a proportion of the manufacturers themselves forget the A.B.C. of business and has robbed the world (for the system spread from Whitehall all over the countries of the world) of the benefits achieved during a generation of industrial progress. Instead of establishing Costing Departments at the Board of Trade and stereotyping this iniquity, we should enter upon a campaign for the education of the workers, the employers and the public in the industrial wisdom which has been accumulated for us since industry began, and a knowledge of which has been lost since August, 1914.

Pre-War and Post-War Methods.

A simple statement of the pre-war and the post-war methods of examining a business proposition illustrates how far back we have to go to get to sanity in these matters. Prior to the war, the paramount consideration with regard to an article was the price which the public would be willing to pay for it. A manufacturing concern would start out with the knowledge that a good article would sell at a sovereign, and would by means of costs and analysis and complete investigation of processes set itself to produce that article to sell at a sovereign, adjusting its costs and expenses within that limit. The selling price, the sovereign, was the ruling consideration, and the basis of the whole calculation was the long-forgotten truth that an article is worth what it will fetch. Operating in this way, the investigation into costs produced at every stage further opportunities for economy. To-day we have reversed all this. A manufacturer determines to market an article; he knows that the public want it; but he does not begin to think of the selling price, that is the last consideration. He begins, let us say, with his office boy, and having ascertained that this youth is desirous of receiving £2 10s. a week, that item promptly goes down as the first entry in the cost account. Similarly, the desires and requirements of everybody associated with the manufacturer of the article in question, or the suppliers of its constituent parts are ascertained, and seeing that a fixed percentage of profit is added to all these items, the greater the demands of orders or suppliers, the greater the profit of the manufacturer or merchant.

Stated in this way, the argument seems too absurd; we have indeed exaggerated; there is still left in each of us a slumbering sense of economy which we inherited from a wiser generation and we are, therefore, saved from the full measure of the evils which would come upon us if the system of costings, as misunderstood to-day, was allowed full play.

Industry will never render its due service to civilisation until it rids itself of war-time abuses such as this. If the Board of Trade will leave it alone and business men get back to business methods, supplies will continue to increase, prices will continue to fall, and the country will begin to prosper. If an article has to be marketed in competition at a given price, there are plenty of brains in industry willing and able to devise ways of bringing costs within that price. If, on the other hand, the authority of the Government is to be used to perpetuate the folly of the cost basis, then both workers and employers will be encouraged in a point of view which, however beneficial to them it may appear for the moment, must in the end encompass the downfall of both.

Hiring Wiring—An Anomalous System.

By "ELECTROCYNIC."

A friend of mine recently acquired (by purchase) the freehold of a small villa in a London suburb. The house, in the manner of all decent domiciles, is lighted by electricity. In a rather vague manner, the purchaser was told that the wiring and fittings belonged to the supply authority; but he did not, I imagine, at the time of purchase, quite realise the significance of this fact. However, his eyes were soon opened. He found that the wiring and fittings were hired to the previous tenant at a charge of about £4 10s. per annum. This charge was not for hire-purchase, but for hire purely and simply.

The Cost.

There are eight points in the house, six of them being ordinary cord pendants, while in the two living rooms cheap brass fittings depend in spidery fashion from the ceilings. I do not suggest that the hiring charge is *unreasonably* excessive, in view of the present high cost of installation and modern ideas of what is legitimate profit. On the other hand, it is by no means low, affording as it does an easy 15 per cent. return on the estimated value by to-day's standards. The charge does not cover lamp renewals.

However, the question of cost is not the crux of the matter. The owner of the afore-mentioned messuage is by way of being an illuminating engineer. I am not sure whether illuminating engineering is to be regarded as a definite profession, but it certainly does denote a quite definite greediness in the matter of light. My friend is impatient of traditional standards. He is not at all satisfied with the existing installation; in fact, he is disgusted with it. He wants more light. He wants more points and, above all, different fittings. Also he has extravagant notions on the subject of "baseboard outlets," both for lighting and heating.

Will Neither Sell nor Modify.

And this is just where the difficulty arises. The supply authority owns the wiring, and refuses to sell it. The tenant does not desire to engraft the fair flower of his extra wiring upon the company's faded and dilapidated system, and he would probably not be allowed to do it if he did so desire. On the other hand, the company are not prepared to extend the wiring, at any rate not for several months. I also understand that so long as the company's wiring is used the company's perfectly abominable fittings must be paid for.

In addition to the question of whether the present installation is satisfactory or not, there is the very important sentimental aspect. My friend's proprietorial instinct is extraordinarily well developed. The house is his and all that therein is, with the single but pervasive exception of the electric lighting system.

Alien Wires.

The intrusion of these alien wires upon the sacred privacy of his freehold tenement is a thing which his proud spirit will not brook. If no remedy be found, these sinister tentacles will, I am convinced, entwine themselves about his soul and embitter the whole period of his tenancy.

What is the tenant to do in this tragic contingency? He has asked my advice, and I have told him that if the company persist in their refusal to sell the installation (minus the fittings, for which he has an unutterable contempt) he should order them to remove it forthwith. I do not think they will care to do this, since, obviously, the withdrawn wires would be quite valueless. The tenant, however, is cautious, and is afraid that the company may call his bluff and proceed to remove the offending wires, with unfortunate consequences to the newly-decorated walls and ceilings.

The Letter of the Bond.

I have not inquired into the legal aspect of such a case as this, and I do not know to what extent the company would be liable for any damage which might be caused during the process of eradication. Presumably they would have to make good broken plaster or paper. In any case, it might be as well for the tenant to adjure this soulless corporation in a paraphrased version of the solemn words which Portia addressed to the plaintiff in that famous Venetian trial for the due redemption of a bond :—

> "Therefore prepare thee to cut out the wires.
> Spoil thou no walls, nor cut nor less nor more,
> But just thy meed of wire : if thou cutt'st more
> Or less than what is yours, be it but so much
> As make it long or short by one poor millimetre,
> Or if thou spill one single grain of plaster in this house,
> Thou diest, and all thy goods are confiscate."

House and Wiring are Inseparable.

This case is merely one instance of the absurdity of hiring wiring. The wiring is essentially a part of the house. The two are inseparable. For the company to retain the ownership and exact a permanent rental is to invite—nay, to ensure—trouble in the near or distant future.

Probably the tenant who made the original arrangement will remain content with his bargain, although even he may repent at leisure ; but the next tenant is almost certain to raise some objection. It will be difficult to make him see the justice of being charged an extra rent for the electric light installation, which he would naturally consider was included in the house rent. He will, no doubt, under pressure, agree to continue the arrangement ; indeed, he can hardly do otherwise. But the element of compulsion will always fester and cause bad blood, to the particular detriment of the central station concerned and the general detriment of the whole electrical industry.

The Good Sense of the Matter.

Of course, the supply authority would say that their object in hiring the installation was to encourage the use of electricity. No doubt their intentions were almost good enough for use in the construction of a road to the nether regions ; but good intentions, without good sense, will never bring us any nearer the millenium. And the good sense of the matter is this : If the tenant cannot afford to pay outright for the installation, let him pay for it by instalments. That will encourage the use of electricity to a much greater extent than the hiring method. The hire system is quite all right in connection with terminal appliances, such as cookers, fires, fittings, &c., because these can easily be removed if at any subsequent time the tenant desires to become the legal owner of the electrical apparatus in his house.

A Preposterous Arrangement.

A great many small houses were wired on this system before the war. In one district, of which I have had personal experience, prepayment meters were installed, and the hiring and current charges combined in a fixed rate per unit. This scheme was so grossly unfair as to bring a blush even to the harsh and forbidding cheek of the collector of accounts. The scheme was unfair because it meant that the rent of the wiring and fittings was determined by the consumption of current. I believe that the consumers who took advantage (*sic*) of this system had to pay 2d. per unit above the ordinary rate. In effect, therefore, the man who consumed 100 units a year paid 16s. 8d. for the use of the installation, while he who was foolish enough to consume 200 units paid 33s. 4d. for the same accommodation. As the cost of wiring and fitting these small houses was about seven or eight pounds (this was before the war), the return on investment was indecently large, even in the case of the smallest consumption.

I know that it is very difficult, if not impossible, for any central station to devise a system of supply and a scale of charges which shall be fair to everybody. In comparison with such an achievement, the most complicated income tax schedule would appear almost childishly simple. But it *is* possible, and also eminently desirable, to avoid the more obvious and irrritating anomalies, in which accurs't category the "hiring wiring" system must be accorded an evil pre-eminence.

Preparations for the British Industries Fair (Birmingham), 1921, which is to be held in the permanent buildings of the Castle Bromwich Aerodrome from Feb. 21 to March 4 next, are well under way, and already there are signs that the undertaking will be a great success. The Fair, run under the control of the Board of Trade and the Birmingham Municipality and Chamber of Commerce, affords an effective and economical method by which prospective buyers of British and British Empire manufactured goods can come in touch with the most representative manufacturers. None but British and British Empire manufacturing firms may exhibit, and none but Bona-fide British or foreign buyers may be visitors. This policy will ensure that calm, businesslike atmosphere which is most highly productive of profitable results. Home and overseas buyers, who know how important it is to meet the producing firm and desire to receive invitations to the Fair, should communicate with the General Manager, British Industries Fair (Birmingham), 1921, 95, New-street, Birmingham.

Correspondence.

CRISIS IN THE ELECTRICITY SUPPLY INDUSTRY.

TO THE EDITOR OF THE ELECTRICIAN.

Sir : Whilst welcoming the frank criticism contained in the letter from "Electricity Undertaking," published in the last issue of The Electrician, we should like an opportunity of dealing with some of the points raised.

In the first place, we desire emphatically to demur to your correspondent's statement that the National Joint Board is a self-constituted body. As a matter of fact it was set up with the cognisance, and in many cases with the definite approval, of the Electricity Undertakings throughout the country, and of the various associations which represent them. A brief outline of the events which led up to the formation of the Board should make this absolutely clear.

As it has been frequently pointed out, a rider was included in award 9,281 to the effect that the parties to the negotiations, should proceed to settle basic rates. On March 19th, 1919 a circular was sent out by E.P.E.A. to all Statutory Electricity Undertakings drawing their attention to the rider and requesting them to appoint a representative body with which the negotiations should proceed, and urging the necessity for the formation of an Industrial Council for Staff Officials. Many Undertakings replied that they were in favour of setting up such a body, and intimated that they were referring the matter to the Standing Conference or to the Association which represented them. A number of undertakings did not reply ; presumably they did not take the E.P.E.A. seriously, or were of the opinion that it ought not to exist or to be encouraged.

On April 16th, 1919, a notification was received from the Secretary of the Standing Conference, to the effect that the constituent Associations in the Conference (*viz.*, the I.M.E.A., the Incorporated Association of Electrical Power Companies, &c.) were prepared to negotiate basic rates with the E.P.E.A., and to make recommendations in connection therewith to the constituent members. On May 30th, a communication was forwarded to the Secretary of the Conference, informing him that the E.P.E.A. had prepared a Schedule of Salaries, and drawing his attention to the two clauses contained therein with regard to—

(1) National Joint Boards.
(2) District Joint Boards.

with the following comments :—

> "The Executive Council of this Association considers that these two clauses constitute the basis of the whole schedule, and that before any consideration can be given to the remainder, it will be necessary to have an agreed decision upon these vital matters."

Some months prior to this period, the preliminary Conference for the setting up of a joint Industrial Council for the Elecricity Supply Industry was held, and though the E.P.E.A., was represented at this Conference, it was unsuccessful in securing a seat on the employers' side when the Council was set up, on account of the opposition of certain of the workers' trade unions. The formation of the National Joint Industrial Council caused the dissolution of the Standing Conference, and the subsequent negotiations in connection with the settlement of basic rates were conducted on behalf of the Associations representing the Undertakings by the Employers' side of the N.J.I.C.

Meanwhile, the E.P.E.A., in view of its failure to secure representation on the N.J.I.C., was pressing for the formation of a separate Whitley Council for the Technical Staffs, and finally it was agreed, on the advice of the Ministry of Labour, that a National Joint Board should be formed, consisting on the employers' side of representatives of four Employers' Associations. That this Board was not set up without the consent of these Associations, can be amply demonstrated. On December 30th, 1919, a letter was received by the E.P.E.A. from the Secretary of the I.M.E.A., intimating that the Council of the I.M.E.A. approved of the formation of an Industrial Council representative on the Employers' side of these members of the Staffs "*who are not eligible for representation on the*

Trade Union side of the existing Joint Industrial Council," and authorising the I.M.E.A. Representatives to serve on the National Joint Board. Further, the letter included an intimation that they agree to nominate Ald. Walker to act as their representative on a proposed Sub-Committee, which was to proceed at once with negotiations with the E.P.E.A. The National Joint Board, which was formed in December, set to work at once to consider the Schedule which was presented by the E.P.E.A.

On March 10th, 1920, a letter was sent to all Undertakings, notifying them of the Constitution of the Board, and recommending them to agree to accept the findings of the Board on all questions affecting members of the staff. Many Undertakings replied in the affirmative, some, however, ignored the communication. This, in the case of the members of the I.M.E.A., was followed on April 15th by a circular letter, explaining the proceedure which had been adopted in the setting up of the Joint Board, and specifically stating that the Board was considering matters relating to salaries and conditions of employment. The circular concluded that "the recommendations of these bodies should be considered as more or less morally binding on Undertakings belonging to this Association." It is not necessary to go any further and reiterate the statement regarding the resolution, which was unanimously passed at the Annual Meeting of the I.M.E.A. on June 21st. Sufficient has been said to show conclusively that it is quite inaccurate for Undertakings to plead at this time of the day, that "they were not consulted, and had no voice directly, or indirectly, in drawing up the Schedule, or knew that it was being prepared." They certainly had an opportunity of making their wishes known, and if they did not choose to avail themselves of it, the responsibility does not lie at the door of the E.P.E.A.

When your correspondent criticises the basis on which the Schedule has been built up, *viz.*, plant capacity, he is probably overlooking the fact that the schedule was drafted by a Committee on which were certain very prominent engineers, representing the employers, and that they accepted the basis as being the one likely to involve the fewest complications. If certain anomalies arise, such as are suggested by your correspondent, they can be dealt with on their merits by the District Joint Boards. With regard to his contention that the length of service is not taken into account in the Schedule, we would remind him that the figures laid down are *minimum salaries*, and there is no reason why undertakings which consider that length of service should be rewarded, should not make suitable increases to the schedule figures. We are sorry to note that your correspondent takes up the position that it is doubtful whether undertakings are likely to permit of interference by outside bodies. Surely he must recognise that so long as salaries and wages are determined as they have been in the past, solely by the unregulated operation of the law of supply and demand, or any individual bargaining between the staff and the employer, strikes will become the usual feature in the supply industry, and not the exception. As regards the technical staff, the most urgent need has been for some kind of uniformity of salaries to replace the chaos which has hitherto existed.

We quite agree with him when he states that the increase involved in some cases amounts to as much as 20 per cent., but we can also supply evidence where the schedule involved no increases at all. No other proof is needed of the lack of uniformity which at present prevails.

The tilt which your correspondent makes at the doubtful qualifications possessed by junior engineers in the smaller stations is very superficial. It must surely have occurred to him that the deterioration in the personnel in the electricity supply industry—the truth of which no one will deny—has almost been entirely due to inadequate remuneration. Is it to be wondered at that efficient and highly trained men cannot be secured at the intolerably low salaries usually offered by such undertakings! I am, &c.,

W. Arthur Jones,
General Secretary,
Electrical Power Engineers Association.
London, December 7.

CRISIS IN ELECTRIC SUPPLY INDUSTRY.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: With reference to the national strike threatened by the Electrical Power Engineers Association, I think it would be of interest generally to explain the position of my committee in the matter, as our membership includes some 120 provincial electric supply companies.

In regard to the schedule of salaries put forward, my committee sent out a recommendation to all their constituent members to pay this schedule of wages for the technical engineers, as recommended by the National Joint Board, wherever the particular company's financial position enabled it to do so. A large number of the provincial electric supply companies are in so serious a financial poistion that it is quite impossible for them to pay the extra salaries involved without making further charges to consumers. In most cases companies are already charging to consumers as much as the Ministry of Transport allows, and they cannot by law charge any more than the maximum sum fixed by the Ministry. The whole crux of the matter is, therefore, whether the Ministry of Transport will authorise higher charges to be made in order to meet these extra demands of the unions. In such case the Provincial Committee recommend the undertakings to pay the schedule wages if and when they obtain the necessary power to charge increased rates for supply. Certain companies have been reduced to these financial straits through the high cost of material, especially coal, and the continuous advance in salaries and wages of workmen, so that the threat of a universal strike, therefore, bears particularly hard upon such companies, since it is not the willingness to pay that is in question, but the ability to do so, and this is entirely outside their power and rests entirely with the Ministry of Transport, as explained.

My committee have, as a matter of fact, been in communication with the Ministry of Transport on this matter of obtaining relief in necessitous cases, and the Ministry are keenly alive to the situation. In a number of cases where the schedule has not been fully adopted, it is only fair to say that the local conditions are such that a corresponding modification of the national schedule is required—and this applies not only to the schedule, but to the general conditions of working therewith embodied. The crisis having arisen, it is to be hoped that the matter may be fully thrashed out and the discrepancies and anomalies prevailing disposed of equitably.—I am, &c.,

T. W. Cole, Secretary,
The Provincial Electric Supply Committee of
the United Kingdom.
Moorgate-court, Moorgate-place, London, E.C. 2.
December 3.

KELVIN *V.* KAPP.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: I trust that no hearer's feelings were harrowed by the hurt tone which your representative thought he detected in my remarks on Mr. Kapp's paper. My real sentiment was admiration—in the full sense of that word :

1. That the author had written a paper on the economics of electric distribution without once mentioning Kelvin's law.

2. That his indication that Kelvin's law does not hold for E.H.T. distribution is given by paragraphs which on the face of them, mean something quite different.

3. That while he does not say, why, how, or in what direction Kelvin's law fails to meet E.H.T. conditions, what he does say may be read as a suggection that heavier loading of E.H.T. cables is justified, whereas the fact is that lighter loading is necessary to keep the cable temperature within safe limits.

4. That he gives no proof that the economic load is excessive as to heating for E.H.T. cables, or any guidance for determining at what points (*i.e.*, voltage, conductor size, cost of conductor as cable, cost of energy) the economy law has to give way to heating considerations. Nor does he make any suggestions as to what are safe temperatures for cables, or the loadings corresponding to such temperatures, or the nature of the relations between voltage and safe loadings.

5. That while he sets out a very ingenious and simple way of equating the temperature rise due to an actual variable load to that due to a continuous load; he omitted to offer any proof—practical or theoretical—of the proposition on which the method is based. That proposition is not even set out in words, though it is conveyed by the equation to a heating curve given on *P* 10 of the paper; without, however, any suggestion that the curve so defined assumes conditions of environment which may not always obtain; or any guidance for evaluating the constants which give the equation practical value.—I am, &c.,

London, Streatham, S.W., **HENRY M. SAYERS.**
December 4

THE DISTRIBUTION OF ELECTRICITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your report of the discussion on the above paper at the Institution, you made me say that while the cost per K.V.A. per mile at 30,000 volts for the cable alone was £0·4, that nevertheless it rose to £0.55 for 60,000 volts, "falling steadily as the voltage rose." As a matter of fact, I made a slip when speaking, but corrected myself instantaneously, giving the figure of £0·27 for the higher voltage. As the statement reads it is of course contradictory, and I should be much obliged if you would publish this correction.—I am, &c.,

Birmingham, December 3. **A. M. TAYLOR.**

SEVERN BARRAGE SCHEME.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I was very interested to see in to-day's "Daily Telegraph" further details of the above scheme, especially those relating to the type of turbine and direct-current generator with step-up gearing that it is proposed to employ.

It is interesting to note that the arrangement for the Severn is the same as that which has been in use at the Chester hydro-electric installation, so successfully, during the last seven years, and although the actual turbine proposed is of similar capacity to those in use at Chester, the generator, owing to a fall of 30 ft. being available at low tide, necessitates the use of a larger dynamo than can be used here.—I am, &c.,

Chester, December 3. **S. E. BRITTON,**
City Electrical Engineer, Chester.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I should like to make the following comments on the proceedings at the Special Meeting of the Institution of Electrical Engineers on Thursday last: After the remarks of Mr. J. E. Kingsbury and the consent of Mr. W. R. Cooper to withdraw his amendment it would have been a gracious act on the part of Mr. F. W. Purse had he respected the wish of the meeting and allowed the resolution of the Council to be unanimously passed.

Mr. Purse has worked hard in this matter and great credit is due to him, because many engineers who are members of the Institution take little or no interest in its affairs, but he would have gone up immensely in the estimation of the meeting had he consented to withdraw his amendment, or, alternatively, have asked permission to leave the meeting with his fellow "conspirators." Those present were greatly annoyed by his unnecessary obstinacy.

The patriotic note struck by the President when he said, "Was the great work of the Institution to go on?" should be made to ring true throughout the industry. There are small matters of difference arising out of the discussion at the meeting, but members generally may have confidence in the Council satisfactorily to adjust these to all concerned.—I am, &c.,

London, December 6. **W. E. WARRILOW,**
Associate Member.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Doubtless the special meeting held on Thursday evening in regard to the proposed increase in subscriptions will receive your usual attention, but, I would like to emphasise two points which definitely emerge from the discussion:—

1. That the Council held out very little hope of cutting down of the present rate of expenditure.

2. That the Council do not propose to entertain the suggestion of distributing any increase in cost equally or proportionally amongst *all members* or to maintain the present differentiation in subscriptions or to increase the entrance fees, or to ask the life members to pay their share of the increased costs.

As it was shown that the "Journal" alone will cost approximately £1 per member for the coming year, and the Students' Subscription is to be kept at £1 1s. per annum, the inequality of the proposals is obvious.

As I still hold that an injustice will be done if the original proposals are carried, I must vote against them at the Confirmatory meeting to be held on the 17th, and am willing to again receive any proxies from members holding similar views, but I must point out that a far greater number must be returned if any protest is to be effective.—I am, &c.,

West Ham, **FREDK. W. PURSE, E.M.C.,**
December 4. Engineer and Manager,
West Ham Corporation Electric Supply.

CO-ORDINATION IN LIBRARIES AND ABSTRACTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The remarks of your contributor, Mr. A. B. Eason, in his article, "Co-ordination in Libraries and Abstracts," in your issue for October 22 last, are naturally of considerable interest to me; but he is in error in stating that the abstracts in the "Technical Review," which, by-the-way, is published weekly, as from October 12 last, are taken from 209 periodicals. That statement might have been true during the early part of this year; but at present upwards of 800 journals, reports, &c., are regularly received from all parts of the world and examined; indeed, so long did the list become that it was impossible to print it on two pages of the "Review," even when arranged in three columns, and it has now disappeared, since it gave an entirely erroneous impression of our resources.

The rapid growth which this indicates has been due simply to normal and intensive development, as it is not till one sets out to cover the world's technical literature relating to engineering, that the enormous field usually unknown is discovered, and it by no means follows that the less well-known reports, periodicals, &c., are of little value, since it is frequently due to the fact that their circulation has been strictly limited in the past to a select circle of readers.

May I suggest that the functions of the three abstracting periodicals referred to by Mr. Eason as published in this country are entirely different, and these form the *raison d'etre* for their existence.—I am, &c., **A. GRAHAM CLARK,**

London, Dec. 7. Editor "Technical Review."

THE ELECTRIC WASHER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: *Re* your article, "The Electric Washer," by "Electrocynic," in your issue of November 26, the concluding paragraph is really the only significant fact in it, for the writer more or less admits that his statements are written with an ulterior motive, and to save his personal expenditure.

Having had an electric washer in my own home for over fourteen months, I can definitely state that it is a wonderfully efficient labour-saver. Previously, wash-day was an all-day affair, from 9 a.m. to 4.30 p.m. Now double the work is accomplished—washed, rinsed, mangled, and dried, by 12.30 p.m. The drying operation is assisted by an electrically-heated galvanised cupboard, which projects 12 in. from the wall, is 6 ft. long by 4 ft. wide. The clothes are arranged on a "horse," which runs on rollers. One maid manages the whole wash. The hot water is drawn from the ordinary hot-water supply.

In less than 54 weeks, the total cost of the washer, plus 10 per cent. interest, has been saved. There have been no mishaps, and so far nobody has been drawn through the electric mangle. However hard the user trys to get through, she won't succeed, on account of an automatic cut-out which operates when the machine is overloaded.

My suggestion to your correspondent is to take advantage of proved, modern equipment, for he will then be rapidly convinced that his *assumptions* regarding "The Electric Washer," are incorrect.—I am, &c.,

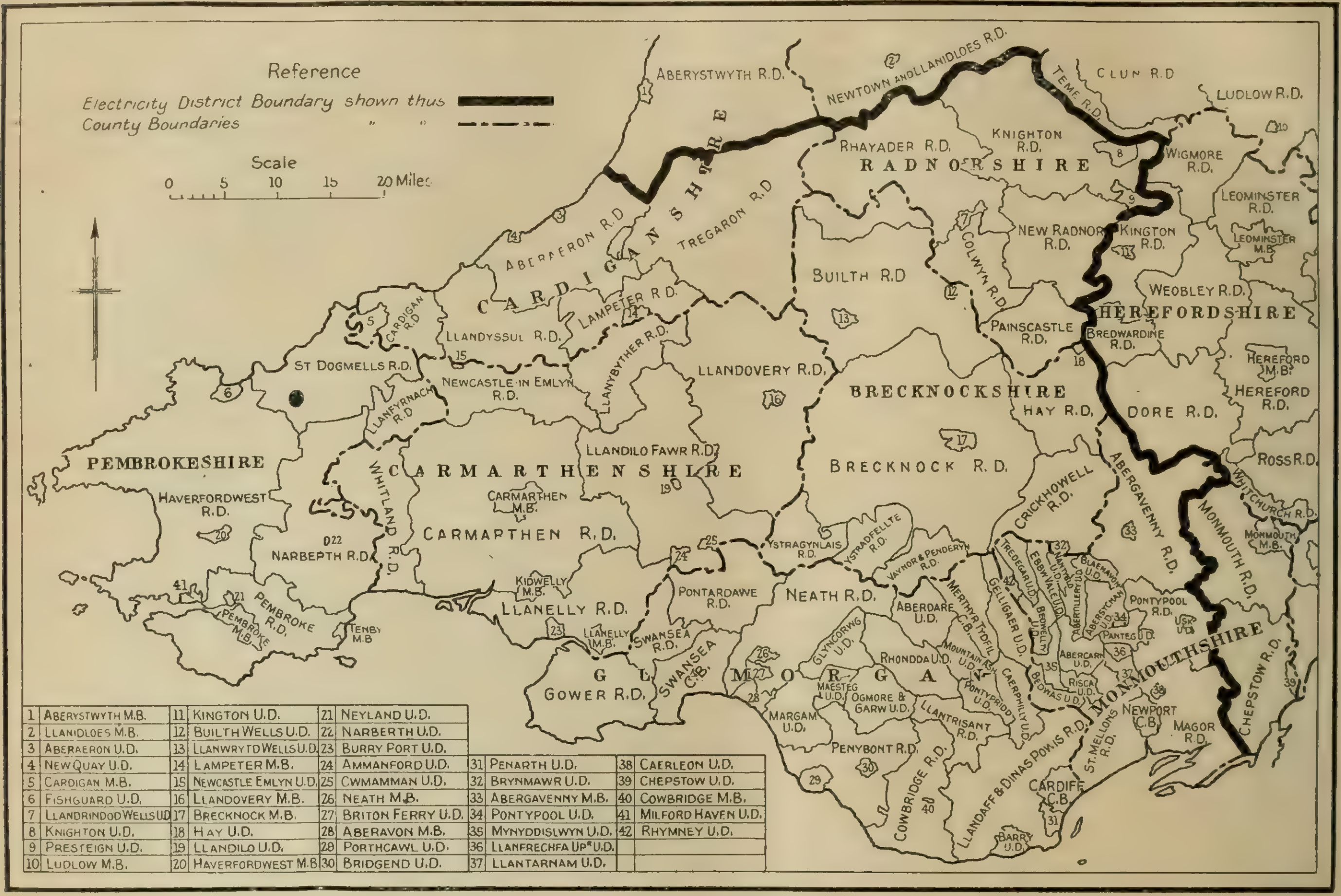
London, December 4. **L. G. HAWKINS.**

Electricity Districts.

The Electricity Commissioners have provisionally determined the limits of the area of another electricity area, viz., the North Lancashire & South Cumberland Electricity district. The district comprises: so much of the County of Cumberland as is included in the Urban District of Millom, the rural district of Bootle, and the detached portion of the township of Nether Wasdale in the rural district of Whitehaven; so much of the County of Lancaster as is included in the County Borough of Barrow-in-Furness, the Municipal Boroughs of Lancaster and Morecambe, the Urban Districts of Carnforth, Dalton-in-Furness, Grange, Heysham and Ulverston, and the Rural Districts of Lancaster, Lunesdale and Ulverston, and so much of the County of Westmorland as is included in the municipal borough of Kendal, the urban districts of Ambleside, Grasmere, Kirkby Lonsdale and Windermere, and the rural district of South Westmorland.

Objections to, or representations in regard to the proposed district must be sent by April 30, 1921, to the Secretary of the Commissioners. It is also notified that the Commissioners intend to hold a local inquiry into the improvement of the organisation of electricity supply in the district, and schemes for effecting such improvement may be submitted on or before the above-mentioned date.

In regard to the Lower Severn Electricity District, which was provisionally determined on the 30th April last, the Electricity Commissioners will hold a local inquiry at the Council House, Bristol, on January 11, 1921, and following days, with reference to the area to be included in the district, the objections and representations made on account of the inclusion in or exclusion of certain areas, and to consider a scheme which has been submitted for effecting an improvement of the existing organisation for the supply of electricity in the said district. Copies of the scheme, which provides for the formation of a Joint Electricity Authority for the district, may be obtained at a cost of 5s. each from Mr. H. Faraday Proctor, The Exchange, Corn-street, Bristol. Representations or objections with regard to the scheme should be addressed to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W.1, by January 4, 1921, and a copy of such representations or objections should also be sent to Mr. H. Faraday Proctor.



1	Aberystwyth M.B.	11	Kington U.D.	21	Neyland U.D.				
2	Llanidloes M.B.	12	Builth Wells U.D.	22	Narberth U.D.				
3	Aberaeron U.D.	13	Llanwrytd Wells U.D.	23	Burry Port U.D.				
4	New Quay U.D.	14	Lampeter M.B.	24	Ammanford U.D.	31	Penarth U.D.	38	Caerleon U.D.
5	Cardigan M.B.	15	Newcastle Emlyn U.D.	25	Cwmamman U.D.	32	Brynmawr U.D.	39	Chepstow U.D.
6	Fishguard U.D.	16	Llandovery M.B.	26	Neath M.B.	33	Abergavenny M.B.	40	Cowbridge M.B.
7	Llandrindod Wells U.D	17	Brecknock M.B.	27	Briton Ferry U.D.	34	Pontypool U.D.	41	Milford Haven U.D.
8	Knighton U.D.	18	Hay U.D.	28	Aberavon M.B.	35	Mynyddislwyn U.D.	42	Rhymney U.D.
9	Presteign U.D.	19	Llandilo U.D.	29	Porthcawl U.D.	36	Llanfrechfa Upʳ U.D.		
10	Ludlow M.B.	20	Haverfordwest M.B	30	Bridgend U.D.	37	Llantarnam U.D.		

South Wales Electricity District.

Fuel Oil Problems.

At the November meeting of the Diesel Engine Users' Association, Mr. Napier Prentice stated that he had communicated with the President (Mr. Charles Gould) to suggest that the present moment was opportune for again considering the question of fuel oil supplies, which was a matter of paramount importance to Diesel engine users. He urged the importance of using, if possible, home produced creosote in place of imported fuel oil. Even if it was not possible to obtain a sufficiency of suitable home-produced fuel oil, he thought that users should take some action to endeavour to secure for themselves suitable supplies at a reasonable price by co-operation or by supporting any concern that was based on the principle of co-operation between the users, British tar and oil distillers and other British interests. The suggestion that the Association should buy supplies of fuel oil for distribution among its members had been considered a few years ago, but it was found to be impracticable, partly because many of the Diesel engine users in this country are municipalities, who could not provide capital for a trading venture, and partly because the Diesel Engine Users' Association itself was not constituted as a trading concern. In these circumstances, he had stated his reasons for taking an interest in the National Fuel Oil Company, which had been formed on a co-operative basis, and was essentially a British concern, whose objects were those which the Association itself approved but was unable to carry out.

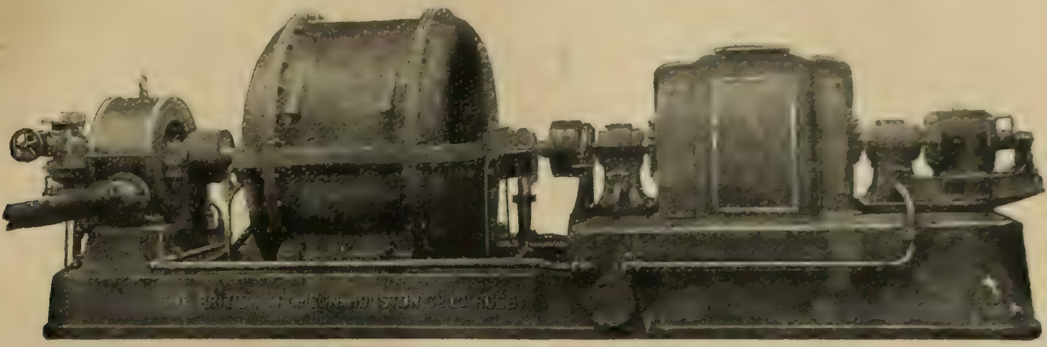
In the discussion which followed several members expressed their surprise that, as it had been considered necessary to restrict the exportation of coal at present, it should not equally have been considered in the national interest to prevent the exportation of creosote oil, the increased use of which as a liquid fuel would relieve the coal situation.

The discussion on Mr. A. J. Wilson's Paper on "The Recovery of Lubricating Oil," adjourned from the previous meeting, was continued. The Paper, with the report of the discussion, is to be circulated among the members; but there will be a certain number of spare copies which can be obtained on application to the Honorary Secretary, Mr. Percy Still, 19, Cadogan Gardens, London, S.W.3.

Electrically Driven Blowers.

The use of the centrifugal compressor for pumping or compressing air and gas for a variety of purposes is steadily increasing. This is not surprising, for this type of equipment possesses most of the advantages which are peculiar to the turbine system generally, and is especially blessed in the fact that it possesses no wearing parts other than the bearings, and as these can be automatically lubricated in the same manner as steam-turbine bearings the wear is negligible, and a comparatively light foundation is required as the moving parts are both light and balanced. It has also the capacity for taking large temporary overloads and of maintaining its high initial efficiency for considerable periods without any great renewal or maintenance costs being necessary. This high efficiency is, of course, due to the recovery in the form of pressure energy of nearly all the velocity energy which in compressors of the ordinary fan-blower type is dissipated in the form of heat. As there are no valves, leakage due to the wear of this accessory is eliminated.

A firm which has for some long period carefully considered the design and manufacture of this important class of apparatus is the BRITISH THOMSON-HOUSTON COMPANY, and the accompanying illustration shows a cupola or gas-producer turbo-blower with a capacity of 10,000-cubic ft. delivery of air per minute against a pressure of 4½ lb. per square inch at a speed of 3,000 revs. per min. This blower is of the double-stage type and is arranged so that it may be coupled by means of clutches to either the steam-turbine or a synchronous motor, thus doubly ensuring that the supply of air will be maintained. The synchronous motor is connected to a 1,000-kw. network and is used as a synchronous condenser for correcting the power factor. The exciter, which is shown connected to the outer end of the motor shaft, provides the necessary excitation for load conditions. The British Thomson-Houston Company have recently issued a comprehensive catalogue textbook dealing with this important subject in which the various problems of design which have been met in producing this class of apparatus are exhaustively dealt with.



A B T.-H ELECTRICALLY DRIVEN TURBO-BLOWER.

Parliamentary Notices.

The following notices of intention to promote Bills in the ensuing ssion of Parliament have been published :—

ELECTRICITY SUPPLY BILLS.

Colne Corporation : To increase maximum charges for electricity supply ; to lay electricity mains in private streets, and to confer further powers in regard to electricity undertaking.

Leyton Urban Council : To provide showrooms for the exhibition and demonstration of electrical installations ; to cut off supply of electricity where used contrary to terms of agreement ; to require minimum payment for electricity taken on extraordinary occasions or used as standby ; to confer powers of entry on premises for the purpose of ascertaining amount of energy consumed or for removal of fittings, &c.

Batley Corporation : To supply electricity or gas to premises in private streets ; to exempt from obligation to supply same in certain cases, and to authorise payment of expenses for re-connection ; increase of maximum price for electricity ; to construct sub-stations in streets ; to provide and maintain showrooms, &c.

The *County of London Electric Supply Company* intend to promote a Bill to acquire land in the urban district of Barking, to erect and work generating stations ; to pay interest out of capital ; to constitute the Barking supply undertaking a separate undertaking, to repeal Section 5 of the Company's Act of 1918, &c.

ELECTRIC TRACTION BILLS.

Hastings Tramways Company : To authorise extension of tramways to Fishmarket ; to alter or modify existing fares, &c.

Durham County Council : To construct and work tramways and trolley vehicles in the Administrative County of Durham and the county boroughs of Gateshead and Sunderland ; to provide and work motor omnibuses,, &c.

The *Chatham & District Light Railways Company* are promoting a Bill to authorise the conversion and subdivision of all or any of the shares in the existing capital of the company, &c.

The Bill for the incorporation of a company to construct the THAMES DEEP-WATER WHARF AND RAILWAYS in Canvey Island in the Rural District of Rochford, will be again introduced this year, and power is sought to work the railway by electricity or steam, &c.

Burnley Corporation : To provide and run motor omnibuses which are to form part of the municipal tramways undertaking ; to make further provision in regard to the borrowing and repayment of money by the Corporation, including the suspension of any payments to any sinking fund for such period as may be specified, &c.

JOINT ELECTRICITY SUPPLY AND TRACTION BILLS.

South Shields Corporation : To revive powers and extend time for completion of tramways authorised by their 1915 Act ; to maintain and run motor omnibuses, to require passengers to form queues ; to extend area of electricity supply, &c.

Hoylake and *West Kirby* Urban Council : To provide and run motor omnibuses ; to enter into working agreements, &c. ; to authorise the Council to refuse to supply gas to persons in debt, &c.

St. Helens Corporation : To maintain and run motor omnibuses within and beyond borough ; to increase tramway fares and charges ; to enter into agreements for working and running powers ; to use trolley vehicles and trailer cars ; to increase charges for electricity, gas, &c.

Wigan Corporation : To construct tramways ; to increase tramway fares and charges ; and to enter into working agreements as to tramways ; to provide and work trolley vehicles ; to increase rates and charges for electricity supply ; to provide and maintain showrooms, &c.

Nelson Corporation : To provide and run motor omnibuses ; to make further provision in regard to the light railway undertaking ; to provide for the payment of a minimum charge for electricity supplied to consumers having a supply of gas ; to authorise the Corporation to provide, sell, let for hire, fix and maintain lamps, meters, electric lines, motors and other electrical fittings, &c.

Grimsby Corporation : To construct and work tramways ; to enter into agreements for working lines ; to provide and run omnibuses and trolley vehicles ; to supply electricity to premises in private streets ; to discontinue supply in certain cases ; to provide and maintain showrooms ; to enter into agreements for supply of electricity in bulk ; to alter method of charging ; to increase maximum price, &c.

Rotherham Corporation : To extend time for constructing tramways authorised by 1911 and 1915 Acts ; to authorise construction of additional tramways ; to increase maximum weight of trolley vehicles authorised ; to maintain and run omnibuses ; to confer further electricity supply powers, including the power to cut off the supply of electricity to consumers using same contrary to terms of any agreement ; to extend the provisions as to penalties for failure to supply under agreement, and the exclusion of liability for payment of damages ; to authorise a variation of price according to the purposes for which and the circumstances under which electricity is supplied ; to prohibit the supply of electricity by any persons supplied by the Corporation, &c.

Liverpool Corporation : Further tramway and omnibus powers and authority to construct new lines ; to enter into working agreements ; to purchase tramways outside city ; to construct electricity sub-stations under streets ; to lay mains in private streets ; to attach brackets to buildings ; to make by-laws as to wires, apparatus and fittings ; to require notice of discontinuance of supply, &c.

Leicester Corporation : To construct new tramways and alter existing lines ; to run trailer cars ; to construct track separate from highways ; to increase tolls and charges ; to run omnibuses beyond city ; to amend accident funds for the tramway, electricity supply and other undertakings, &c.

SCOTTISH PROVISIONAL ORDERS.

Under the Private Legislature (Scotland) Act, 1899, it is sought to incorporate a company for utilising water power in the Perthshire Highlands for the generation and supply of electric power. The water powers to be utilised include Lochs Ericht and Garry, and the river Truim, Bruar Water, Banavie Burn, Tarf Water, &c. The company ask for power to sell and distribute electricity in the counties of Perth, Kinross and Forfar ; and in parts of Inverness, Argyll and Stirling. The British Aluminium Company are reviving their Lochaber scheme of two years ago, and the Airdrie and Coatbridge want to form a Trust to acquire the local tramways.

Osrams and Elephants.

Conspicuous in the procession of Animated Posters, which took place on the Saturday prior to the opening of the Great International Advertising Exhibition at the White City, was the Osram elephant—a living representation of the popular G.E.C. poster and showcard. It being impossible to have a live elephant in the same position, relative to the lamp, as in the poster design, the arrangement adopted for the procession was to have a large plaster cast of an Osram supported on the elephant's back, the animal being suitably draped, as will be seen from the illustration. The elephant lumbered slowly along, and the joint efforts of four attendants were necessary to keep her up with the horses in front. She might, in fact, aptly be described as the "funny turn" of the procession, as by her antics she attracted the attention and excited the admiration of the thousands of sightseers who lined the route of the procession from Bayswater Road, via Hyde Park Corner and Victoria Street, to the Embankment and Surrey Street, where the procession broke up.

The Works Magazine.

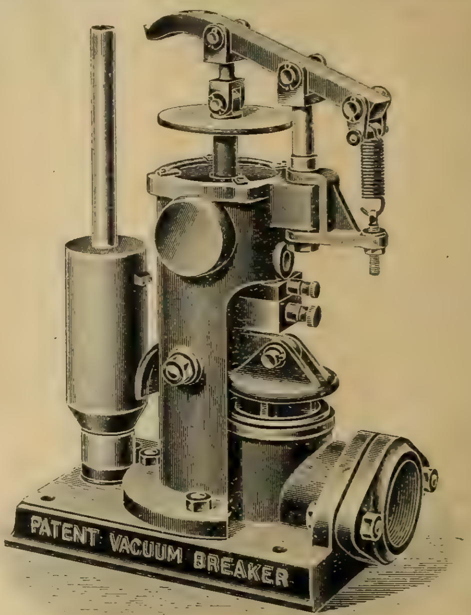
The first national conference of works' magazine editors was held at the offices of the Industrial Welfare Society on Monday last, under the presidency of Mr. Robert R. Hyde.

In the course of an address on "The Mission of the Works' Magazine," Mr. E. J. P. Benn said there were several agencies at work to-day having for their object the promotion of industrial harmony, but amongst all these agencies there was no more powerful force for good than the works' magazine. There were now no less than 200 of these house organs published regularly, and it was hoped that at this conference their editors would perhaps be able to arrive at something in the nature of a common policy, which would enable them to carry on their work with greater effect. The ideal policy for such a magazine might be summed up as "sympathetic reaction," for it came to light once a month to remind us that in the midst of all our present ethical endeavours its readers must not forget how to make the product of the establishment in which they were engaged. The works' magazine should deal particularly with the practical and technical side of the industry, and the interests of the individual engaged in that industry could be roused by bringing home to him the fact that success was not obtainable unless the common work of life was honestly, efficiently and economically performed by all of us. The works' magazine could supply that yearning for a wider interest which was now so evident, and the workers should be told in its columns everything there was to tell about the raw materials and machinery, the departments, markets, the processes, customers, and all the other interests which were to be found within the walls of any factory. If a magazine were to be successful, it must be looked upon as a mission, then its power would extend indefinitely and others would be encouraged to follow its lead.

Electrically Operated Vacuum Breaker.

Accidents such as that which recently occurred at Woolwich draws attention to the need for high-speed turbo-generating plant being fitted with some safety device whereby in case of necessity the set may be quickly brought to rest. As the turbine depends for about 50 per cent. of its power upon a high degree of vacuum, an easy means of doing this consists in breaking the vacuum, and an interesting electrically-operated device recently placed on the market by Messrs. Ledward & Beckett, Ltd., enables this to be done with great ease.

As our illustration shows the apparatus consists essentially of a heavy sliding weight with suitable starting and tripping gear, and an air admission valve arranged for connection to the main exhaust pipe of the turbine. The weight is fitted with a steel lug which engages with the end of a rocker bar fixed over the apparatus, and controlled at the opposite end by a strong spring so adjusted as to balance the weight. Between the fulcrum and the weight is attached the core of a solenoid, which is energised when the speed increases to an abnormal degree, and, drawing down the plunger, pulls down the rocker bar, and so releases the weight. This falls to the bottom of the guide rod, and in so doing forces down the toe of the air valve lever, thus allowing air to enter a 2½ in. pipe connected to the main exhaust and destroying the vacuum.



The electrical portion of this apparatus, which is manufactured by Messrs. Nalder Brothers & Thompson, Ltd., consists of a soft iron voltmeter relay (which normally indicates the line voltage, and is operated by a potential transformer), an electromagnet and switch, and a D.C. supply, which can generally be conveniently obtained from the exciter circuit. The primary of the potential transformer is connected across one phase of the alternator, the secondary being connected to the indicator relay, which is set to operate at a predetermined voltage in excess of the normal line voltage. When this voltage is reached a small platinum contact attached to the pointer of the instrument closes in the electromagnet circuit, which holds the needle firmly in position, and energises the main electromagnet mentioned above. The plunger is thus drawn into the solenoid, and the vacuum is broken as already described. An interesting feature of the apparatus is that the electrical gear automatically resets itself.

Labour Movements.

By ARTIFEX.

Discussions are proceeding between the Joint Committee of Coalowners and the Executive of the Miners' Federation, regarding proposals for the future regulation of wages.

Councillor Gregory, of the Amalgamated Society of Engineers, will be the Labour Candidate for Warrington at the next General Election.

Mr. Harry Gosling estimates that the fusion of the 19 unions affiliated to the Transport Workers' Federation into one Transport and General Workers' Union will produce a united membership of a million within a year.

The ballot of the members of the Union of Post Office Workers upon the question of the adoption of a strike policy and the creation of a strike fund, has resulted in a majority of 12,746 favouring the proposals.

Upon the question of railway control, Mr. J. H. Thomas, M.P., declares that railwaymen can do much to help in improving our transport system, and predicts a big fight over the matter in the next few months.

A provisional settlement has been made of the dispute between the stokers and the management of the South Wales Electrical Power Distribution Company by the provisional increase of 3d. per hour, subject to the decision of the National Council, which will be accepted as final by both parties.

Ampere-Hour Meters for Use on Electric Vehicles.

A short time ago we mentioned some features which should be present on all ampere-hour meters employed on electric vehicles. This important subject has now received the attention of the Electric Vehicle Committee, who recommend that the following general requirements should be complied with :—

1. The following capacities in amperes are to be recognised as standard : 30, 40, 60, 80, 100.

2. The meter should be capable of withstanding without injury a 400 per cent. overload for one minute (the normal load being the rated capacity of the meter as marked thereon), and should record any current flowing in excess of 5 per cent. of the normal current rating. The passage of an overload current (it being permissible to pass lower overloads for a proportionately longer time than one minute) should not cause oxidation of the mercury wherever such is employed in the meter.

3. The meters for use on road electric vehicles should be provided with a dial not less than 3½ in. in diameter. Meters intended for use on industrial electric trcuks and tractors should have dials not less than 2½ in. in diameter. The scale should be marked in divisions representing either 1, 5 or 10 ampere-hours per division. The main divisions of the scale and the figures should be so clearly formed that they can be read without difficulty by a person possessing normal eyesight at a distance of 5 ft. The standard dial ranges should be 100, 150, 200, 300, 400 and 500 ampere-hours.

4. The pointer should rotate clockwise on discharge and counterclockwise on charge, the pointer standing at zero when the battery is fully charged.

5. The needle should have a pointed end. A resetting arrangement should be provided and so constructed that it cannot be interfered with by an unauthorised person.

6. The meter should read correctly on discharge, but slow on charge, the percentage slowness being adjustable (from inside the case) within the limits of 0 to 30 per cent.

7. The meter should be provided with contacts arranged to close a circuit which will trip an automatic circuit-breaker for the purpose of interrupting the flow of the charging current to the battery when the needle of the meter has returned to zero during the charging operations. The trip coil contacts shall be capable of carrying a current of 1 ampere.

8. The error of a meter when tested should not exceed 5 per cent. at any part of the range from one-tenth of full-load up to 200 per cent. in excess of the full-load current. Full load is to be construed as meaning the normal rating of the meter in amperes. The error referred to above shall mean the variation from the true ampere-hours in the case of discharge, and in the case of charge the variation from the figure representing the true ampere-hours less the percentage slowness at which the meter has been set to work at on charge. The temperature at which a metter is calibrated shal be that given in the British Standards Specification (No. 37) for electricity meters—*i.e.* 15 deg. C.

9. The case of the meter and the terminals should be of substantial construction, the former being so made that it will effectively prevent the ingress of dust, water or moisture. No holes should be left through which moisture or dust could enter. If keyholes be necessary to fulfil the requirements they should be provided with covers.

10. The normal rating of each meter in amperes should be clearly marked upon the meter.

The Commercial Counsellor to H.M. Embassy in Rome has forwarded some particulars of the great reservoir and hydro-electric works which are under construction near PALERMO (SICILY) by an Italian firm. The main reservoir, which will be situated at Piana dei Greci, about 10½ miles from Palermo, will be rendered possible by the construction of a dam 34 metres high and 400 metres long. The "utilisable capacity" of the reservoir will be 15 million cubic metres. The water will be taken by means of a canal of 10 miles, six of which are tunnelled through the mountain, and aqueducts which lead into a reservoir cut into the rock having a capacity of 50,000 cubic metres. The water will then flow into a tunnel over half a mile in length, at a gradient of two per thousand, and thence be conducted into a pipeway to a level of 406 metres. It will thus fall 474 mteres, and will be used for actuating three groups of turbines and alternators developing 3,500 kw. each.. It is anticipated that the completed scheme will cost 40 million lire. An important feature of this enterprise lies in the fact that from the altitude of 406 metres it is possible to utilise the waters for irrigating more than 2,000 hectares of the cultivated lands, known as the Conca d'Oro, which until now were irrigated by means of thermal engines, thereby ensuring a great saving in coal. The plant will distribute 16 million units per annum, thus giving a great impetus to local industries. The overhead line, 2½ miles in length, will transmit current at 10,000 volts to Palermo.

The Organisation of Transport.

The announcement of the proposal to amalgamate no less than 19 dock and transport Trade Unions represents the most important labour movement of recent times. If the scheme now approved by the executive of all these bodies, secures, as it no doubt will, the support of the rank and file, a Trade Union with some 400,000 members will be brought into existence. It is important to notice that the constitution of the new body gives to the Executive the right to call a strike without previous consultation with the members as a whole. This complete organisation of transport workers on the road, for it excludes, of course, railwaymen, was only to be expected in view of the enormous rise in the importance of the transport industry since the war ended. The coming together of the workers is not so far balanced by any movement on so large a scale among the employers. Indeed, having regard to the variety of interests on the employing side of the transport industry, it is difficult to see how a big federation could be established at this juncture. The "Transport World and Motor Freight Exchange," the new weekly to be published by Messrs. BENN BROTHERS, LTD., in January, comes upon the scene at the psychological moment ; it is evident that the transport interests are beginning to talk themselves out, and that we are really witnessing the birth of a new industry, or, at least, a new industrial consciousness. The "Transport World" should be able to do much to guide these new developments and lead them in the right direction.

Legal Intelligence.

Lamp Sale Dispute.

In the Shoreditch County Court last week Mr. C. S. Engzelius (Weston Electric Lamp Company) sued the Electrical Manufacturing Company to recover £39 18s. 8d., balance of account for goods supplied. Defendants had a counterclaim of £50 for misrepresentation, alleging that they purchased half-watt argon gasfilled lamps, but the representation proved to be false. Counsel said plaintiffs were electrical lamp manufacturers, and they obtained an order per a man who did a little travelling for the lamps, the price being 5s. 6d., less 30 per cent. After delivery defendants conceived the notion that they had been defrauded and suggested that what was sold to them were half-watt lamps, but really the traveller sold half-watt type lamps.

The traveller was called and said he was certain he said half-watt type lamps. He amused the court by frankly admitting that he did not know what a half-watt was. The sales manager, who gave evidence as to the order and the despatch of the goods, said if there had been any complaint they would have changed the lamps, but defendants kept the lamps. They were made by the Stellar Company.

For defendants, evidence was given that the lamps were not efficient. They tested one to see if it was gas-filled and found it was not. The filament was ordinary Tungsten wire.

Judge CLUER : I cannot see that you have made out any misrepresentation. You could have returned them, but you have kept them to make an investigation.

Mr. ROBERTS (for defendants) : "I am entitled to do that, to see whether we shall sue for breach of warranty or recission of the contract." Taking all the circumstances into consideration, it was entirely improbable that his client would give an order for these lamps, unless he had the impression that he was getting an efficient half-watt lamp at a price that was cheaper than the half-watt lamp on the market, and was thereby making a bargain. "Is it likely that he would have agreed to pay 5s. 6d. less 30 per cent. which is higher than the market price, for the "vacuum filled" lamp, unless he thought he was buying, and would be able to sell, higher efficiency lamps, under the ordinary price of those lamps ? Plaintiffs are incompetent to say whether they are half-watt or not. They were sold recklessly, to the detriment of the purchaser, whilst we were relying on the skill of the seller."

Judge CLUER found there was no misrepresentation. He did not think they were held out to be half-watt and gasfilled ; it seemed impossible to him, and he regretted that a business man should have come and made such a pitiful exhibition of himself. The allegation was that the sale was by a careless seller, who sold in his spare time. Had he have been asked if they were gasfilled, he would probably have said "Yes," as he did not know enough about them to say "No." Defendant was the only one to blame, as he had a few faulty lamps, and would not return them. Judgment was given for plaintiff on the claim and counterclaim, with costs.

Electricity Supply Contracts.

Last week Mr. Justice P. O. Lawrence heard an application by the North Metropolitan Electric Power Supply Company for the cancellation of a contract made before the war, under which they supplied electricity in bulk to Stoke Newington Borough Council. The application was made under the Courts Emergency Powers Act, 1919, the ground being that, owing to the alteration of trade conditions due to the war, the continuation of the contract would inflict serious hardship upon the applicants.

Mr. Jenkins, K.C., for defendants, resisted the application, and said he would be a bold man who suggested that the rise in the price of coal and the demand for higher wages had not begun long before the war.

Judgment was reserved.

Commercial Topics.

Electrical Supplies for South Africa.

According to recent reports from South Africa, electrical supplies from the Continent are reaching South Africa at prices below those of English and American houses. The "Natal Advertiser" states that the Government is likely to undertake considerable expenditure on public works in Durban. These include a scheme for erecting a large electric power station at Durban, and the construction of the graving dock at Congella. Johannesburg Town Council recently decided to spend over £40,000 on the purchase of cables for the electric lighting and tramways department. Other local authorities are contemplating extensions of electric supply works, and there should be a good demand for electrical plant and supplies, &c.

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British Trade with the Continent.

An interesting speech on the necessity of opening up trading relations with Russia and other countries was made by Mr. Birch Crisp at the meeting of the British Bank for Foreign Trade last week. He said the trade of the United Kingdom was languishing because Europe lacked the stability which went with settled peace. European unrest had disorganised the trade of the British Empire. Until Russia, Germany and the other Continental States could absorb the surplus products of the colonies the outlook for British manufacturers was bad. Exporters could no longer sell bills upon Australia, New Zealand, South Africa or India, which was tantamount to saying that they could not be paid for the goods awaiting shipment. A partial relief had come since this country began to import freely dyes, clocks and various other goods from Germany. This country could afford to buy the articles enumerated because it earned large amounts by rendering services to world commerce. The sterling credits resulting from such importations enabled German houses to buy colonial produce on the London markets, the sale of which permitted colonial buyers to take our manufactures.

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The Demand for Economy and Bureaucratic Methods.

Just now there seems to be much talk about the need for economy and the curtailment of public expenditure, but judging by the way our bureaucracy is being steadily increased and strengthened we are afraid that little heed is paid to the demand for retrenchment. During the week details were published of the constitution of the new Mines Department. The Secretary for Mines is the Rt. Hon. W. C. Bridgeman, M.P., and the Permanent Under-Secretary is Mr. E. A. Gowers, C.B. There are four Assistant Under-Secretaries, a Director of Health and Safety, a Chief Labour Adviser and a Financial Adviser, with various minor officials to be appointed in due time.

The report of the Committee of Inquiry on the Employment Exchanges, which has also been published during the week, shows how rapidly a Government department can create officials. It is stated by way of preface, that "since the Unemployment Insurance Act, 1920, has increased the number of compulsorily insured persons from 3¾ millions to 12¼ millions, and since it contemplates the general administration of unemployment insurance through the employment exchanges its passage has affected the whole problem before the Committee. The general conclusion is that the employment exchanges must be retained as a national system, but in the interests of national economy they should be made fully effective for their purpose, and various recommendations are made for their improvements. Among these are (1) that the Ministry of Labour should immediately overhaul the central office, the divisional offices and the central claims and record office, with a view to curtailment, simplification and economy; and (2) the departments acting in respect of appointments and analogous matters arising out of the war should be absorbed with as little delay as possible in the employment exchange organisation. Since the exchanges were first estbalished in March 1910 the staff has increased from 524 to12,631 in June last.

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Our Export Trade.

The Foreign Samples Exhibition of the Department of Overseas Trade has opened its new home, 7-11, Old Bailey, London, E.C., on Tuesday by the Right Hon. F. G. Kellaway, M.P. In the course of a short address, Mr. Kellaway said an important problem facing the country was the recovery of its overseas trade. Unless we re-secured and extended the position we previously held in the overseas markets tbe outlook would be grave. Our experience, however, since the war gave every reason for hope. Industry had made a remarkable recovery, but foreign buyers were now holding back, hoping for a break in prices. He hoped manufacturers who had not up to now engaged in the export trade would take advantage of the present lull to perfect their organisation for getting into the foreign markets as soon as the buying power of those countries was renewed. It was part of the duty of British trade representatives abroad to send to the Overseas Trade Department samples of foreign goods sold in their districts, with prices, the names of the customers who were buying the goods, &c. About 100,000 samples were shown in that exhibition, but the Department also sent samples of particular classes of goods to British manufacturers in various parts of the country. The number of samples that had been lent was 4,308. It had been found also that employees who were suspicious of employers' statements in regard to the keenness of foreign competition were prepared to accept the information collected there, and in localities where the Department had sent certain classes of goods it had been arranged for trade union representatives and shop stewards to see the exhibits, with the result that there had been an improvement in the work on the classes of goods in question. Another useful feature was that it had collected 15,000 foreign catalogues, which were at the service of British manufacturers.

Electricity Supply.

Reigate Council have received sanction to a loan of £2,000 for electric supply purposes.

Barnstaple Council have received authority to borrow £9,700 for plant and mains.

Tunbridge Wells Council have increased the war bonus of the electrical engineer (Mr. R. N. Torpay) from 10 to 20 per cent.

Bedford Corporation have applied for the sanction to borrow £20,000 to cover excess expenditure on the electric supply undertaking.

Hull Electricity Committee has been authorised to dispense with the services of women employees in order to make room for ex-Service men.

St. Helens Corporation are applying for the loan of £47,550 for additional plant and mains. The salary of the borough electrical engineer has been increased from £600 to £800 per annum.

Application has been made by the Morecambe Council for sanction to borrow £3,000 for electric light mains and services to the mew municipal houses.

Kirkcaldy Corporation has increased the salary of the Tramway Manager and Electrical Engineer (joint salary) from £575 to £675 per annum.

Colchester Council has applied for authority to increase the maximum charge for electricity to 1s. per unit. It is proposed to increase the charge for lighting 1d. and for power ¼d. per unit.

The City Council of Newcastle-on-Tyne has instructed the Parliamentary Committee to report on the question of the Corporation exercising the rights of purchasing the electric undertakings in the City.

Birmingham Corporation finds some difficulty in financing some of its big schemes, the chief of which is the building of the new generation scheme at Nechells. Further enquiries are being made by the Finance Committee but it is hoped to secure the Treasury assent to the flotation of stock.

The Electricity Commissioners have sanctioned a loan of £42,250 for the purchase of two new boilers for the Blackpool electricity works. The Electricity Committee has decided to install a system of oil firing as an auxiliary to the existing method, and an order has been placed with the Gretna Engineering Company for the installation of the apparatus.

West Ham Corporation has applied for sanction to a loan of £19,712 for the purchase of a 1,500 kw. converter, and the laying of high-tension main cables for linking up with the East Ham, Barking and Ilford electric supply undertakings. The Electricity Commissioners recently suggested that West Ham should supply electricity in bulk to East Ham, Barking and Ilford, and these districts will contribute to the initial expenditure in proportion to the length of connecting cable laid in their respective areas.

The accounts of Cardiff Electricity Department for the year ended March 31 show revenue £117,625, compared with £84,011 in previous year, and working expenses £76,355 (£61,599). Interest and sinking fund required £22,689 (£21,625) and net profit was £18,581 (£787), after provision out of revenue of £3,971 for new meters. Units sold, exclusive of traction suppiles, were 9,043,534 (9,193,918). Heating and domestic apparatus connected are equal to 3,077 kw., an increase of 855 kw., and motors connected 9,444 h.p. (increase 538 h.p.).

A conference of representatives of electric supply undertakings in Scotland was held in Edinburgh on the 29th ult., Councillor Bruce Lindsay presiding, in order to consider the question of forming a District Joint Board in connection with the National Joint Industrial Council for the electricity supply industry. After discussion it was decided by a majority to set up a District Board for Scotland, to deal with the technical staffs only. It was decided that the employers' representatives should meet the representatives of the Electric Power Engineers' Association at an early date to consider the situation in Scotland.

By way of increase of salary the Darlington Corporation has decided to pay the borough electrical engineer (Mr. Lunn) the bonus on any reduction effected in working costs per unit sold below the average of the 40 lowest municipal undertakings. Ald. Bates objected to the proposal because he thought the principal was a wrong one. Mr. Lunn was a most capable man and was not paid the salary his services commended. For many years he had kept the cost of generating electricity at the bottom of the list, and he thought the Council would be willing to give him a substantial increase of salary. The chairman of the Electricity Committee, Ald. Sir Charles Starmer, considered the proposal to pay commission would work satisfactorily. They would have keen competition to meet in respect to the supply to the new works, and they would not be able to do that unless they got costs down to a minimum. The proposal was ultimately adopted.

It is natural that the publication of the Severn Barrage Scheme of the Ministry of Transport should arouse a feeling of friendly rivalry in other quarters. Already the Liverpool Tramways and Electric Light Committee have instructed the City Electrical Engineer (Mr. H. Dickinson) to prepare a report as to the utilisation of the tidal water of the Mersey for the generation of electricity.

A Wallasey councillor has suggested that it might also be possible to utilise the Wallasey Pool. He thought that two tunnels would be required to empty it and two tunnels to fill it at high water. The passing of the water through the latter tunnels would drive the turbines for generating electricity at a big generating station somewhere on the Wallasey side. Sufficient electricity could be generated to supply Wallasey, Birkenhead, and the Dock Board with all the power they wanted.

Electric Traction.

Barrow Council has decided to purchase four additional electric vehicles for refuse collection.

A new subway, stairways and booking offices have been opened at the Charing Cross Station of the Underground Electric Railways Company during the week.

Mr. J. H Rider has been appointed arbitrator in the dispute between Torquay Corporation and the local tramways company as to the charge to be made for current for traction purposes.

Finding their original application for permission to increase tramway fares by 50 per cent. is not likely to meet the increased charges upon the undertaking, Colne Council have now decided to apply for sanction to put up fares 100 per cent.

Brighton Council has resolved to increase the tramway fares again in order to meet the increased expenses. Although it was decided, by a majority of one, to ask the Tramways Committee to prepare a system of 1d. stages, one member, Ald. Carden, prophesied that within a year a 3d. minimum charge would previal for both trams and omnibuses.

The severe gales during Friday and Saturday did considerable damage to overhead tramway and telephone wires, especially in the North. At Halifax two tramcars were blown over on Friday on a highly exposed portion of the Queensbury section of the route. For some time on Saturday only cars with uncovered tops were used.

At the meeting of Belfast Corporation on the 1st inst. it was announced that the first instalments of new tramcars had arrived. It was also stated that the temporary power station at Musgrave Channel had been started, and was giving them an additional 4,500 kw., of which Messrs. Harland & Wolff were getting 2,500.

The accounts of the Wallasey Tramways Department for the year ended March 31 show income £130,239, compared with £100,078 in the previous year, and working expenses, war allowances, &c., amounted to £100,587 (£69,869), leaving gross profit £29,652 (£30,209). Interest required £5,959 (£6,530), sinking fund £4,723 (£4,466), and instalments of loans £1,234 (£1,190). Of the remainder, £4,000 (as in previous year) has been placed to depreciation, £2,500 (£5,000) to deferred renewals suspense account, and £14,000 (£12,000) allocated for relief of rates. Receipts per car-mile were 21·24d. (18·76d.), and working expenses, including power, war allowances, &c., were 16·47d. Passengers carried were 21,435,873 (19,354,654) and car-miles run 1,465,595 (1,273,333).

A deadlock has arisen in connection with the recent demand of the tramway employees for a further increase of 12s. a week in wages. The companies owning tramways recently intimated their inability to concede the demand, but negotiations continued between the men and the municipal undertakings. On Tuesday, however, the conference between the parties at the Ministry of Labour proved abortive and the employers declined to consider any further advance or to agree to arbitration. We are not surprised at this development because during the past week or two many municipal tramway departments have published accounts which show that they are already working at a serious loss and any additions to the wages bill would only mean a still further loss and the closing down of some of the smaller concerns.

Personal and Appointments.

Mr. J. A. Bromley, of Leeds, has been appointed manager of the Keighley tramways and trackless trolley undertaking at a salary of £400 a year.

Mr. Robert P. Tod has been appointed an O.B.E. for special services during the war in connection with the British Aluminium Company's factory at Kinlochleven.

The professorship of metallurgy in the University of Manchester was recently offered to Prof. Benedicks, the Swedish scientist, but he has gratefully declined the offer, as he wishes to devote his activity to his own country.

Sir John F. C. Snell, member of Council of the Institution of Civil Engineers and past-president of the Institution of Electrical Engineers, has been appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

Mr. S. Douglas Cox, who since the inception of the company some seven years ago, has been chief electrical engineer of the Dubilier Condenser Company, Ltd., has now severed his connection with the company. Future communications should be addressed to him at 22, Tavistock-street, Covent Garden, London, W.C.2.

Educational.

The regulations governing the award of Admiralty scholarship in electrical engineering at the Royal Naval College, Greenwich, are under the consideration of the Board. Until further notice, however, a three-years' electrical course will be granted to the successful scholar, but only the boy who obtains the highest number of marks in three years instead of two years, as previously, will be awarded a scholarship.

An endeavour is being made to raise a loan of £500,000 for the University of Leeds. About £250,000 is required for a new laboratory for teaching and research in pure and applied science, especially in the chemistry, physics, engineering, textile, fuel and mining departments. The remainder will be applied for extensions of buildings, &c., in other departments of the university.

Miscellaneous.

The Will of Mr. Robert Stewart Bain, managing director of the London Electric Supply Corporation, has been proved, and the gross value of the estate has been returned at £70,624.

The late Sir William Mather, D.L., a former chairman of Mather & Platt, Ltd., and a member of Council of Owen's College and Manchester University, left estate of the value of £405,840, of which £394,896 was net personality.

Dame Beatrice Katharine Denison-Pender left estate of the value of £42,597. By the will, which was proved by her husband, Sir John Denison-Pender, G.B E., K.C.M G., Alex. R. Hardie and Wm. H. Burman, after some bequests to servants the property was left to her sons.

On the 1st inst. the staff of the Bristol depot of the Edison Swan Electric Company held the first of a series of Socials in the company's showroom, Mr. Fifield, district manager, presiding. After an informal music programme had been performed dancing followed.

An Efficiency Exhibition is being organised by the "Daily Mail," and will be held at Olympia, from Feb. 10 to 26. The object of the exhibition is to demonstrate a practical means by which a higher standard of efficiency can be obtained in production, distribution and transport.

It has been proposed that a re-union dinner for past and present British Thomson-Houston draughtsmen be held in London on a Saturday in the near future. It is hoped that those willing to support this function will write to Mr. J. H. Castell, Clun House, Surrey-street, Strand, London, W.C.

The recent ballot on the wages offer to employees of electricity undertakings in the Greater London (No. 10) Area has resulted in 3,788 votes being cast for acceptance and 1,957 against. With two exceptions, the Unions involved were in favour of acceptance, the members of the E.T.U. voting 1,484 for and 1,028 against.

The Christmas course of juvenile lectures at the Royal Institution will this year be delivered by Prof. J. A. Thomson on the "Haunts of Life." The lectures will commence on Tuesday, Dec. 30, when the subject will be "The School of the Open Shore." The following lectures will be on the "Open Sea," "The Great Deeps," "the Freshwaters," "The Conquest of the Land," and "The Mastery of the Air."

At Birmingham Police Court on Friday, Alfred Downes, trading as the Aston Electrical Company, was fined 40s. for unlawfully connecting a meter with an electric line without having given 48 hours' notice of his intention to the Electric Supply Department. It was stated that defendant's supply of electric current was cut off because he had not paid his account. It was found when a representative of the department went to remove the meter that the supply had been reconnected.

After the regular meeting of the Kelvin Lodge on the 26th ult. the reigning master, Mr. H. Porter-Cox, presided at the banquet over a gathering of 79 members and visitors, including Messrs. Leonard G. Tate, J. G. Hood, A. T. Turney, W. E. Warrilow, &c., and after an excellent musical programme everyone went away feeling that they had enjoyed a happy evening, and that the Kelvin Lodge was in for another successful year.

In reply to a question, Mr. Illingworth (Postmaster-General) stated in the House of Commons recently, that a series of experiments were recently made to test the feasibility of distributing news messages from a central distributing station by means of wireless telephony. The general results of the experiments were satisfactory so far as audibility of speech was concerned, but owing to the slow rate of transmission, and to the fact that the messages could be easily intercepted, the news agency, on whose behalf the experiments were made, had not seen its way to adopt the system. It was also found that the experiment caused considerable interference with other stations, and for the present the trials had been suspended. Experiments were, however, being made to test the practicability of using high-speed wireless telegraphy for news and commercial services, and promising results had been obtained.

The Fire Brigade of the Edison Swan Company, which is one of the oldest private fire brigades in the country, held their annual dinner in the staff cafe at Ponder's End Works on the 3rd inst. About sixty sat down to an excellent dinner under the chairmanship of Dr. C. E. Hiatt, the chief guests being the members of the Ponder's End Fire Brigade, who brought their motor fire engine with them in order to be prepared for any emergency. After the usual loyal toast, the vice-chairman, Mr. W. B. Clarke, proposed "the Visitors," and Second-Officer Walters (P.E.F.B.) responded. Some amusement was caused by the chairman demanding a count of the medals worn by two of the firemen present. The final result was Fireman Hull (Ponder's End F.B.) 37, and Capt. Hack (Ediswan F.B.) 28. The remainder of the evening was devoted to an excellent concert given by members of the Ediswan Girl's Musical Association and the Ediswan Entertainers.

The annual prize distribution at the Northampton Polytechnic Institute took place on Friday. The workshops and laboratories were open for inspection and demonstrations were arranged in the lecture rooms. Dr. S. Russell Wells, vice-chancellor of the University of London, who presented the prizes and certificates, said he believed that the capabilities of the British people were as great as ever, but it was up to the nation at large to supply the young soldiers of commerce with the necessary armament of education. He regarded the Northampton Institute as one of the great recruiting and organising centres from which went forth reinforcements to those who were engaged in the strenuous battles of trade and commerce.

The principal, Dr. R. Mullineux Walmsley, reported that work had now resumed pre-war dimensions and the number of students approached 3,000.

Business Items, &c.

Cecil Sutcliffe and Noel Williams, electrical engineers and contractors, 6, Wood-street, Cedar-street, Blackpool, have dissolved partnership.

A provisional agreement has been entered into by the directors of Baldwins, Ltd., and the British Mannesmann Tube Company for the fusion of the two companies by an exchange of shares.

Albert Bonnan and Benjamin T. Chonchol, trading as the Manchester Private Telephone & Electric Lighting Company, 25, Cooper-street, Manchester, have dissolved partnership so far as concerns Mr. Chonchol. Debts by Mr. Bonnan, who continues the business.

Stanley Jas. Potts and Norman Fawkes, civil and electrical engineers, 42, Baltic-chambers, Quayside, Newcastle-on-Tyne, have dissolved partnership so far as concerns Mr. Potts. Debts by Mr. Fawkes, who continues the business under the style of Potts & Fawkes.

Mr. Stainer Hutchins has acquired the control of the Thames Iron Syndicate, Ltd., which controls the Cowper-Coles Patents for the deposition of iron, and is arranging to install a plant in this country for the commercial demonstration of the process.

The Lanston Monotype Corporation, Ltd., 43 and 43a, Fetter-lane, London, E.C.4, has on sale a little machine called the Safe-Guard Cheque Writer, which, while writing the amount of the cheque, perforates the paper distinctly in such a way as to prevent subsequent tampering.

The business of the Patent Laughton Drive Company and that of Mr. H. Laughton, engineers' factor, of Nottingham, have been formed into a private limited company, under the title of the Patent Laughton Drive Company, Ltd. Correspondence should be addressed to the company at 84, Bridge-street, Sheffield.

Peter Allman and Wm. Turnbull Gray, trading as P. Allman & Company, electrical and mechanical engineers, 5, Queen-street, Manchester, have dissolved partnership, so far as concerns Mr. Gray. Debts by Mr. Allman, who continues the business. Mr. Gray will carry on business on his own account as an electrical and mechanical engineer at 22, Piccadilly, Manchester.

The trade will be interested in a striking poster issued by the British Electrical Development Association, Hampden House, 84, Kingsway, London, W.C.2, in connection with the movement to induce the public to buy electrical presents at Christmas and to popularise electrical appliances for household use. "Let's buy Electric Presents this year" is printed at the head of the poster, and this proposition is presumably being made by the lady in the picture to her male escort. Many electrical appliances would, undoubtedly, make attractive and useful presents, and the opportunity for pushing them afforded by the present season should not be neglected by dealers in electrical supplies.

The General Electric Company, Ltd., are making arrangements for the forthcoming removal of their stockrooms to their new premises in Kingsway, and they notify that goods sent by rail from provincial suppliers for delivery to their Queenhithe, Upper Thames-street and Little Trinity-lane warehouses may be forwarded by rail up to Dec. 17; after that date no further traffic is to be sent forwarduntil after Xmas, except urgent consignments specially ordered forward by passenger train. After Xmas all goods usually consigned to the above-mentioned warehouses must be consigned and addressed to the new premises at Magnet House, Kingsway, W.C. (goods entrance, Keeley-street). In regard to goods for the wire and cable departments from suppliers in the London area, these may be delivered by road to Upper Thames-street up to 4 p.m. Dec. 16, and from 9 a.m. Dec. 20 to noon Dec. 24, they may be delivered to Magnet House, Kingsway. Goods for Queenhithe and Little Trinity-lane may be delivered by road to these addresses up to noon Dec. 24. No traffic will be received at any of the premises mentioned during the week ending Jan. 1, 1921, and on and after Jan. 3 all goods usually delivered to Queenhithe, Little Trinity-lane and Upper Thames-street must be delivered to Magnet House, Kingsway.

Obituary.

The death occurred suddenly last week of the Earl of Bessborough, chairman of the London, Brighton & South Coast Railway Company. During his tenure of office, sections of the company's line were converted to electric traction, and a complete scheme for the introduction of electric working on the line from London to Brighton was formulated. The deceased is succeeded in the title by Viscount Duncannon, M.P., chairman of the London Electric Supply Corporation.

The death is announced of Sir Wm. de W. Abney, K.C.B., F.R.S., well known for his work on photography. He was born in 1844, entered the Royal Engineers when 17 and retired in 1881. For his researches into the phenomena of radiation he was awarded in 1882 the Rumford medal of the Royal Society, of which he had been elected a Fellow in 1876. He was the author of many Papers and books on photography and light. His treatise on "Photography with Emulsions" was long regarded as a standard work of reference, and his work, "Instruction in Photography," has run into many editions. In 1884 Sir William Abney was appointed assistant director for science in the Science and Art Department, and in 1888 he was made a C.B. He became a director in 1893 and assistant secretary six years later. In 1900 he was appointed Assistant Secretary to the Board of Education, and in 1903 he became scientific adviser to the Board. He was chairman of the Council of the Society of Arts from 1903 to 1905, and after acting in 1909 as a member of the International Exhibitions Royal Commission, was made a K.C.B. Apart from his work in photography, Sir William Abney was an authority on many scientific matters, especially those relating to colour vision.

Tenders Invited and Accepted.

Littleborough Urban Council invite tenders for the supply and laying of h.t. cables and roadwork. Tenders to the Clerk by Dec. 20.

The Société Nationale des Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels, invite tenders by Dec. 20 for a 10-ton electric crane.

Pontypridd Guardians require tenders by December 14 for three months' supply of electrical material, &c. Forms of tender from the Clerk.

Napier (N.Z.) Council require tenders by Jan. 17 for a 500 kw. gas-electric generating set. Specification at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1, until Dec. 15.

Eccles Health Committee require tenders by Dec. 15 for electric light installation work in 24 houses on the Ansen-street housing site. Specifications from Borough Electrical Engineer.

The Municipality of Salisbury (Rhodesia) invites tenders for the supply of electric generating plant, switchgear, cable and converters. Tenders to the Town Clerk, Town House, Salisbury, by noon Jan. 13, 1921.

Antwerp municipality require tenders by Jan. 25 for 20 5-ton electric cranes. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

The Victorian Railway Commissioners want tenders by Feb. 2 for various requirements, including axle generator train-lighting material and accumulator cells (contract 33,750) and miniature electric staff instruments (contract 33,694.)

Southampton Corporation invite tenders for the supply and erection of steel work for extensions to boiler-house; also extensions to boiler-house equipment. Specifications from the borough electrical engineer, Mr. W. G. Turner. Tenders to the Town Clerk, by noon, Dec. 17.

The Southland (N.Z.) Electric Power Board invite tenders, by Jan. 18, for supply of plant for the Lake Monowai hydro-electric scheme, including two 3,530 k.v.a. generators, a 105 kw. generator exciter, a 6,600/110 volt, 105 kw., motor-generator exciter, a battery charging set, a 60 cell battery, two 5,000 h.p. and one 150 h.p. water turbines, transformers, &c. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

The New Zealand Public Works Department require tenders by Feb. 11, 1921, for the supply and erection of steel pipe lines and fittings in connection with the Mangahao electric power plant. The Department also require tenders (by Jan. 21) for steel pipe lines and fittings in connection with the fourth pipe line for the Lake Coleridge electric power plant. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

The Rand Water Board (Johannesburg) invite tenders by Jan. 13 for the supply and erection of a steam boiler, superheater, stoker, economisers, &c. (contract No. 191), at the Swartkopjes pumping station; also steam turbo-driven centrifugal pump, condenser, piping, &c. (contract No. 192). Specifications may be consulted at the machinery section of the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

Electricity Commissioners of Victoria (Australia) invite tenders for the supply of plant and material required for the Morwell Power Scheme, including 25,000–12,500 kw. turbo-alternators, 600 kw. turbo-alternators, transformers, switchgear, cables, transmission steel towers, steel telephone poles, &c. Tender forms and specifications can be obtained from the Agent-General for Victoria, Victoria House, Melbourne-place, Strand, London, W.C.2, and drawings can be seen at the offices of Messrs. John Coates, & Company, Ltd., consulting engineers, at the same address. Tenders by noon Feb. 24, to Mr. R. Liddelow, secretary, Electricity Commissioners, 673, Bourke-street West, Melbourne.

Birkenhead Council have accepted the tender of W. T. Helney's Telegraph Works Company for h.t. mains at £8,832 16s., and that of the British Thomson-Houston Company for rotary converting plant at £4,660.

Bankruptcies and Liquidations.

Jas. Wm. Layton, electrician, 5, Nobles Bank, Hendon, Sunderland, has been adjudicated bankrupt.

Geo. Wm. Lester, formerly trading as Lester & Browne at 44 and 46, Surbiton-road, Kingston, Surrey, has been adjudicated bankrupt.

Claims against E. Goossens, Pope & Company, Ltd. (in vol. liq.), are to be sent by Dec. 31 to Mr. P. J. Payne, 36, Basinghall-street, London, E.C.

The public examination of Jas. Cruickshank Thompson, electrician, Station-street, Mansfield, took place at Nottingham last week. Liabilities were £185 and assets £115.

A meeting to receive an account of the winding up of the British Ever-Ready Company, Ltd. (in vol. liq.), will be held at the offices of the Ever-Ready Company (Great Britain), Ltd., Hercules-place, Holloway, London, N., on Jan. 6.

John Harrison, trading as Harrison & Son, electrical engineer, 93, Princes-street, Southend, was publicly examined at Chelmsford last week. Liabilities were £915 16s. 5d and deficiency was £665 16s. 5d. Debtor, who said all his assets were covered by a bill of sale, attributed his difficulties to strikes in the building trade. At a private meeting he had offered creditors 10s. in the pound, payable by instalments, but it had been refused. Debtor was ordered to file an assets account from May, 1920, to date of receiving order (Oct. 11), and the examination was adjourned.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1918 Specifications.

112,938 Corbino. Transformation of three-phase into practically constant direct currents. (8/1/16.)
152,696 Arno. Cooking stoves heated by electricity. (2/1/18.)

1919 Specifications.

130,595 Dubilier Condenser Co. Electric condensers. (1/8/18.)
131,583 Arntzenius. Telephone systems. (19/8/18.)
132,495 Automatic Telephone Mfg. Co. Impulse transmitting devices for use in connection with automatic or semi-automatic telephone systems. (13/9/19.)
132,784 Bolis. Ignition magnetos for internal combustion engines. (17/9/18.)
134,195 Bakker & Bureau voor Uitvinders. Distributing and draw-in boxes for electric conduits. (24/10/18.)
135,502 Burgess Battery Co. Electric dry cells. (19/11/18.)
140,045 Dubilier Condenser Co. Electric condensers. (7/3/19.)
140,046 Dubilier Condenser Co. High-potential electric condensers. (7/3/19.)
143,492 Graf. Switches for electric installations. (16/5/19.)
152,694 B.T.-H. Co. (G.E. Co.) Electric incandescent arc devices. (4/3/16.)
152,702 Lenaghan. Automatic telephone systems. (23/4/19.)
152,703 Barry. Methods of and means for reducing the lagging current on alternating current systems supplying induction motors and the like. (24/4/19.)
152,707 Coulson & Optalyte. Electrical signalling lamp. (28/11/19.)
152,709 Hope. Shade carriers for electric lamp holders. (10/6/19.)
152,710 Hope. Electric lamp holders. (10/6/19.)
152,716 Harrison. Repair or renewal of electric incandescent lamps. (18/6/19.)
152,727 B.T.-H. Co. & Wheat. Electric light fittings. (9/7/19.)
152,728 Parsons, Bennett & Rowe. Searchlight and other projectors. (9/7/19.)
152,733 Holslag. Electrodes for electric welding, cutting, reducing or like operations. (12/7/19.)
152,745 Thompson. (Compagnie Generale de Radiotelegraphie.) Telephone and the like systems and loading coils therefor. (17/7/19.)
152,758 Murray. Radio-navigational apparatus and the like. (18/7/19.)
152,759 B.T.-H. Co. (G.E. Co.) X-ray tube shields. (18/7/19.)
152,761 Timmons. Telephone transmitters. (18/7/19.)
152,781 Smith. Electric signs. (22/7/19.)

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APPLICATIONS FOR PATENTS

June 23, 1920.

17,030 Sinzig & Wenger. Switches. (9/10/19, Switzerland.)
17,042 Marks. (Gleichrichter A.G.) Heavy current relays.
17,047 Siemens & Halske A.G. Telegraphic reception. (27/9/18. Germany.)
17,048 Siemens & Halske A.G. Type printing telegraphs. (16/12/18, Germany.)
17,055 Allgemeine Ges fur Chemische Industrie. Heating device inelectric resistance furnaces. (13/3/19, Germany.)
17,049 Siemens-Schuckertwerke suspension insulators. (29/11/19, Germany.)
17,081 Garde. Electric lamp-holders.
17,082 Garde. Electric fittings.

June 24, 1920.

17,103 Jackson. Arc lamps.
17,123 Barker & Saxton. Locking device for electric, &c., hoists.
17,132 Bennett. Electric current interrupters. (24/6/19, U.S.)
17,135 Plant. Electrically welding steel.
17,144 Apollo Plug Mfg. Co. & Brown. Electric diaphragm alarms.
17,189 Siemens-Schuckertwerke. Electric machines.
17,195 Kuhn. Electric boring and drilling machines.
17,228 Parnacott. Terminals for electric cables.
17,239 Bureau voor Uitvinders & Bakker. Distributing, &c., boxes for electric installations.

June 25, 1920.

17,273 Dransfield. Telephone and telegraph receivers.
17,319 Schattner. Circuit making and breaking device.
17,334 Siemens-Schuckertwerke. Electric machines. (6/9/19, Germany.)
17,335 Siemens-Schuckertwerke. Electric machines. (12/1/17, Germany.)
17,348 Pechkranz. Electrolysers. (27/6/19, Switzerland.)
17,351 Malhomme. Electric heating apparatus. (19/8/19, France.)
17,360 Steward Davit & Equipment Corpn. Electric compensators. (25/6/19, U.S.)

June 26, 1920.

17,394 Sanders. Quick make and break switches.
17,408 Suchostawer. Magnetic motor.
17,413 Soc. Francaise Radio-Electrique. Electromagnetic wave receiving and transmitting arrangements. (3/11/16, France.)
17,471 Creed & Co. & Lenaghan. Electromagnetic relays.
17,472 Calvert. Voltaic batteries.

June 28.

17,497 Atkinson. Device for driving electric generating plant, &c.
17,545 B. T.-H. Co. (G. E. Co.). Electric regenerative control.
17,556 Couaillet. Electric vehicles with storage batteries. (19/8/19, France.)
17,558 Hungarian Elekthermax Co. (22/3/19, Hungary.)
17,564 Siemens-Schuckertwerke. Totally enclosed electric machines. (7/10/14 Germany.)
17,565 Siemens-Schuckertwerke. Electric machines. (30/3/16, Germany.)
17,589 Sokal (Luftfahrzengbau Schutte Lanz). Electric heating bodies.
17,590 Sokal (Luftfahrzengbau Schutte Lanz). Electrically heated cooking plates.
17,591 Igranic Electric Co. (Autler-Hammer Mfg. Co.). Thermally controlled circuit interrupters.

June 29.

17,709 Western Electric Co. Electric repeaters (20/5/19, U.S.)
17,723 North. Electrically separating dust from gases and vapours. (27/8/17. Germany.)
17,732 Marsollier. Electrical connecting devices. (8/2/16, France.)
17,733 Marsollier. Electrical connecting devices. (8/2/16, France.)
17,735 Siemens-Schuckertwerke. Electric machines. (29/1/16. Austria.)
17,744 Mond (International Precipitation Co.). Apparatus for electrical treatment of gases.
17,747 Daniels. Means for safeguarding electrical recording, &c., instruments against fraud.
17,769 Bunn. Switches.
17,775 Greir. Electric calculating machines.

June 30.

17,822 Garrard, Wilson & Soloman. Motor-controlling switchgear.
17,843 Torrance. Electric generators.
17,849 Cliffe & Rutter. Automatic electric switch mechanism for kinematograph apparatus.
17,857 Ges. fur Dnahtlose Telegraphie. Electro-magnetic wave receiving arrangements. (6/5/18, Germany.)
17,858 Ges. fur Dnahtlose Telegraphie. Thermionic tube amplifier. (16/11/15, Germany).
17,901 Boorne. Electrode for depositing molten metal.
17,946 Siemens & Halske, A. G. High-tension transformers. (30/6/19, Germany.)

Companies' Reports, &c.

An issue of £50,000 ten per cent. seven-year notes is being made by Messrs. Drake & Gorham, Ltd. The company has a fully-paid share capital of £125,000, with no debentures.

The revenue of the West African Telegraph Company, Ltd., for 1919 amounted to £75,041, from which is deducted £23,525 for ordinary expenses and £37,264 for maintenance of cables, sundry differences in exchange, payments to staff and other expenses incidental to the war, and special contribution to pension and superannuation funds towards depreciation of investments, leaving a balance (including £90 brought forward) of £14,343. There has been transferred to reserve £4,000, and a dividend of 4 per cent. (tax free) has been paid for the year, carrying forward £1,039.

The report of the directors of the Western Telegraph Company, Ltd., for the year ended June 30, 1920, states that the revenue amounted to £2,683,076 7s. 7d., and the working expenses to £939,933 3s. 9d. After providing £32,747 for debenture stock interest, and £687,992 15s. 6d. for income tax, excess profits duty and Corporation profits tax, the balance is £1,022,403 8s. 4d.; with £37,803 2s. 1d. brought forward the total is £1,060,206 10s. 5d. The directors have transferred £450,000 to general reserve fund, £145,000 to provision on account of investment fluctuations, £50,000 to the maintenance ships reserve fund, and £50,000 to the land and buildings depreciation fund. The expenses of issue of new capital and interest on instalments paid in advance on account of new issue amounted to £7,866 11s. 7d. One interim dividend of 1¼ per cent., two interim dividends of 2½ per cent. each, and a final dividend of 3½ per cent. have been paid, amounting together to £207,930, making a total distribution of 10 per cent. tax free, for the year, leaving £149,409 18s. 10d. to be carried forward. In accordance with the resolution passed at the extraordinary general meeting in March last, the capital has been increased from £2,500,000 to £3,500,000 by the creation of 100,000 shares of £10 each. The directors have appointed Mr. John Cuthbert Denison-Pender, M.P., to a seat at the Board.

For the year ended Dec. 31, 1919, the revenue of the Eastern Extension, Australasia & China Telegraph Company, Ltd., amounted to £2,446,865 17s. 4d., from which is deducted £605,990 14s. 1d. for ordinary expenses, and £355,790 9s. 3d. for maintenance of cables and special expenditure, leaving a balance of £1,485,084 14s. After providing £413,865 2s. 5d. for income tax and excess profits duty payable in England, and £30,096 for interest on the mortgage debenture stock, there remains £1,041,123 11s. 7d., to which is added £41,316 10s. 7d. brought forward, making a total available of £1,082,440 2s. 2d. Out of this the directors have placed £350,000 to general reserve and made a further provision of £200,000 towards investment fluctuations, making the total provision against depreciation £450,000. Three dividends of 1½ per cent. each and a final dividend of 5½ per cent. have been paid, amounting together to £300,000, making a total distribution for the year of 10 per cent., tax free. The above appropriations absorb £850,000, leaving £232,440 2s. 2d. to be carried forward.

In accordance with the authority given at the extraordinary general meeting in March last, the issue of 100,000 new shares was offered to the shareholders at par and taken up by them to the extent of 90,629 shares, leaving a balance of 9,371 shares, of which 2,165 represent the fractional shares still to be disposed of by the directors for the benefit of those shareholders entitled thereto. The remaining balance of 7,206 shares was allotted to the staffs of the Eastern Extension and Eastern Telegraph Companies at par. The vacancy in the directorate occasioned by the death of Mr. F. A. Bevan, has been filled by the appointment of Mr. J. C. Denison-Pender, M.P.

The report of the directors of the Eastern Telegraph Company, Ltd., for the year ended Dec. 31, 1919, states that the revenue amounted to £4,059,062 19s. 9d., from which are deducted £1,123,551 18s. 7d. for ordinary expenses, and £1,083,627 5s. 9d. for expenditure relating to maintenance of cables, sundry differences in exchange, income and war taxes payable abroad, share of contribution to the pension and superannuation funds towards depreciation of investments, and payments to staff and other expenses incidental to the war, leaving a balance of £1,851,883 15s. 5d. After providing for income tax and excess profits duty payable in England, interest on mortgage debenture stock, and dividends on the preference stock, which in all absorb £580,326 1s. 5d. there remains a balance of £1,271,557 14s. 0d., to which is added £44,524 19s. 4d. brought forward, making a total available balance of £1,316,082 13s. 4d.

The directors have placed £500,000 to the general reserve. Three interim dividends of 1½ per cent. each, and a final dividend of 5½ per cent. have been paid on the ordinary stock amounting together to £400,000, making a total distribution of 10 per cent. (tax free) for the year. These appropriations absorb £900,000 and leave £416,082 13s. 4d., which, in view of the additional heavy taxation, &c., in 1920, is carried forward. The general reserve fund has been charged with £573,264 17s. 7d. in respect of the new Porthcurnow—Gibraltar (No. 4) cable, partial renewal of main line cables and other special expenditure, and with £200,000 as a further provision on account of investment fluctuations, the result being a net reduction of the fund of £273,264 17s. 7d. In accordance with the authority given to the directors at the extraordinary general meeting in March last, the issue of 1,000,000 new ordinary shares of £1 each was offered to the ordinary stockholders at par, and was taken up by them to the extent of 933,121 shares. The staff was given the option of applying for the balance of 66,879 shares, and applications were received from them for over three times the number of shares available.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics."—"Aeronautics and the Universities"; "New Method of Testing Models in Wind Tunnels," by W. Margoutie; and "Airship Piloting," by Major F. H. Scott, C.B.E., A.F.C. (late R.A.F.), A.M.I.M.E.

"The Cabinet Maker."—"Spanish Furniture in London"; "Retail Advertising: The Use of Posters"; "Christmas Activity in the Furnishing Trade."

"The Fruit-Grower" (Book Number).—"The Value of Horticultural Literature"; Reviews of New Books; and "National Fruit Show Prospects."

"Gardening Illustrated."—"The Failure of the Fruit Crop"; "Pear Beurre Diel" (illustrated); and Gardening Literature.

"Gas World."—"The Hot-plate Efficiency of Gas Cookers"; "The Status of Engineers"; and "Model Constitution for Works Joint Committees."

"Hardware Trade Journal."—"Profit Sharing for Ironmongers"; "Single-edged Cutting Tools"; and "Electrically-driven Tinplate Mills."

"Chemical Age."—"Centrifugal Extractors and Separators as applied to the Chemical Industry," by Dr. Broadbent; "Polymerisation of Fatty Oils" (II.); and "What the Dye Industry Really Wants" (from a chemical correspondent).

"The Transport World."—First issue, Jan. 5, 1921.

Forty Years Ago.

(The Electrician, December 11, 1880.)

Electric Light at Havre.—La place Louis XVI., le Jardin Public, and la place de la Sous-Préfecture are about to be lighted by the Jablochkoff system.—*La Lumiere Electrique.*

Navigation by Electric Light.—We understand that important trials have been made lately on the Rhine in order that navigation may be carried on at night by means of the electric light.

The Electric Light in Bristol.—At the meeting of the Bristol Sanitary Authority last week, it was resolved not to accept the price offered by the gas company for lighting the city, and the Committee resolved to authorise the expenditure of £500 in an experiment for lighting the city by the electric light.

Mr. Swan's Patent.—The mystery of Mr. Swan's carbon is, we are told, at length disclosed. They are made of vegetable parchment—commonly called parchment paper—cut into strips and carbonised; they are then bent to the required shape and fixed inside the exhausted globes in the manner publicly described by Mr. Swan. The so-called vegetable parchment is paper prepared with sulphuric acid, whereby it becomes exceedingly tough and compact.

Prices of Metals, Chemicals, &c.

Tuesday, Dec. 7.

		Price.	Inc.	Dec.
Copper—				
Best selected.........	per ton	£87 0 0	£1 0 0	—
Electro Wirebars...	,,	£91 0 0	£2 0 0	—
H.C. wire basis......	per lb.	1s. 1½d.	¼d.	—
Sheet	,,	1s. 3d.	—	⅜d.
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. 5½d.	¼d.	—
Brass 60/40—				
Rod, basis	,,	0s. 9¾d.	—	—
Sheet, basis	,,	1s. 2¾d.	—	¼d.
Wire, basis	,,	1s. 2¼d.	—	¼d.
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£42 0 0	—	—
Lead Pig—				
English	,,	£28 10 0	£1 10 0	—
Foreign or Colonial	,,	£26 10 0	£1 0 0	—
Tin—Ingot	,,	219 0 0	£9 14 0	—
Wire, basis	per lb.	0 2 11	1d.	—

Salammoniac.—Per cwt. 110s.–105s.

Sulphur (Flowers).—Ton £16 15s.

,, (Roll Brimstone).—Per ton £16 5s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £40.

Boric Acid (Crystals).—Per ton £74.

Sodium Bichromate.—Per lb. 11d.

Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 2¼d.: plantation 1st latex, 1s. 1¼d. lb.

The metal prices are supplied by British Insulated & Helsby Cables.

The Editorial, Advertisement and Publishing Offices of "The Electrician" *are at 8, Bouverie Street, London, E.C.4. Telegrams: Benbrotric, Fleet, London. Telephone: City* 9853 (*4 lines*).

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Arrangements for the Week.

FRIDAY, December 10th.

Institution of Electrical Engineers.—Scottish Centre Students' Section.

7.30 p.m. At the Royal Technical College, Glasgow. Paper on "Static Transformers," by Mr. R. Dickson.

Physical Society.

5 p.m. At the Imperial College of Science, S. Kensington, London, S.W. Papers on "Some Slide Rule Improvements," by Mr. J. St. Vincent Pletts; "Absorption of Gases in the Electric Discharge Tube," by Mr. F. H. Newman; "A Sodium Vapour Electric Discharge Tube," by Mr. F. H. Newman; and "The Current Density in the Crater of the Carbon Arc," by Mr. N. A. Allen.

SATURDAY, December 11th.

Institution of Electrical Engineers.—Scottish Centre.

7.30 p.m. At the Institution of Engineers and Shipbuilders, Glasgow. Smoking Concert.

MONDAY, December 13th.

Institution of Post Office Electrical Engineers.

5.30 p.m. At the Royal Society of Arts, John Street, Adelphi, London, W.C. Lecture on "The Development of Wireless Telegraphy," by Mr. E. H. Shaughnessy.

Institution of Electrical Engineers.—Informal Meeting.

7 p.m. At the Chartered Institute of Patent Agents, Staple Inn-buildings, High Holborn, London, W.C. Discussion on "Percentage and Accuracies"; "Meter Constants and Standards," and "Name-plates," opened by Mr. W. J. Minton.

Institution of Electrical Engineers.—Liverpool Sub-Centre of N.W. Centre.

7 p.m. At the University, Brownlow Street, Liverpool. Papers on "The Distribution of Electricity," by Mr. W. B. Woodhouse, and "Some Economic Aspects of E.-H.-T. Distribution by Underground Cables," by Mr. R. O. Kapp.

Institution of Electrical Engineers.—Dundee Sub-Centre.

7.30 p.m. At University College, Dundee. Lecture on "Electric Vehicle Operations in U.S.A.," by Mr. M. B. MacDonald.

Faraday Society.

8 p.m. At the Chemical Society, Burlington House, London, W. Annual General Meeting. Papers on "A Force Field Dissociation Theory of Solution Applied to Some Properties of Steel," by Prof. E. D. Campbell; "The Electrical Resistivity of Dilute Metallic Solutions," by Mr. A. L. Norbury, and "The Forms of Electro-Deposited Iron and the Effect of Acid upon its Structure.—Part 1. Deposited from the Chloride Bath."

TUESDAY, December 14th

Institution of Civil Engineers.

5.30 p.m. At Great George-street, London, S.W. Paper on "Notes on the Standardisation of Shock Tests," by Sir R. A. Hadfield and Mr. S. A. Main.

Institution of Electrical Engineers.—North Midland Centre.

7 p.m. At the Hotel Metropole, Leeds. Discussion on the Report on the Heating of Buried Cables.

Institution of Electrical Engineers.—Scottish Centre.

7.30 p.m. At 207, Bath-street, Glasgow. Paper on "The Distribution of Electricity," by Mr. W. B. Woodhouse.

Institute of Metals.—Birmingham Local Section.

7.30 p.m. At the Imperial Hotel, Temple Street, Birmingham. Paper on "Some War Experience in the Electro-Deposition of Metals," by Mr. W. R. Barclay, O.B.E.

Illuminating Engineering Society.

8 p.m. At the Royal Society of Arts, John Street, Adelphi, London, W.C. Report on Progress during the Vacation and Exhibits of New Developments in Lamps and Lighting Appliances, Illumination-Photometers, &c.

WEDNESDAY, December 15th.

Institution of Electrical Engineers.—Wireless Section.

6 p.m. At the Institution of Civil Engineers, Great George-street, London, S.W. Paper on "Range of Wireless Stations," by Capt. R. C. Trench.

Institute of Costs and Works Accountants.

7 p.m. At the Institute of Chartered Patent Agents, Staple Inn-buildings, Holborn, London, W.C. Lecture on "Decimals and their Application to Costing," by Mr. G. E. M. Johnson.

THURSDAY, December 16th.

Institution of Electrical Engineers.

6 p.m. At the Institution of Civil Engineers, Great George-street, London, S.W. Discussion of the Report on the Heating of Buried Cables.

FRIDAY, December 17th.

Institution of Mechanical Engineers.

6 p.m. At Storey's Gate, London, S.W. Paper on "Thermodynamic Cycles in Relation to the Design and Future of Development of Internal-Combustion Motors," by Dr. W. J. Walker.

Junior Institution of Engineers.

7.30 p.m. At Royal United Service Institution, Whitehall, London, S.W. Presidential Address on "Some Reflections on Our Industrial Situation," by Rt. Hon. Lord Weir of Eastwood.

THE ELECTRICIAN

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CHRISTMAS HOLIDAYS.

The Editorial and Advertisement Departments of "The Electrician" will be closed from 6 p.m. on Thursday, December 23rd, until 9 a.m. on Tuesday, December 28th.

Notes.

The Electricity Commissioners and the Severn Barrage.

The political and engineering details of the Severn Barrage Scheme, which have been published broadcast in the technical and lay press, emanated from the Ministry of Transport. The Electricity Commissioners, though independent of the Ministry of Transport, are represented in Parliament by the Minister of Transport. The part played by the Commissioners in the preparation of the electrical features of the scheme has therefore been the subject of a certain amount of speculation, and not a little inquiry among electrical engineers. We are, therefore, authorised to state that neither Sir John Snell or any of the other Electricity Commissioners, and none of their staff had any hand in the preparation of the scheme, nor were they consulted as to its details.

Another View on Tide Utilisation.

There seems to have been quite a pretty little contest between the Ministry of Transport and the Board of Trade as to who should first lay before an expectant public a scheme whereby the tidal power of the Severn could be utilised for "the use and convenience of man." It is, perhaps, unnecessary to say that the former scored both in promptness and in sensationalism, and it would be interesting to know how much Departmental jealousy had to do with the hurried publication and the more lurid features of the Ministry of Transport's version of how the problem ought to be tackled. After this effusion or series of effusions the third interim report of the Water Power Resources Committee issued by the Board of Trade on Monday night comes like a cold douche after a warm bath. But a cold douche after a warm bath, though salutary, is not popular, and we fear that the sober reasoning of Sir John Snell and his committee will not receive the wide recognition that its forbear enjoyed. Once again Jacob has stolen Esau's birthright.

Details of a Severn Scheme.

This report is devoted entirely to the question of tidal power utilisation, with special reference to the possibilities of employing the rise and fall of the Severn for this purpose. Details of a scheme were worked out on much the same lines as those followed by the Ministry of Transport, and careful attention to the electrical side of the problem, especially the methods of working turbo-generators on a variable head, was given by a sub-committee consisting of Sir Philip Dawson and Prof. A. H. Gibson. As might perhaps be expected, manufacturers and designers were not in a position to express final opinions on the various questions raised, and the estimates prepared are therefore to a certain extent tentative. For these reasons the committee can give no definite figures as to the cost of the scheme, and while not dismissing the idea as impracticable they are not in a position to recommend it as a practical proposition, thus exhibiting an attitude of caution very different from the optimistic exhortations of Sir Eric Geddes' department.

An Attitude of Caution.

This caution is also evident in the Committee's estimate of the power obtainable under any such scheme. They think the figure would be of the order of 260,000 kw. for a 10-hour day, as compared with the figure more than twice as large given by the Ministry of Transport. As regards transmission, they think the Midlands would mark the economical limit of supply from the Severn, and say nothing about London. They are also diffident on the subject of capital cost. They consider that before a definite pronouncement can be made as to the practicability of the proposals a number of physiographical, engineering, commercial and industrial investigations would be necssary. They therefore recommend that a special Committee should be set up to look into the whole problem. Now we are not in favour of Committees when it is a question of getting things done, but as in this case we consider that action should wait upon thought, we hail the recommendation as an excellent suggestion which ought to be adopted.

Still Another Electricity Bill.

READERS of THE ELECTRICIAN will be interested to learn that the Electricity (Supply) Bill now before Parliament has been dropped and that an entirely new Bill, whose provisions are of "such a nature that its passage is not likely to be delayed," was introduced on Tuesday and is to be passed through all stages as soon as possible. It will be remembered that the compulsory clauses which were cut out of the present Electricity (Supply) Act during its passage through the House of Lords last year provided for the setting up of District Electricity Boards in districts where it had not been possible to form Joint Electricity Authorities and for the compulsory purchase by joint authorities or district boards of the generating stations of electrical undertakers on prescribed purchase terms. The Electricity Commissioners were also allowed to issue electricity stock up to a limit of £25,000,000, with a Treasury guarantee of interest. But though these clauses have been re-introduced in a new Bill, which has received a first reading in the House of Commons this session, no progress has been made, or seems likely to be made, with it. But the Commissioners, we are interested to learn, have every reason to hope that joint authorities will be voluntarily formed in most areas, and the Government have therefore decided to withdraw the contentious parts of the Electricity (Supply) Bill, 1920, and to substitute for it a shorter Bill giving the Commissioners certain powers, without which they will find it difficult to carry on.

A Non-Contentious Measure.

THE new Bill, for instance, confers upon joint authorities financial powers, without which they could hardly exist, by enabling local authorities and electrical undertakers generally to lend money to the joint authorities or to guarantee interest on loans. The Government will not, however, lend the money, though they will assist the authorities to get it on the most favourable terms. The Bill also contains a provision whereby maximum charges may be revised every three years, instead of every five years as at present, it being found that the present-day rapid change of circumstances brought about by variations in the cost of materials and labour render this necessary. A third provision enables owners of large traction and tramway and generating stations to dispose of their surplus power, if any, for public purposes if the Commissioners and electricity undertakers concerned permit. We agree that these are all powers which are urgently necessary, and should therefore be granted without delay. There seems no reason why the new Bill should not enable certain obstacles ,which are now tending to prevent the proper progress of electricity supply to be cleared out of the way. If this is so, it can be certain of a hearty welcome in progressive quarters. But no time must be lost.

The E.P.E.A. Dispute.

THE E.P.E.A. dispute has now taken a turn which we sincerely hope will lead to a permanent settlement. The situation is not, however, without its complications. During the course of the last few days more and more of the undertakings which at first refused to accept the award have come to the conclusion that their best interests would be served by falling into line, and including all the large London companies, have definitely agreed to pay the increase. On Monday this left outstanding a group of undertakings in Greater London, including Hackney, Hornsey, East Ham and Barking; Aberdeen, Perth, Paisley and other undertakings in Scotland; Newport (Mon.), Swansea, Portsmouth, Birkenhead and York in England and Wales; and, of course, the poverty-stricken undertakings of the Provincial Electric Supply group. At this point the Ministry of Labour made arrangements to open negotiations direct with the obdurate undertakings, and in the meantime the strike has been postponed. Incidentally it may be remarked that several of the recalcitrant municipal undertakings are controlled by Labour Councils, which goes to show that in reactionary procedure Jack is as good as his master—and even better.

The Next Step.

So far so good! The question now arises what can the Ministry of Labour do? It may use its powers of persuasion to get the award paid by those who are not at present inclined to this policy. If it fails then the strike danger again threatens in a form worse than before. The matter is also complicated by the fact that a Government Department generally works for compromise. But the E.P.E.A. is in such a position that it cannot compromise even if it wished. For if it was difficult for its members to retreat a week or two ago it would be doubly difficult now. It cannot make special terms with a minority of undertakings when the majority have conceded their full demands. On the other hand the employers' side can make offers just a little less favourable to the E.P.E.A. than their full demands, and when these are rejected can throw the blame of deadlock on Mr. JONES and his colleagues. It all illustrates the danger of brandishing the strike weapon when you are not sure whether you want to use it or not.

High Current Arcs.

ON another page of this issue we give an abstract of a Paper by Capt. J. P. YORKE on "Some Recent Developments of High Current Arcs." The Paper which is published in the current issue of the "Journal" of the Institution of Electrical Engineers is a tribute to the large amount of research work which Capt. YORKE successfully carried out during the war, and of the advantageous results arising from it, both from the military and the electrical points of view. We have often felt that there has been very meagre recognition of the searchlight services alike for naval operations, coast defence and aircraft defence. Airmen and gunners received, very properly, their mead of praise, but the searchlight man was rarely truly appraised, whether by the general public or by the authorities. It is more than possible that the average man has no idea either of the services rendered by the searchlight units, or of the many problems which they had to contend with. But it will be recognised by all that when aeroplanes started their almost nightly visitations the problem of "finding" them in a searchlight beam was much more difficult than the "finding" of the larger and less mobile Zeppelin, and infinitely more difficult than locating a ship moving on the face of the water. The provision of more powerful searchlights, therefore, became a matter of the greatest importance, and the Paper in question gives an account of some of the work done to that end. For Capt. YORKE'S electromagnetically-controlled arc not only enabled higher current arcs to be run smoothly, but also enabled a higher current density to be used, a fact which brought about an increase in the efficiency of the arc in terms of total flux of light per watt expended. This may seem starting a long way back, but the fact is that nearly all the information in the possession of the authorities was empirical, and a good deal of it was wrong.

The Manipulation of Searchlights.

A FURTHER matter in connection with searchlight work to which a good deal of attention has recently been paid, is the manipulation of the projectors—a subject upon which the outbreak of war found us singularly wanting in knowledge. During the progress of hostilities it was,however, studied to some extent and when the armistice was declared a solution seemed to be about to emerge from a mass of detailed investigations. Now it is more than probable that all this information will be lost, though it is a matter of some little general interest. At first sight the problem seems simple. The projector barrel has to be moved in two planes, the movement being simultaneous or separate depending on the movement of the target at a particular time. There must be some form of distant control, as a man standing alongside the projectors is prevented by the glare from seeing anything in the beam; and this form of distant control must enable the director to move the projector at a considerable variety of speeds, but generally very slowly. A form of motor drive has long been in use, but the motors employed have suffered through being hardly large enough for their work, while the control arrangements were of such a primitive character that accuracy was neither obtainable or to be expected. The fact that the supply is unusually on the continuous-current system precludes the use of the induction motor, and thus rules out what might be a very efficient solution. It is only right to add that the same difficulties were experienced by the French, American and German authorities. The latter indeed favour the use of a purely mechanical control which, though simple, reduces the distance the director can be from the projector, and introduces difficulties with regard to backlash and adjustment. There is a subject here for a certain amount of research, as it is possible that a solution of the problem might extend the application of the control shown to be the best to other branches of industry, where the introduction of some cheap and efficient form of machinery is rapidly becoming a necessity.

Electric Heating and Scientific Measurement.

Our readers are well aware of the advances that are being made in using electric heating for meeting both domestic and industrial requirements, but the ease, accuracy and control which are rendered possible by its employment in scientific investigations of all kinds is not so generally appreciated. How much can and is being done in this direction was amply demonstrated during a recent visit to the Physics Department of the National Physical Laboratory. Here we saw a number of heat, optical and other measurements being made, nearly all of which depended on electric heating in some form or another. For example, we may refer to the calibration of an optical pyrometer at the melting point of gold and palladium. A tube system is raised to a temperature of 155 deg. C., which is within 200 deg, of the melting point of platinum. To this temperature the junction of a thermocouple and also a short length of gold or platinum are exposed, the end of the latter being connected to a millivoltmeter by two platinum wires. In this way the melting point of the gold or the palladium can be indicated. Such an indication enables a fixed point to be obtained, and allows the furnace to be maintained steadily at a certain temperature, while a series of observations is made with the optical pyrometer.

Atmospheric Measurements by Electrical Means.

A combined anemometer and thermometer employed at the Laboratory also makes use of a system of electrical measurement by exposing a fine platinum wire in one arm of a Wheatstone bridge to the air stream over a hot vertical plate. With a small current in the Bridge this wire acts as a resistance thermometer, while with a large current it acts as a hot-wire anemometer. An electrical method of measuring the humidity of the air in cold storage chambers is also of some interest. Two similar coils of nickel wire are used, one being shellac varnished and the other plain cotton covered. The coils form two arms of a Wheatstone Bridge, which is balanced. These coils are wound on a frame, and when this is brought from a dry to a moist atmosphere heat is evolved in the uncovered cotton which causes a rise in temperature of the nickel wire, and throws the Bridge out of balance. The deflection of the galvanometer therefore gives the measurement of the humidity.

Constitution of the Authority.

Our readers will remember that the area under consideration includes the cities of Bristol and Bath, and parts of the counties of Gloucester, Worcester, Somerset, Wilts, Monmouth and Hereford. The Joint Authority is to consist of thirty members, of which ten will form a quorum. The County Councils are to appoint three members and the remainder of the authority are to be representatives of authorised undertakers, local authorities and of large consumers of electricity in the district. They are to be elected according to a sliding scale, set out in the first schedule to the scheme. This scale depends on the consumption of electricity. For the first 50,000 units sold per annum one vote is given, and this voting power increases by a graduated scale to 40 votes for 2,500,000 units with one further vote for each additional 100,000 units. No single authority is, however, entitled to exercise more than 45 per cent. of the total voting power of all the "electoral" members of the Authority. We notice that there is no definition of a "large consumer," and it is pretty obvious that by an understanding between two or three of the more important undertakings they could elect a majority of the members and thus control the policy of the authority. Perhaps this may not be a bad thing in the early days of the authority, provided that those elected are imbued with progressive and business-like views, but we are afraid that trouble may ultimately arise unless something like proportional representation of all parties interested is introduced.

Further Powers of the Authority.

The Joint Authority will, naturally, have all the powers, rights and duties conferred by the Electricity (Supply) Acts, but we notice that several clauses of the Electric Lighting (Clauses) Act of 1899 are excluded. It will, for instance, have power to borrow money for the purchase of generating stations and transmission lines, to issue stock, bills and bonds; it may obtain advances by way of temporary loans up to £1,000,000 or up to £2,000,000 with the sanction of the Electricity Commissioners, and it may also use sinking funds instead of borrowing for defraying capital expenditure. Under proper safeguards no doubt these are proper powers to confer upon such a body. Authorised undertakers, and any authority, company or person receiving a supply of electricity or any county council may lend money or guarantee loans to the Joint Authority subject to the consent of the Ministry of Health. There is power to levy a deficiency rate, but judging by the announced policy of the Authority to fix charges so that the revenue shall cover all expenses it will be not necessary to have resort to this device. The chairman of the Joint Authority may receive remuneration for his services and the members may be paid "travelling and subsistence expenses." We have no doubt that in considering this scheme the Commissioners will take the most progressive view and we hope that those constituting the proposed Authority will do the same in order that the greatest good may ensue.

An Engineer's Club for London.

The statement recently made by the President that the inclusion of anything in the way of a club among the "greater activities" of the Institution of Electrical Engineers would mean an enormous increase in the sum contributed to the revenue authorities by way of income tax effectually killed a scheme which was already rather more than a half-formed wish in the minds of certain members. We do not think that this is altogether to be deplored. For being repressed in one place the idea has sprung up with even greater vigour in another, and we see no reason why the proposal that has been made to establish a London Engineers' Club *ad hoc*, as the lawyers say, should not be carried forward to a successful conclusion, seeing that it has the backing of such well-known electrical men as Mr. C. H. Wordingham, Mr. D. N. Dunlop, Mr. J. W. Beauchamp, to say nothing of the support of the whole of the Electrical Press. We shall be interested therefore to learn what our readers think of the idea, and to publish opinions for the proposal and against it, too (if there are any).

Why a Club Should be Successful.

In our view the formation of a club of this sort has much to recommend it. As a daytime meeting place for both London and provincial engineers and their friends it would have inestimable advantages, as the Manchester Engineers' Club has already demonstrated. For provincial engineers it would provide an easy means of bodily and mental refreshment during their numerous visits to the metropolis, and also we hope a place where they might lay their weary heads at night without all the turmoil and uncertainty which is now apparently inseparable from obtaining sleeping accommodation in London. So strong is our prejudice in favour of the idea and so few the disadvantages that we can see in the scheme, that we hope it will not be long before the many unofficial movements which have been in progress sometime will coalesce and move forward together with a definite preliminary scheme.

The British Electrical Development Association.

When an Englishman wants to celebrate anything, from an extra successful round at golf to the death of his mother-in-law, he generally stands himself, or someone else, a meal with appropriate appanages. It is, therefore, quite in accordance with the fitness of things that the General Meeting of the British Electrical Development Association, which is to be held on December 17, should this year be followed by a luncheon at the Hotel Cecil. We know to a certain extent what the Association has done, what their success has been, and more important, what their plans are for the future. But we are glad that the opportunity is to be taken on this occasion to give some fuller information on these subjects. We understand that some influential guests are to be present, and we feel sure that the function will not only be successful as a social gathering but as a means of impressing on the electrical public the need for greater and greater publicity as the preliminary to a wider and wider development.

The Institution Subscriptions.

In view of Mr. Purse's threat to interfere with the course of the business at the meeting of the Institution of Electrical Engineers, which is being held to-day to confirm the resolution to increase the subscriptions of the various classes of members, the Council have thought fit to issue a "whip" signed by the President requesting those affected either to attend the meeting or to send in to the secretary proxies supporting the Council. It is unfortunate that this appeal was circulated too late for it to be published in the electrical journals last week, and that both our contemporaries and ourselves were not given an opportunity to call the attention of members to the desirability of making their opinions heard at this second meeting, which is, of course, of a purely formal character Nevertheless, even at this eleventh hour, we do appeal to all those who have not sent in their proxy papers to do their best to attend the meeting this evening and to support the Council's proposals. It is the only safe course that can be followed in view of loud but very misdirected opposition which has been organised.

Mr. Purse Unrepentant.

Some of our readers may be surprised that we publish a letter from Mr. F. W. Purse which appears on another page of this issue. There are two reasons. The first is that we think it only right and proper to let all correspondence we receive that criticises our opinions and policy see the light of day; and the second is that the more Mr. Purse talks the more evident it becomes that he represents himself and very little else besides. His eloquence and persistency may, however, lead those who were unable to attend the meeting to suppose there was some real opposition to the Council's proposals. That there was an opposition is true; that it was stridently vocal is also true; but that it is numerically stronger than it appeared to be at the meeting we refuse to believe, and we feel sure that Mr. Purse will only carry the day if the apathy, and not the consent, of the large body of members allows him to do so.

The "West of England" Electricity Authority.

Electrical engineers will follow with interest the progress of the inquiry by the Electricity Commissioners, which is announced to be held at Bristol on January 11th, into the scheme for the formation of the "West of England" Joint electricity Authority. The district is sometimes referred to as the Severn District, but in view of the Severn barrage white elephant, and in order to avoid confusion, it is better to designate it as the "West of England" area, though it is not an accurate description if custom is taken as a guide. In our issue of July 16th last we published particulars of the draft scheme which was adopted on July 6th at a meeting of representatives of electric supply authorities, local authorities and other interested parties in the area concerned, and in its present form the scheme is substantially the same as when approved in July. The only addition is the incorporation of provisions for the constitution and administrative powers of the Joint Authority, the election of its members, employment of voting powers, &c. Nothing is, however, said about the engineering problems that will arise on the incorporation of the authority, or about the methods of generation or transmission suggested for adoption; but no doubt these will be dealt with in a separate scheme later.

Scientific Societies and Income Tax.

As each and all of us knows to his cost the workings of the Income Tax Law are weird and peculiar in their operation; and they become still weirder and more peculiar when they are applied to public bodies rather than to private individuals. Thus it appeared at the meeting of the Institution of Electrical Engineers the other evening, that to provide members with light refreshments in the Library or Writing Room, except on meeting nights, would involve an increased demand for income tax running into some thousands of pounds. The connection is not very clear, but we presume that those in authority regard even such watery junketings as those suggested as beneath the dignity of scientific bodies and apply their veto accordingly in order that no unseemly revellings may take place. It is a wonder that Entertainments Tax is not charged on admission to the meetings. Such action is, however, at best a short-sighted policy. Who knows but that in such an informal gathering of engineers over coffee and cigarettes some scheme might not be hatched which would not only be to the universal benefit of the inhabitants of this country (including the Government officials), but might produce many times the revenue that could be expected by taxing the relatively small income of a scientific society!

Necessary and Unnecessary Expenditure.

IN the present cry for national, municipal and personal economy there lurks a real danger. For expenditure is not an evil in itself and, even under the existing conditions of stringency, some spending is not only advisable but absolutely necessary, if our resources are to be properly developed. This applies particularly to the electricity supply schemes which are now under consideration in various parts of the country. Apart from such grandiose conceptions as those to which we have just referred, a number of very well-thought plans for the erection of new plant and for interlinking existing stations are in being, whose translation into actual material entities cannot fail to be for the good of the community. This side of the case should receive more attention than it has done.

Australasian Electrical Developments.

WE are so preoccupied with our own industrial difficulties, with schemes for the reorganisation of electricity supply and the conversion of the railways to electric traction, &c., and generally with the application of electricity to an increasing number of purposes, that we often pay inadequate attention to what is being done overseas, especially in the British Colonies and Dominions, and to the great possibilities for the export of electrical machinery and supplies. We referred only a short time ago to the necessity for British electrical manufacturers, not only to regain and to extend their influence in pre-war markets, but to find new ones, so that this way they may assist in the expansion of a key industry and help the country to bear the heavy burden of the war.

PROGRESS IN NEW ZEALAND.

We are induced to make these remarks by recent reports of electrical progress in Australasia. For example, in New Zealand, which is one of the most enterprising and progressive of the Dominions, circumstances have compelled the Government to give closer attention to the development of its water power. Coal is scarce and increasing in price; the output of existing mines is decreasing, and consequently more coal has had to be imported. Therefore, an intensive hydro-electric programme has been drawn up and the Government proposes to spend about £20,000,000 upon generating plant and transmission lines. It is estimated that over 10,000,000 h.p. is available, of which only 500,000 is in the North Island.

WATER POWER LEGISLATION.

It should be noted that as far back as 1908 an Act was passed in order to vest the sole right to use this water power in the Crown, and the Government has, therefore, the exclusive right to develop such power with authority to delegate it to a local authority or to a company, subject to certain conditions. Apart, however, from the big Government station at Lake Coleridge, which has already proved a financial success, very little actual work has been done to develop the Dominion's great resources in water power, though a certain amount of preliminary work has already been done in connection with a project for another big generating station at Manganhoe, in the Manawater district, near Wellington. This is intended as the first section of a complete system of transmission lines in the North Island.

Provision has been made in this year's Budget for raising a local loan for the work. Some years ago Mr. EVAN PARRY estimated that the North Island scheme would cost £7,000,000, but it is calculated that it will now entail an expenditure of at least £10,000,000, while at least £10,000,000 will be required to complete the Government programme for the South Island.

THE POLICY OF THE POWER BOARDS.

It must be remembered that these large sums only cover the generating plant and main transmission lines, as the distribution of the electrical energy has been left in the hands of the local authorities since 1918. Nine of these local authorities or power boards have already been called into existence, and they recently met at Wellington in order to decide upon a general policy. They have agreed not to entertain any demand for a supply service to a district unless a minimum of 80 h.p., with a certain fixed annual revenue, is guaranteed; the supply districts are to include both urban and rural areas and the boundaries of the districts, which will have a population of not less than 4,000, will be so drawn as to encourage and foster the community of trading interests.

The Minister of Public Works, who attended the recent meeting of the power boards, estimated that the full use of the hydro-electric power proposed to be developed will save an annual expenditure of £3,000,000 on coal and £1,000,000 on other fuel. He also stated that the Government proposed to get on with the schemes in both islands as rapidly as possible, and for the distribution networks the Boards would be empowered to borrow money with a Government guarantee.

TARIFF CONCESSIONS.

In order to facilitate progress and to reduce the first cost of the plant the power boards have requested the Government to remit all customs duties on electrical machinery and apparatus. At present the tariff is 10 per cent. *ad valorem* on electrical generators, motors, transformers, &c., with 5 per cent. additional on foreign goods. If this step be taken British firms will have lost the present small preferential rate, but it is not certain that the Government will accede to the demand of the power boards as there is every desire to develop inter-Imperial trade and to favour British manufacturers.

DEVELOPMENT IN TASMANIA.

In Tasmania, where there is also a considerable amount of undeveloped water power, a Bill has been introduced for the purpose of vesting all the rivers and lakes in the Crown, but the existing rights of mining companies will be preserved. Under the Bill, whose principal object is to encourage the development of water power, a Water Commission of five members will be appointed. This Commission will undertake the systematic recording and gauging the volume and flow of rivers, and they will also carry out surveys to ascertain the nature and extent of the water power and storage resources of the State and determine the means and cost of improving such resources. Power is to be given to the Commission to issue licences for the use and diversion of water.

AUSTRALIA.

In other parts of Australia, but particularly in the states of Victoria and New South Wales, extensive schemes have been prepared for the application of brown coal and for developing water power. All these projects will represent very big contracts for the supply of electrical plant, cables and other apparatus, and with proper organisation British manufacturers should secure a large proportion of them. Fortunately, there is everywhere a strong predilection in favour of British goods, and it should not be difficult for our manufacturers and exporters to put this to good account.

The work done by the New Zealand and Tasmanian Governments has an important lesson for us. Legislation has been passed to make the water power state property; the Governments will generate hydro-electric energy and supply it in bulk to local power boards, who will distribute it to local consumers for lighting and for industrial and agricultural purposes. This country is not blessed with a large amount of water power, but in certain districts, especially in Wales and Scotland, there is a fair amount, and it is time the Government decided upon a policy for the utilisation and distribution of this power.

On K.S. Magnet Steel.

By KÔTARÔ HONDA and SHÔZÔ SAITÔ.

In June, 1917, a new remarkable alloy steel possessing an extremely high coercive force and a strong residual magnetism was discovered by Mr. H. Takagi and one of the present writers (K. Honda). This steel is prominent as a magnet steel among those hitherto known, *i.e.*, tungsten magnet steel, and is named the "K.S. Magnet Steel," after Baron K. Sumitomo, who offered a sum of 21,000 yen to the Tokio university for the investigation of alloy steels. During the last two years several important improvements in the steel and also numerous measurements of its characteristic constants have been made; but for reasons connected with patent law, the publication of these data has been suspended up to the present. In the following pages, a short account of the result of our investigation is given.

The Composition of the Steel.

The alloy is a special steel containing cobalt, tungsten and chromium. A favourable range of the percentages of these metals is carbon 0·4 to 0·8 per cent., cobalt 30 to 40 per cent., tungsten 5 to 9 per cent., and chromium 1·5 to 3 per cent. The alloy being somewhat brittle, great care is required in forging the ingot; but with practice it can be forged into any desired shape. For K. S. magnet steel, the best quenching temperature is 950°C., and the best quenching bath a heavy oil. As shown below, K. S. magnet steel requires almost no heat treatment in order to be used as a permanent magnet in electrical instruments.

Details of the Tests.

The specimens tested were in the form of a cylindrical rod, 20 cm. long and 5 mm. thick. The intensity of magnetisation was measured by the ballistic method in the usual way. The magnetising coil was 40 cm. long and was wound in 13 layers with an insulated copper wire about 1·5 mm. thick, the coil constant being $4\pi n=483{\cdot}4$, where n is a number of turns in unit length of the coil. The effective field H was calculated by the well-known relation

$$H=H'-IN,$$

where H' is the applied field, I the intensity of magnetisation, and N the demagnetising factor.

Residual Magnetism and Coercive Force.

Fig. 1.—K.S. Magnet Steel Annealed.
Magnification 1,000.

Two important quantities for a permanent magnet are the intensity of residual magnetism I_r and coercive force H_c, of which the latter is more important than the former. Since these quantities increase with the magnetising field, a strong field of about 1,500 gausses was employed. By varying the percentages of carbon, tungsten, cobalt and chromium within certain limits, alloys having different values of I_r and H_c can be obtained. The following table contains some of the values hitherto obtained :—

Specimen.	I_r(C.G.S.)	H_c(gauss).
No. 1	920	226
2	841	221
3	828	245
4	620	257

Thus the coercive force is about three times greater than that of the best tungsten steel hitherto known. The residual magnetism is also greater than that of the tungsten steel.

Hardness and Microstructure.

The hardness of a steel is closely related to its microstructure. Generally speaking, the harder the steel the finer is the structure. The Brinell and now the Shore hardness of an annealed and quenched K. S. steel are given in the table below :—

	Brinell.	Shore.
Hardness (annealed)	444	38
Hardness (quenched)	652	55

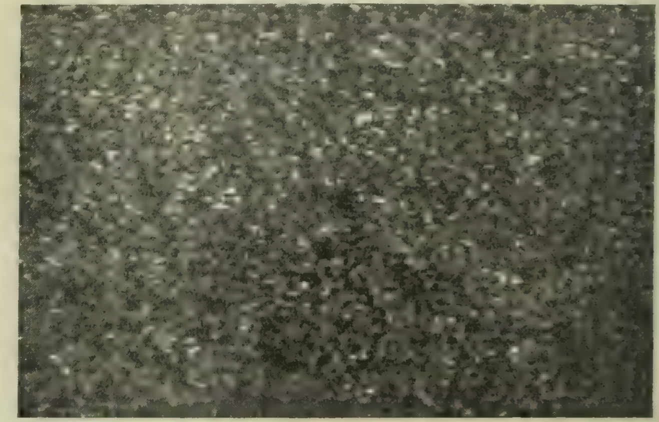

Fig. 2.—Quenched Specimen.
Magnification 1,000.

In Figs. 1 and 2 microphotography of annealed and quenched K. S. steel are given; the microstructure of these specimens consists of an aggregate of very fine grains. The hardness is also intimately related to magnetism, *i.e.*, mechanically hard steel is also magnetically hard. Thus, since K. S. steel is mechanically very hard and has a very fine structure, it cannot easily be magnetised; but when it is once strongly magnetised, its residual magnetism is very large, and cannot easily be lessened.

Hysteresis Curves.

The following table contain the results of observations of the intensity of magnetisation in different fields, both of the annealed and quenched states of the same specimen.

Annealed.		Quenched.	
H (gauss).	I (C.G.S.)	H (gauss).	I (C.G.S.)
19	281	53	54
30	805	91	107
78	1.227	200	365
247	1.372	295	909
377	1.410	344	998
675	1,450	581	1.171
776	1,465	870	1,266
960	1.479	982	1,293
1.322	1.499	1,281	1.346

These numbers are also plotted in Figs. 3 and 4, together with the hysteresis loops for the cyclic change of magnetising field between +1,300 and −1,300. In the annealed state, the coercive force is only 30 gausses; but in the quenched state it amounts to 238 gausses, and the area of the loop is exceedingly large, the loss being about 909,000 ergs. In the best tungsten steel, the same quantity is found to be 290,000 ergs.

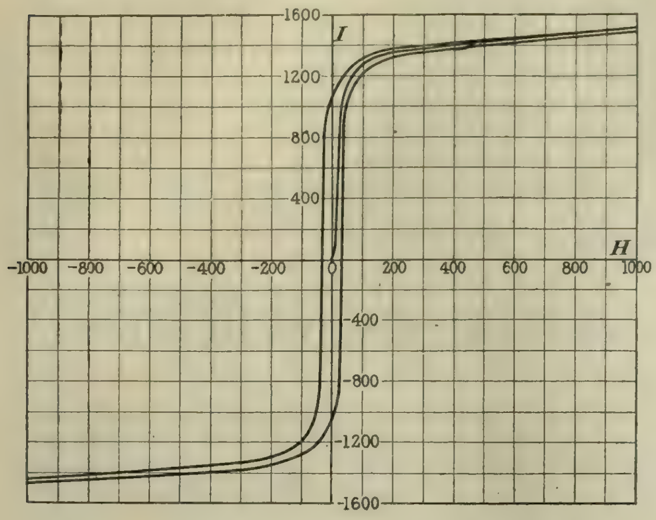

Fig. 3.—Hysteresis Curve for Annealed Specimen.

Effect of Artificial Aging.

It is known the permanent magnet is always acted on by a demagnetising force due to the end distribution of magnetism; this force rapidly increases, as the dimension ratio of the specimen decreases. Heating the specimen exposes it to molecular vibrations under the action of the demagnetising force, and hence residual magnetism is usually reduced considerably during prolonged heating, especially in a short specimen, for which the demagnetising force is large. Since K.S. steel has a large coercive force, it may be expected strongly to resist the weakening effect of prolonged heating.

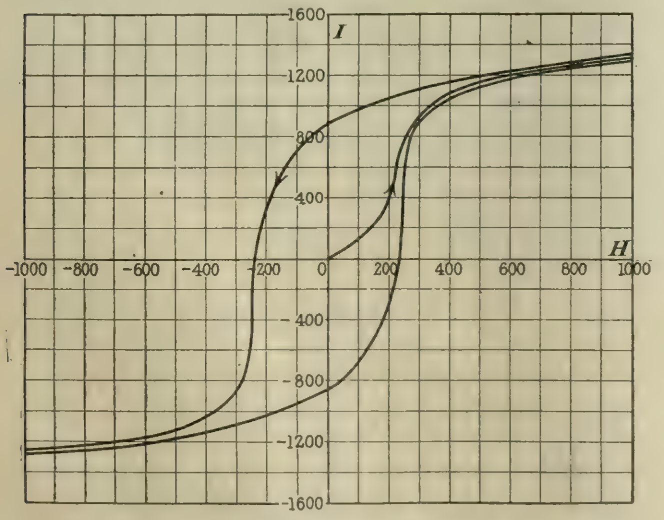

Fig. 4.—Hysteresis Curve for Quenched Specimen.

The Effect of Heating and Shock.

The effect of heating the specimen in boiling water is given graphically in Fig. 5(*a*). A rod of K.S. steel having the same dimensions as before was quenched, and strongly magnetised in a coil. The specimen was afterward constantly heated in boiling water, and its residual magnetism measured from time to time for 40 hours. From the curve, it will be noted that during the first heating for three hours, the residual magnetism slightly increases and afterward remains perfectly constant. In other K.S. magnet steels a slight decrease of magnetisation is usually observed during the first one or two hours of heating, and then an increase to its former value after about three hours, the magnetisation afterwards remaining constant (curve *b*). The decrease and increase of magnetisation are due to the simultaneous action of two opposite causes. The first decreasing cause is the molecular vibration due to heating, and the second increasing cause the tempering; that is, during heating, a small fraction of carbides, which are present as solid solution, is set free, and hence the magnetism increases. The effects of these two causes soon reach their asymtotic values as the heating continues.

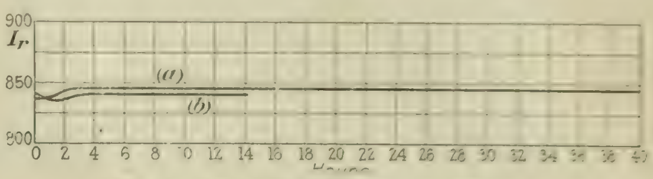

Fig. 5.—Decay Curve in Boiling Water.

Hence the superposition of these two effects results in the decay curve (*b*) as actually observed. When the first effect is very small, the curve takes the form as shown in curve (*a*).

The effect of a repeated shock was also observed; a specimen of the same dimensions as before was quenched and magnetised by a strong field; it had initially a residual magnetism of 854 C.G.S. units. Two series of experiments were made; in one, the specimen was repeatedly allowed to fall on a wooden floor from a height of 1 metre, and in the other, on a concrete floor from the same height. The result of experiments is graphically given in two curves in Fig. 6. The ordinate is the residual magnetism and the abscissa the number of falls. The first diminution of magnetisation is comparatively rapid up to 20 falls, and afterwards very slow. The fall on the concrete floor has a greater demagnetising effect by about 6 C.G.S. units than the fall on the wooden floor. After 850 repeated falls on the concrete floor, the intensity of the residual magnetism diminished from 854 to 800 C.G.S. units.

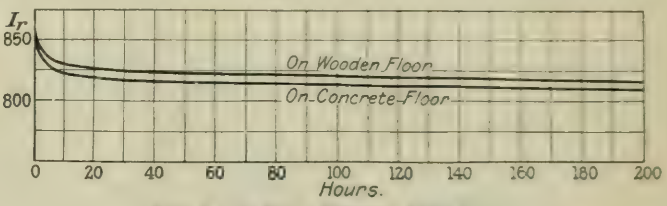

Fig. 6.—I_r Fall Number Curve.

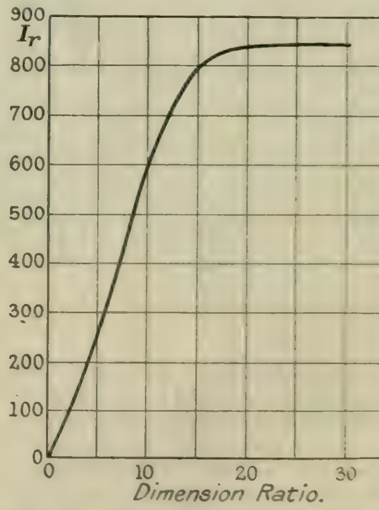

Fig. 7.—I_r Dimension Ratio Curve.

Effect of Dimensions on Residual Magnetism.

As the dimension ratio of a permanent magnet decreases, the demagnetising force acting in the interior of the magnet becomes greater, and hence the residual magnetism rapidly decreases with the dimension ratio. The resistance to this demagnetising action is measured by the coercive force. Suppose the length of a bar magnet be gradually diminished, then the material having a smaller coercive force undergoes a greater diminution of magnetism than one having a greater coercive force. Hence, for a bar magnet, K.S. magnet steel has a very great advantage over the ordinary tungsten steels. For a dimension ratio of 15, the permanent magnetism of K.S. magnet steel is about 1·8 times stronger than that of the tungsten steel.

In Fig. 7 the I_r dimension ratio curve for K.S. magnet steel is given. It shows how rapidly the residual magnetism increases with the increasing ratio of the dimensions, and that above the ratio of 20, the residual magnetism is not affected by the ratio.

Summary of Results.

1. K.S. magnet steel has an extremely large coercive force; its intensity of residual magnetism is also considerably larger than that of ordinary tungsten steels.
2. The area of the hysteresis loop of K.S. magnet steel is very large.
3. K.S. magnet steel, when quenched, is mechanically very hard, and has a very fine microstructure.
4. The residual magnetism of K.S. magnet steel does not appreciably diminish by a prolonged heating at 100°C. over several ten hours.
5. 850 repeated falls of the steel bar from a height of 1 metre on a concrete floor causes only a diminution of magnetisation by 6 per cent. of its initial value.
6. K.S. magnet steel is specially suited for short bar magnets.

Some Recent Developments of High Current Arcs.*

By J. PALEY YORKE.

The Paper deals principally with the developments which have been made in high-current arcs between plain carbons during the war period, and with a method of comparing the relative intensities of searchlight beams at working ranges.

Historical.

The author treats the development of the high current arc historically, pointing out that it was always a matter of difficulty to maintain a uniform crater and a steady arc between horizontal carbons. He refers to the methods used prior to 1914 to ensure reasonably smooth operation, such as the covering of the positive carbon; provision for the movement of the positive carbon, so that any lip might be burned off; provision for the rotation of the positive carbon axially; and the introduction of a magnetic "deflector," designed to counteract the natural arch of a horizontal arc. Whilst this deflector did produce improved operation, the variation of its magnetic properties due to temperature variation, often made its debit side greater than the credit; and when the searchlight came to be used for anti-aircraft work so that the projector (and therefore the arc) had to be moved through angles of elevation varying from 30 deg. to 150 deg. The difficulty of maintaining a steady arc and a central crater was tremendously increased, and the iron deflector became useless.

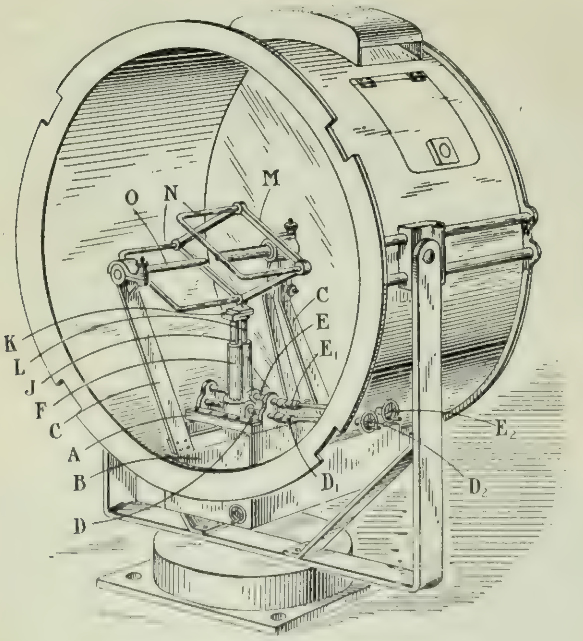

Fig. 1.

The relationship between the diameter of the carbons and the strength of the current was also an important factor, and under the conditions of running, briefly indicated above, it has been found that it was not possible to run an arc smoothly and quietly at a greater current density than 0·15 ampere per square millimetre of the area of cross-section of the positive carbon.

The "Yorke" Control.

The author then describes his scheme for "controlling" the arc by acting upon it in all directions perpendicular to the axis of the carbons by a system of electro-magnetic forces, which is adjustable in space. The scheme consisted in an arrangement of four bare copper conductors placed parallel to the axis of the carbons. One of these was vertically above the axis (assuming a horizontal arc for the purpose of description), another vertically below and the other two were placed one on each side of the axis in the same horizontal plane. They were connected in series with one another and with the arc.

Fig. 1 represents the general assembly in a projector, the mirror of which has been removed. The four conductors are supported from the four corner bosses of a metal frame M. Two of the bosses are insulated. The current is led into the conductors by means of asbestos-covered flexible coupling in such a way that it passes along the side conductors in the same direction as the current in the arc and along the top and bottom conductors oppositely to that in the arc. The system is mounted on a platform K, which can be adjusted in space by means of the controlling wheels E_2 and D_2 on the bottom right-hand of the figure. By means of these handles the system of conductors can be moved up and down or to and fro at right angles to the axis of the carbon.

Fig. 2 is a diagrammatic representation of the resultant magnetic field about the arc stream. It represents a section across the arc stream looking towards the negative electrode. T and B represent sections through the top and bottom conductors, whilst R and L represent those through the side conductors. The directions of the

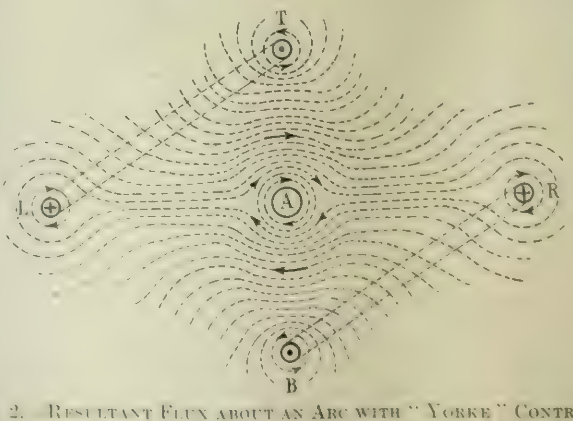

Fig. 2. Resultant Flux about an Arc with "Yorke" Control.

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* Abstract of a Paper published in the "Journal" of the Institution of Electrical Engineers.

currents are indicated conventionally, and directions of the magnetic forces are shown by arrows.

It is seen that about the arc stream we have a magnetic field parallel to and in the same direction as the field produced by the current in the arc, and as there is pressure across a magnetic field it follows that the arc stream is being urged towards the centre of the system.

If the framework carrying the four conductors be moved up or down it will be seen that the upward or downward force upon the arc will be changed. If the system be moved to the left then the pressure will be increased towards the right, and *vice versa*. In this way any tendency for the crater to burn irregularly can be counteracted.

There is a reason for placing *R* and *L* further than *T* and *B* from the centre of the arc, for if they be uniformly spaced the system will be found to be unstable. It might also appear that the same or a better effect might have been obtained by spacing the conductors uniformly and passing the currents through all against the direction of the arc current—that is to say, having all the conductors exerting repulsive forces upon the arc. The resultant flux about such a system of conductors would, however, tend to encircle them completely, leaving little or no flux inside.

The Effect of the Control.

Having thus exercised some measure of control on the path of the arc stream, it was then found possible to maintain a steady arc between carbons of smaller diameter than had hitherto been used for a given current. And it was also found possible to run steady quiet arcs with greater currents than had hitherto been possible. It was also found that the central core of the positive carbon could be dispensed with, and that as the current density was increased the area of the crater became greater in proportion to the area of the positive carbon, and more and more shallow until at a current density of 0·31 amperes per square millimetre the crater diameter was nearly as great as the diameter of the carbon and of the form of a shallow saucer.

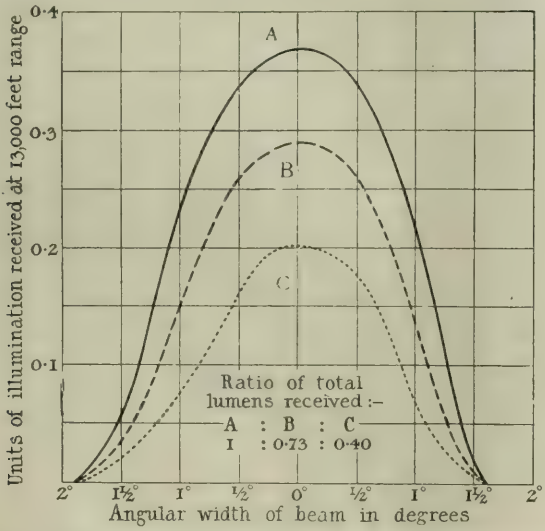

Fig. 3.—Illumination across the Diameter of Searchlight Beams produced by Arcs between Three Types of Carbon, *A*, *B* and *C*, of equal Diameter and equal Carrying Current. Range, 13,000 ft.

With the increase in current density there was an increase in the efficiency of the arc, so that with a given current the mere reduction of the diameter of the positive carbon to such a size that a current density of 0·31 amperes per square millimetre was obtained, gave 50 per cent. increase in the total flux of light obtained in a searchlight beam over that given at a current density of 0·15 amperes per square millimetre. A current density of 0·31 amperes per square millimetre represents the maximum so far attained with plain carbons whilst still maintaining ease of manipulation and smoothness of running, and it is necessary in order to secure this smoothness and steadiness that the path of the arc stream shall be "controlled." It was also found necessary to put on a slight plating of copper on the positive carbon, as otherwise they became red hot along their entire length and spindled rapidly.

Tests on Searchlight Beams.

The Paper then deals with the methods adopted by the author for making tests of the various searchlight beams in the open at ranges of not less than 13,000 ft. He indicates the various precautions taken in order to get results which could be compared with one another, including a method of measuring a co-efficient of transmission of light through the atmosphere of the test range, and points out that every arc, mirror or other device tried was always tested against the standard of reference during the same atmospheric conditions, and on the interleaved system. The numerical basis of comparison consisted in measuring the intensity of the beam at frequent intervals across its diameter, and in integrating to find the total flux of light in the beam at the given range.

Fig. 3 illustrates a set of results comparing the intensities of the beams and the total flux of light produced by arcs carrying equal currents at equal current densities, the only difference being in the composition of the "carbons." *A* is a plain carbon, whilst *B* and *C* are carbons impregnated with some special mixtures. The author states that all impregnated carbons which he has so far tested give a flame of greater luminosity than that of plain carbons, but they also produce a smaller flux of light in the beam. This is probably due to the absorptive effect of the fumes emitted from impregnated carbons and to the reflective and absorptive properties of the flame itself. He also points out that the luminosity of the flame is a great drawback to observation from the neighbourhood of the projector and that the fumes produce cloudy deposits on the mirror and front glass much more rapidly than with plain carbon arcs.

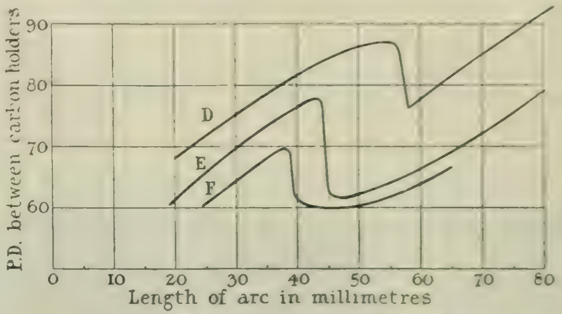

Fig. 4.—P.D. (across Carbon-Holders) of Arcs between Three different Carbons, *D*, *E* and *F*, at Constant Current of 200 amps. and at Increasing Arc Lengths, the Arcs being under Electromagnetic Control.

Voltage and Length of Arcs.

The relationship between the voltage across the carbon holders and the length of the arc for constant current is of considerable interest, and Fig. 4 shows some results taken with three different types of carbons, *D* being plain, whilst *E* and *F* are impregnated. The arcs were controlled and run at 200 amperes, and the carbons were all the same diameter. It is seen that the P.D. is less with impregnated than with plain carbons; that a considerable length of arc can be maintained by the Yorke control; and that in each case a remarkable drop in the P.D. occurs at a certain length.

The equation of the controlled arc between plain carbons and within certain limits was of the form $V=V_0+al$, where V is the P.D. across the lamp, V_0 the voltage drop at the positive and negative arc contacts plus the drop in the carbons themselves, a the voltage drop per minute of arc length, and l the arc length in millimetres. Capt. Haworth, working with a 220-ampere arc, and with a 30 mm. solid coppered positive and a 16 mm. cored coppered negative found that the average value of V was $55{\cdot}8 \pm 4$, a was 0·44 between extremes of 20 and 120 mm. length. As he points out, the voltage drop per millimetre is much lower than that obtained by Mrs. Ayrton for low current arcs—viz., 2·07—and it may be due to greater concentration of the cathode stream and its probable higher temperature.

The Paper concludes with a brief reference to other forms of electromagnetic control * which have been developed by the author.

Books Received.

[Copies of the undermentioned works can be had from The Electrician Office on receipt of published price, plus postage.]

"The Platinum Minerals." by A. D. Lumb. Imperial Institute monographs on mineral resources, with special reference to the British Empire (London: John Murray). Pp. ix + 63. 3s. 6d. net.

"The Electric Lamp Industry." by G. A. Percival. (London: Sir Isaac Pitman & Sons.) Pp. xxi. + 109. 3s. net.

"Home Mechanics' Workshop Companion." by Andrew Jackson, Junr. (London: Henry Frowde, & Hodder & Houghton.) Pp. 222. 5s. net.

"Motor and Dynamo Control: Theory and Practice." by W. S. Ibbetson, B.Sc. (London: E. & F. N. Spon.) Pp vxi. + 487. 21s. net.

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* British Patents.

Modern Electrical Instrument Manufacture.

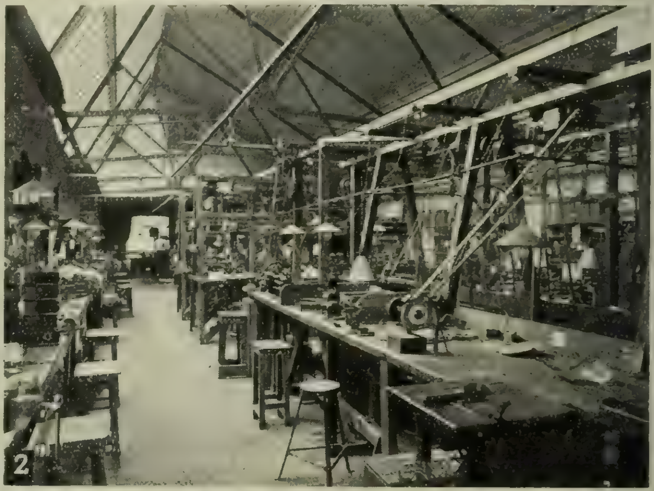
Some Interesting Features of the Works of Messrs. Nalder Brothers & Thompson.

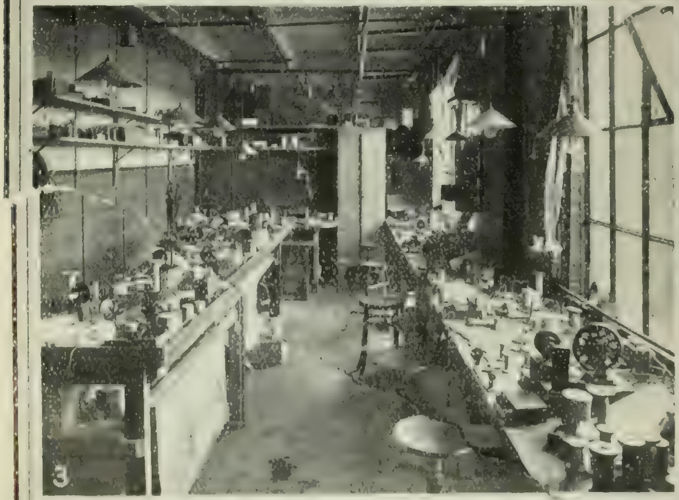
The development of electrical engineering has always been closely connected with the science of measurement; and from the very earliest days instruments of various types have been devised for measuring and recording such quantities as the energy, pressure, current, resistance, and power factor, on electrical circuits. But electrical work is not only a science, but an industry, with the result that the care, maintenance and operation of a large amount of electrical apparatus has perforce to be placed in the hands of relatively unskilled personnel.

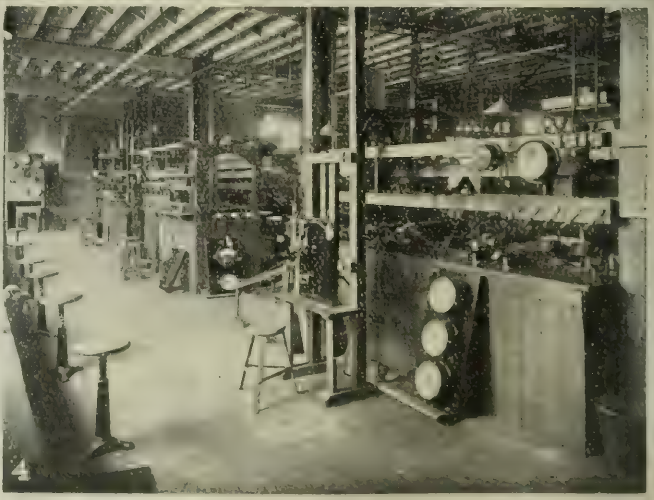
This necessity has largely influenced the design and manufacture of all modern electrical measuring apparatus, except that of an essential laboratory character, and has caused the introduction of details in its design, making not only for strength, foolproofness and adaptibility to industrial conditions, but permitting at the same time the accuracy which is essential in scientific instruments.

A Wide Range of Output.

These considerations were evident to us during a visit which we recently paid to the works of Messrs. NALDER BROTHERS & THOMPSON, at Dalston Lane, London. In these works, it is not going too far to say that every sort of electrical instrument is made. The range of output includes every sort of ammeter, except the hot-wire type, these instruments being used for an equal variety of purposes with the notable exception of radio measurements. Voltmeters of every description are also manufactured, such as the moving coil, soft iron and dynamometer types and in patterns suitable for both switchboard and portable work and as sub-standards, also for recording instruments. A complete line of relays is manufactured, including the Fawssett-Parry relay, which is the most sensitive type produced for use with well-known systems of mains protection; reverse power relays for the protection of alternating current generators also reverse current relays manufactured under McColl's patent. Overload relays of the fused type, also induction type relays with adjustable time limit. Synchroscopes, frequency and leakage indicators were also to be seen under manufacture and test during our visit, while the well-known Ohmer insulation testing sets were also much in evidence. Among the other products of this firm, we may mention power-factor indicators, and telethermometers, of which last instrument we gave recently a description in these columns. Ammeters and voltmeters in combination sets are also to be found, as well as revolution indicators of the electro-magnetic type for indicating at a distance. In this connection it may be mentioned that during the war large numbers of mechanical type revolution indicators were made for aeroplane work. Circuit-breakers of all sizes, from the smallest to the largest, are also made, as well as automatic accumulator switches. In connection with the last-named, Messrs. NALDER BROTHERS &







VIEWS IN MESSRS. NADER BROTHERS & THOMPSON'S WORKS.

FIG. 1.—TEST ROOM. FIG. 3.—WINDING SHOP. FIG. 2.—INSTRUMENT SHOP. FIG. 4.—TEST ROOM.

THOMPSON have the distinction of being the oldest manufacturers of this class of apparatus, the original Nevile type having been made by them. Self-aligning porcelain-clad fuses are also being manufactured in accordance with the designs of the late Mr. Nevile.

THE HISTORY OF THE FIRM.

Before describing the works, where all these activities are carried on, it may be interesting to give some historical account of the firm concerned. In 1884, Mr. F. H. **NALDER**, the present managing-director, and his brother, Mr. H. Nalder, established the firm of Nalder Brothers, at Westminster, with small works at Brentford, for the manufacture of electrical instruments and physical apparatus. The business of this firm gradually expanded, and was soon moved to Westminster, where it was carried on under the name of Nalder Brothers & Co., again being transplanted about the year 1890 to Clerkenwell.

One of the results of the growth of the firm was the departmentalising of the ammeter and voltmeter business, with the result that it was eventually decided to separate this from the other activities of the firm. Mr. F. H. Nalder, whilst remaining a partner in the original firm, purchased the goodwill and plant of the ammeter, voltmeter and switchboard department, and being joined by Mr. E. Thompson, carried on under the name of Nalder Brothers & Thompson, at 34, Queen Street, London. Shortly afterwards, however, Mr. Nalder gave up his direct interest in the latter concern, and, in 1899, the business of the firm with which he was now most intimately connected having increased very largely, additional works were taken at Kingsland Green, London. In 1913, a further extension became necessary, as the Queen Street works had become quite inadequate to cope with the increased business, and additional premises were therefore taken at 97, Dalston Lane, London, where the work of the firm is now carried on jointly with the Kingsland Green Works. As the business of the firm is still growing, and as a vacant site is conveniently situated with regard to the Dalston Lane works, it is probable that in future there will not only be a concentration, but an extension of the works, so that all its operations may be carried on under one roof.

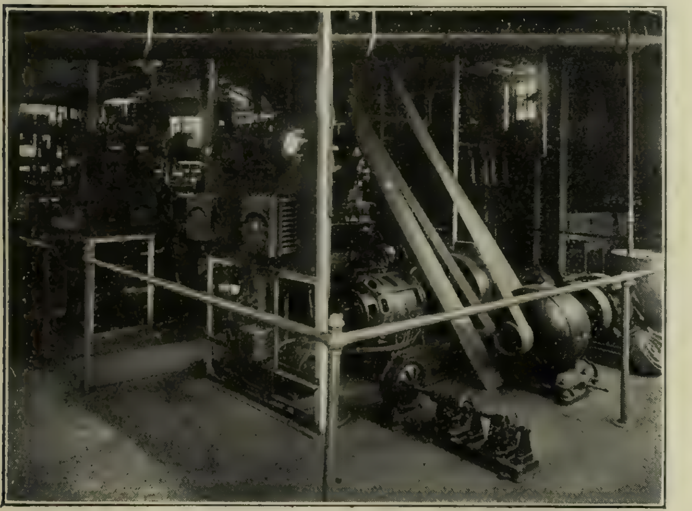


FIG. 5.—TEST ROOM POWER PLANT SUPPLYING CONTINUOUS CURRENT FOR TESTING PURPOSES.

At the present time the work is divided as follows between the two sets of premises: At the Dalston Lane works are to be found the administration, management, and drawing offices, together with packing and despatching departments. In addition, the whole of the instrument assembly, calibrating and testing is carried out here, together with all the small winding and a good deal of the necessary enamelling work. The machine shops are at the Kingsland Green works, here the switchgear parts are made and assembled, and the larger instrument parts, including the cases, also the bare copper parts necessary for circuit-breaker manufacture. The instrument shunts are also made at these works, but are adjusted at Dalston Lane. It is interesting to note that the design of the instruments now produced by the firm is the result of the experience not only of the manufacturers, but of suggestions made by the users. In fact, Messrs. Nalder Brothers make a great point of their "Ideal" range of instruments, which contain certain characteristics which have been suggested by the experience of both themselves and the users.

THE DALSTON LANE WORKS.

The illustrations which we give herewith show a good idea of the general lay-out of the works at Dalston Lane. The first floor comprises the administration department and the drawing office, together with a small research department. A large part of the floor space is taken up with the fine winding shop, where are wound the various coils necessary for the different classes of instruments. Each of the winders is driven by a separate sewing machine motor, which is equipped with a revolution indicator and is easily under the control of the operator by a finger switch. These motors are mounted on the benches alongside the winders.

On the same floor is also to be found the enamelling room, where, by means of an aero-style apparatus, the dials, scales and covers of the instruments are suitably treated. There is also a small subsidiary department for some of the heavier winding, and near by is an impregnating plant for dealing with the windings and a vacuum cleaner plant for collecting the dirt and waste of the whole works. In a convenient central position on this floor is to be found the parts store which is laid out on the most modern lines and where the various parts from the benches are brought to be re-issued to the assembling department. A detail of the arrangement in this store is that glass pickle jars are used for holding small parts, such as nuts, screws, &c. As is well known in the case of instrument manufacture, these are exceedingly small, and it is found that a container of the homely kind we have just mentioned is most efficient and satisfactory in every way. Not the least of its advantages is that the state of the stock can easily be seen.

THE MACHINE SHOP.

On the second floor is the machine shop. Here the parts which are brought over from Kingsland Green are dealt with, and the thousand and one intricate operations necessary in the assembly of a modern electrical instrument are carried out. Each small lathe, drill or other machine is driven by a separate electric motor. In the case of the smaller size motors four or more are carried on a frame suspended from the ceiling. In the case of the larger size machines the driving motors are mounted on the floor, the drive in each case being effected by a belt in the usual way. Power for these machines is obtained from the mains of the Hackney Corporation Electricity Supply Department at a pressure of 240 volts for the small machines and 480 for the larger machines.

An instance of the care and enterprise which Messrs. Nalder's exhibit in carrying out their work is given by the statement that practically the whole of the tools necessary for the manufacture of these instruments are designed and made by the firm themselves, it being found that only in this way could satisfactory results be obtained, and in instrument making more than anything else, satisfactory results are the whole battle, as can easily be conceived. This attention to detail includes the cutting of gear wheels for the portable Ohmeter sets, and most careful tests for balancing the revolving parts of these sets which is, as is well known, run at very high speed.

TESTING ARRANGEMENTS.

Perhaps the most interesting part of the works is to be found on the ground floor, where the calibrating and testing of the instruments is carried out. For testing the frequency meters and revolution indicators the stroboscopic disc method due to Dr. C. V. Drysdale is employed. For direct current voltmeter and ammeter calibration, a direct current potentiometer is employed, the zero method being used, while as an additional check the firm's sub-standard instruments and Kelvin balances are alternatively employed. In fact, as a general rule, it may be said that these three sets of instruments are employed together for the whole of the testing necessary in the works, and form in combination an interesting check on the results obtained by each other. Wattmeters are calibrated against the Drysdale double wattmeter and also against the firm's sub-standard wattmeters. A very large range of direct current pressures and currents are obtained in the case of voltage testing from a series of machines installed in one corner of the test room, and in the case of current from a range of large secondary batteries which are installed under the test benches.

A special testing transformer allows alternating pressures up to 180,000 volts to be reached, while an intermediate range of pressures are obtained by means of tappings. There is also a Westinghouse transformer giving alternating current voltages up to 30,000. For testing alternating current voltmeters a potentiometer is employed, consisting of 60 coils of very high resistance and suitably insulated to deal with pressures up to 10,000 volts; by means of a substandard electrostatic voltmeter, which can be placed across any number of coils, any desired pressure can be applied to the voltmeter under test; exact adjustment being obtained by means of a choking coil in the primary circuit of the transformer

Magnet Testing.

Messrs. Nalder Brothers & Thompson, Ltd., are one of the oldest makers of permanent magnets, having made their own for a great number of years. The magnet is forged and hardened at the Kingsland Green Works, in specially constructed furnaces fitted with an electrical pyrometer connected to an indicating instrument, so that the exact measure of the temperature can be obtained.

These magnets are then sent over to the Dalston Lane Works for magnetising and testing. They are first magnetised and the coercive force measured. This proving satisfactory the magnets are again magnetised and aged.

For the purpose of magnetisation a large battery supplies current through a magnetising coil, about 1,000 amperes being used for this purpose. On this floor also is to be found the finished instrument store, and adjacent to it is the packing room, whence the instruments go out to their work of indicating and recording the world over.

Institution of Electrical Engineers.

Further Discussion on "Distribution Problems."

At the meeting of the Institution of Electrical Engineers on December 9th, the discussion on Mr. W. B. Woodhouse and Mr. R. O. Kapp's Papers, read on November 25th, was continued before a very meagre audience. Abstracts of the Papers and an account of the first part of the discussion were published in our issue of December 3.

The Integraph.

The President opened the proceedings by giving some details of an apparatus known as an integraph, which he described in The Electrician as long ago as 1889. This instrument would enable, he said, the final temperature of cables to be determined by simpler methods than those described in Mr. Kapp's Paper. He exhibited an instrument designed by Mr. Barker, of Cambridge University. A demonstration given by Mr. F. W. Hewitt showed that such an apparatus when fitted with two plotting frames would draw curves giving the maximum temperature of cables for all currents, as well as the temperature of the cable at any hour of the day and night. It might, Mr. Atkinson continued, be worth the while of the Institution or some other body to obtain such a machine so that the temperature of cables at any given load could be easily determined. The President is inclined to be apologetic about taking part in the discussions, but on a subject of this sort surely no apology is needed. Indeed he possesses the faculty of throwing new lights on old subjects, which we wish was more general among members than it is.

American v. British Rules.

Mr. C. Beaver, who spoke from the back of the room, and thus continued the long line of modest contributors to discussions, expressed himself somewhat naturally as being most interested in the cable design questions raised in the two Papers. He thus exposed himself to Mr. Selvey's criticism, made later on in the evening, that these Papers prevented many of their readers from seeing the forest for the trees. He objected to Mr. Woodhouse's statement that a minimum section of 0·05 sq. in. was "necessary" for cables working at pressures above 10,000 volts. He thought "advisable" was a better adjective. For a given voltage the thickness of the dielectric generally decreased with the size of the cable. He admitted that cable makers had had insufficient experience to standardise the current densities employed on high-pressure cables. The density chosen would depend on the thermal conductivity of the cable and its surroundings. It was interesting to know that the American rules on the subject of rating cables were based on a maximum temperature of 85°C. with a deduction of 1°C. for every thousand volts of working pressure. This was an implied compliment to British manufacture, as over here a much higher pressure than the figure so given would be permitted. In 30,000-volt cables the effect of dielectric heating was almost negligible. Mr. Woodhouse had given the maximum size of conductor for the higher pressures as 0·25 sq. in., but his (Mr. Beaver's) firm were already making cables in large quantities with a cross section of 0·3 sq. in. He pointed out, however, that such cables required a substantial lead covering. Other points that he made were that protective gear had lost the importance it once had owing to our greater knowledge of what happened inside cables, and that the duplication of smaller cables in parallel, as suggested by Mr. Kapp, increased the power losses. A useful practical contribution which might equally well have been given on the Heating of Buried Cables Report!

The Influence of Local Factors.

Mr. P. Dunsheath who, in a low voice, read what appeared to be a short Paper from the back of the room, remarked that Mr. Woodhouse's statement that the losses were approximately constant only held good if the temperature was constant. He referred to a Paper by Rennison in "La Revue Générale de L'Electricité," in which it was pointed out that the losses fell to a minimum as the temperature rose, and then commenced to increase again. He (the speaker) had found that as the current increased, the dielectric losses also increased in the same proportion up to a certain point, and then rose more rapidly. On a large scale that gave an alarming idea of what was happening, but really the dielectric losses were negligible compared with the C^2R losses. He made the good point that the rating of cables was not so simple as Mr. Kapp implied, and that local factors such as variation in the depths at which the cables were buried, and approximity to other sources of heat had a tremendous effect, while variations in the temperature and moisture of the soil had also to be taken into account. Mr. Kapp's load curves had the weak point that the temperature varied not as the square of the kilowatts, but as the square of the current. The actual resistance was also important, while the omission of the relation of power factor to temperature factor might introduce an error of 10 to 15 per cent.

The Standardisation of Voltages.

Mr. P. Rosling was idealist enough to plead for the standardisation of voltages. He disagreed with Mr. Hunter's statement that the cable makers could not give accurate figures for the carrying capacity of high-tension cables. But even if that were so they could at least say what the temperature rise of such a cable would be on a definite voltage. It was very necessary to know under what circumstances the cable was to be used. It should be possible now-a-days to measure their temperatures by thermo-couples or resistance coils inserted along their length. Temperance in the application of bending tests to high-tension cables was also a point that needed attention.

The Drawbacks of Mechanical Integration.

Mr. S. W. Melsom was another of the speakers who with difficulty resisted the temptation to discuss the Heating of Buried Cables Report. He said some curves that he had prepared bore out Mr. Kapp's theory that the time of cooling of a cable was practically identical with that of its heating. He objected to the mechanical method of integration suggested by the President as to use it it was necessary to have a knowledge of the time constants, the conditions of laying, the size of the cable, and its heating curve. Proximity of other cables also had an effect. He described an arrangement he had used of employing a current recorder for measuring the temperature rise of cables which enabled results to be obtained with an error of 4 per cent. He thought this was better than anything that could be obtained by any method of integrating the load curve. With alternating currents it was true that difficulties occurred, but he hoped that these would be overcome, and that generally patent integrators would become "a back number." He backed up Mr. Kapp's treatment of Kelvin's law, and thought that of the two authors Mr. Woodhouse had treated this law the more cavalierly by not putting sufficient weight on the depreciation factor. It was probably true that if one took the first cost of the cable and the annual capital charges, and put their sum against the heat losses, a most economical size of cable might be arrived at, providing depreciation was neglected. If depreciation were included then Mr. Kapp was quite correct in saying that temperature was the only factor that mattered.

A Supporter of Overhead Lines.

The next speaker, Mr. Leach, was the most audible of all those contributing to the discussion. Nevertheless he was only an understudy for Mr. G. V. Twiss, which, from an elocutionary point of view, was a pity. Mr. Twiss per Mr. Leach made the amusing point that while Mr. Woodhouse advocated the employment of the lowest possible pressure of transmission Mr. Kapp advocated the highest. This pointed to the desirability of the authors discussing each other's Papers. The Twiss-Leach combination did not like Mr. Hunter's suggestion that the greater reactance of the overhead line was to their disadvantage. It was cheaper with a given voltage drop to transmit at 33 kv. with an overhead line than at 22 kv. with an underground cable, and the former would do the same work at less cost. Increasing the voltage on an overhead line reduced the reactance and at the same time decreased the current, so that the cost per kilowatt transmitted diminished as the pressure rose, which was an economical advantage. With underground cables the opposite was the case so far as cost was concerned, and also as the voltage increased so did the dielectric losses rise and the permissible current density. A better knowledge of dielectrics would make the high-tension cable problem easier. He was an out-and-out supporter of high voltages, but thought that both cables and overhead lines would have their places in the scheme of things and even be mutually helpful.

Mr. G. L. **Addenbrooke** confessed that the Severn barrage scheme had prevented him reading the papers under discussion. Nothing daunted, however, he began some preliminary paragraphs to an introduction to a treatise on dielectrics calling attention to the work of Cavendish, Clerk-Maxwell, Faraday, Gordon and Boltzmann. He was well under way with the developments of his thesis when the President's bell suddenly arrested the flow of his eloquence.

Higher Cable Temperatures.

Mr. H. **Brazil** was all for forcing up the amount of work that could be got out of the cables, owing to the important part they played in the capital cost of a scheme. Nevertheless we could not afford to run at 1,000 amperes per square inch nowadays. He referred to a Paper by Mr. Ralph W. Atkinson read before the American Institute of Electrical Engineers which confirmed the method of finding temperature rise already given by Mr. Beaver. There was often, he said, confusion between temperature rise and maximum temperature. The latter was the important thing and he could not get from Mr. Kapp's Paper any suggested figure for it. Cables should be able to stand quite as high a temperature as generators, and he thought 160° or 170°, rather than the temperature given by the 50° rise of the Institution rules, should be aimed at.

Mr. W. M. **Selvey** said that with these Papers there was a tendency for the wood to be obscured by the trees. There were, however, some gems which ought to be emphasised. He thought that the 2,000 volts should be standardised for industrial purposes except on small installations. This is surely one of the gems thought of by Mr. Selvey rather than the author's cutting. He went on to say that a 50 H.P. motor could easily be wound for 2,000 volts and would stand a voltage of 8,000 quite easily without flashing over. Switchgear suitable for these pressures could also be made. Even to use 500 volts instead of 400 volts meant a great saving of cable, and this saving would be in a much greater proportion if 2,000 volts were employed. He thought Mr. Woodhouse had suffered from want of adequate technical language to express his new ideas. He referred to the use of transmission mains for providing additional feeding points on routes between stations. Mr. Woodhouse did not really mean this, but what was wanted was a new term for real transmission mains. He complained that while the curves relating to the cost of cables in both Papers told them something they were incomplete and yet they were the very basis of the whole argument of both Papers.

Some Financial Objections.

Mr. J. R. **Beard** rather doubted the practical application of some of the authors' investigations, but at the same time they would provide the inspiration which was necessary in laying out distribution systems. Step by step development as advocated by Mr. Woodhouse had the disadvantage that each opening up of the ground meant great expense, and it would be better to lay larger cables in the first place, if the interest on the expenditure could be considered as being chargeable to capital. Makers were still diffident about cutting down their insulation, and it was impossible at the present time to arrive at definite conclusions about high-pressure lines. It would seem from figures given by Mr. Woodhouse that the economical current density of a 20,000-volt cable was 22 per cent. greater than that of the lower voltage cables. Personally, he thought the current density was independent of the pressure of working and he had had an economical current density of 910 amperes on a low voltage cable and of 1,190 amperes on a 20,000-volt cable. Kelvin's law, in his opinion, could not be ruled out at any rate on lower voltages. His experience was that inter-connection on the larger systems meant a very appreciable overall economy which was worth the cost of the necessary protective apparatus. He did not agree with Mr. Kapp's curves of cost and he thought that such charges as excavation, telephone cable, cover boards, &c., must be left out.

Mr. W. B. **Woodhouse**, in reply, said that his cable rating figures were based on tests which he made many years ago on temperature rise. Commercially, at the present time, it was not economical to work cables up to the full limit of their capacity. An important point he made was that electricity had not only to be sold cheaply in 20 years time, but it had to be supplied now, and there must therefore be a continual compromise between to-day's conditions and those of the future. He protested that he had not intended to condemn overhead lines, but he had paid more attention to the question of cables because it was important to explore the limits of their use. The cost of the energy lost must be taken into account, as of course must be the cost of the capital expended on extensions.

Mr. R. O. **Kapp** also replied, and began by remarking that he did not think that Mr. Sayers was so upset, as had been implied, by his (the author's) throwing over of Kelvin's law. Really all that Mr. Sayers had done was to find a neater way of expressing his (Mr. Kapp's) attitude to this law. To take an example, for a 66,000 volt cable the current densiry would have to be more than 2,000 amperes per square inch in order that Kelvin's law might apply. With regard to Mr. Beard's objections to his figures for the cost of cable per kilovolt-ampere, any figures of this sort largely depended upon the particular conditions of heat distribution. Such factors as soil dryness also affected heat distribution, and so the continuous safe loading of a cable might involve the introduction of a large factor of safety. It was therefore necessary to find out the equivalent of the load curve. The principal use of protective gear was that it enabled the faulty cable to be cut out at once instead of waiting until the failure actually occurred, but it was largely a question of personal opinion whether it was worth the extra cost involved.

The Reason Why:

III.—The Factory Clerk is a Producer.

By **W. J. HISCOX.**

There is a mistaken idea abroad that the factory "shop clerk" is an encumbrance, and that part of the mechanic's earnings are diverted to pay this individual his "salary." It is a strange idea, but it has a large number of adherents amongst the mechanics, who are apt to label themselves "producers" and the clerks "non-producers." That the latter contribute anything to the output from the factory is not believed by the mechanic, and so a few words on this subject may result in a little illumination.

"Organisation" and "Production."

Often have I heard the remark, "What would be the use of your organisation if you had no one to produce the goods?" Of course, the organisation would be useless, and the fact is not evaded. But, on the other hand, I would ask this question: "Of what use would be the producers, if there were nothing to produce?" The one question is as pertinent as the other. There is no factory in existence which is absolutely unorganised, or, in other words, manned entirely by "producers" (using the word in its narrowest sense). Some factories are better organised than others, but taking the case of the very worst organised factory, it includes somebody who (in the view of the mechanic) does not actually produce. And, strange to relate, in that badly organised factory the mechanic is not nearly so well off as his brother in the factory where organisation is taken into consideration. It would no doubt hurt the "producer" to be told that, so far from the clerk being dependent upon the mechanic for his livelihood, the position is, to a very large extent reversed. Yet this is undoubtedly the truth, as would be perfectly clear to the mechanic if he would give the question due consideration. The clerk is not there on sufferance, but from necessity. He is as necessary to industry as is the mechanic, and in every piece produced in the factory will be found a certain amount of clerical labour. The mechanic sees in the piece nothing but his own handiwork. The other is hidden from view, but it is there, nevertheless.

Specific Instances.

Shall we take specific instances in order to see what is meant? Just as an analysis of a piece of material would reveal many constituent parts, although for general purposes it is known as steel, so also would an analysis of labour reveal unsuspected constituents, although generally speaking it is known as "turning." It is upon the obvious that we form our ideas, without troubling to search below the surface for the parts which are hidden.

Leaving out of our calculations such obviously necessary people (howbeit "non-producers") as the works manager and the department foreman, we will descend at once to the clerk—that obscure personage who nevertheless clings so tenaciously to the mechanic's earnings. First of all, the wages clerk. Is he necessary?

It cannot be argued that the employer can compile the necessary records and disburse wages personally, excepting in the very smallest of factories, "the one man show," whilst it is equally ridiculous to expect the mechanic to work for love. He wants his wages, and the job would be of no use to him without them. This being so, the wages clerk is a necessity, and the mechanic is not losing a penny off each job he does in order to pay the wages clerk's salary. That is charged against administration, which is a definite cost, and quite as legitimate as the actual wages cost and the material cost. All are charges against the selling price.

The Stores and the Producer.

The stores organisation! This again is an asset to the mechanic, for he would not produce much if he were obliged to search for his material. Imagine him hunting throughout the factory for the correct sizes of steel necessary for his job, or for the requisite bolts, nuts and other small parts. He would do each day, if he were lucky, two hours' work—the remaining six hours would be spent in "preparing." But now! The material is available upon demand. It is in a certain place, and no unnecessary time is spent in locating it. The store organisation simplifies the mechanic's work, it saves his time, and it enables him to *produce* more and to *earn* more. Is the store labour unrepresented in the constituent parts of the piece?

And the shop clerk, and the progress-chaser—do they not assist? The movements of the work are recorded, and as a consequence each part goes to its appointed place, thus obviating confusion and delay. The mechanic responsible for the second operation of a piece must have that piece before he can commence, and if he has to look for it he is losing money. The energies of these people, so far from penalising the mechanic, actually put money in his pocket.

Draughtsmen and Buyers.

We have omitted such obviously important people as the draughtsmen, progress men, buyers and salesmen—people who *cannot* be dispensed with, even though dubbed "non-producers." It may be observed that the mechanic does not doubt their usefulness, but he deplores the necessity which brings them into existence. And all because he has a feeling that, by the sweat of his brow, he is paying their salaries—a most preposterous idea.

It is not denied that some concerns are overstaffed, although the great majority are in reality understaffed. Still the fact remains that the services of many highly paid officials *could* be dispensed with, and this without adversely affecting output. Such a course would not, however, benefit the mechanic. His wages would not be increased as a result, and, therefore, from a purely selfish standpoint, he need not evince any interest.

An unwieldy staff does not give results proportionate to its numbers. The foreman does not allow two equally experienced men to operate the same machine, neither is it necessary for two clerks to handle the same job. A well-balanced staff is, however, a necessity and earns its money.

Mechanic and Clerk Interdependent.

So let us admit without further argument that the mechanic and the clerk are interdependent—that one cannot exist without the other—and this being so, it is easy to see that neither is there on sufferance The one provides the facilities—the other produces. The better the facilities, the greater the production; and the greater the production, the higher wages for all concerned. The turner does not produce the complete engine—the erector does that. Yet the latter cannot claim the whole of the credit, for he could not produce the engine without the assistance of the turner, the miller, the driller, the grinder, and numerous other operators. He cannot argue that he pays these people their wages—that if they were not in existence he would get the whole labour value himself.

The clerk is not of the tribe who "toil not, neither do they spin." He toils right enough, even though the result is not made manifest by the production of a definite article. But the result of his labours is in that article, and he has just as much right to claim credit for it as the mechanic who actually put on the finishing touches. Every person whose activities have been brought to bear upon that article, no matter in what capacity—clerical or manual—is entitled to a share of the credit in the product; and each and every one can therefore claim to be a "producer."

Inauguration of the Extended Nauen Wireless Station.

By Dr. ALFRED GRADENWITZ.

Since it was first installed in 1906 as a modest 10 kw. experimental plant, the Nauen Wireless Station has gradually been extended by the erection of a 35 kw. and then of a 100 kw. sender. The latter is still in use, with the addition of two high-frequency generators of 150 kw. and 400 kw. respectively, so that Nauen may be said at present to comprise three self-contained radio stations, of which

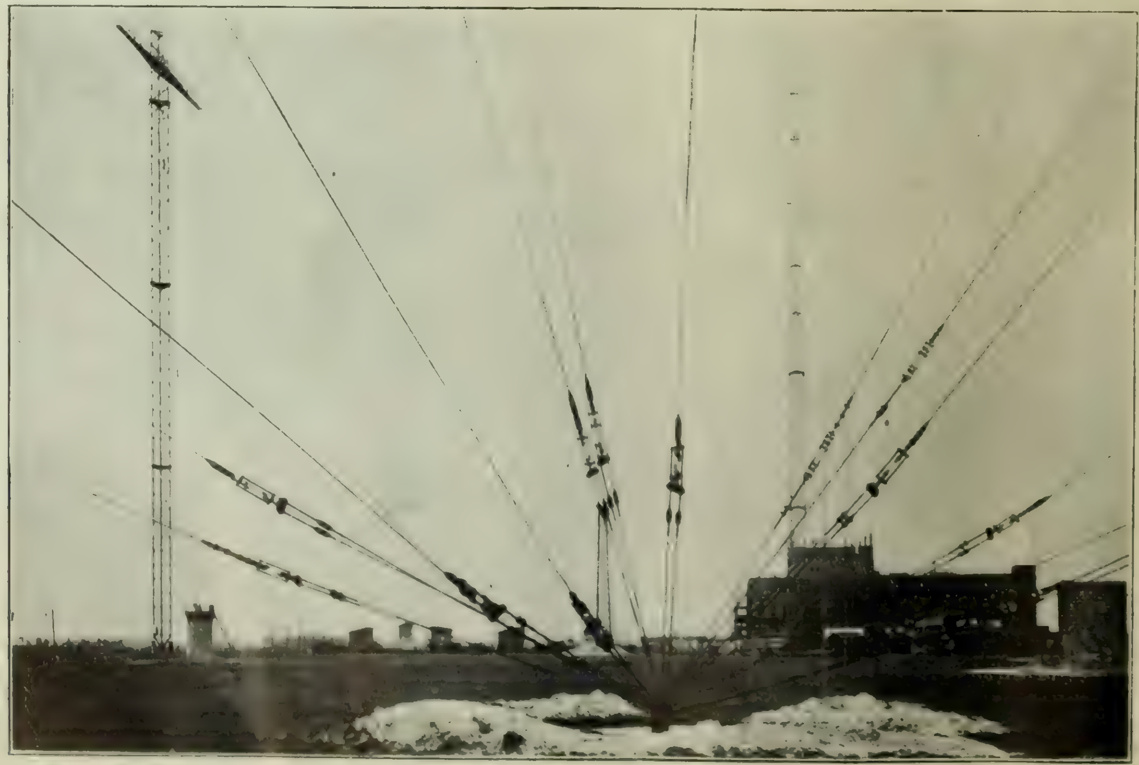


Fig. 1.—One of the Joining Sections showing the Wire Stretching Arrangements.

the smallest, a 100 kw. spark sender, in conjunction with the 150 high-frequency generator, is set apart for the time signal and meteorological, as well as for transcontinental service, whereas the 400 kw. high-frequency generator serves as sender for the overseas traffic with a range of 20,000 km.

The antenna system is 2,500 metres in total length and comprises no less than 3,000 tons of iron and cement as well as an aggregate length of 50 km. of antenna and earth wire. Beside two antenna masts each 120 metres high, there are two others each rising to the height of 260 metres. There are two antenna systems, the larger one having the shape of a T-antenna and serving for high-power reception, and the smaller antenna, which is in the form of a horizontal triangle, is used for smaller amounts of energy and is placed with its central line at right angles to the larger antenna, energy being supplied at the apex. This is probably the first instance of a double antenna system on a large scale, permitting simultaneous sending. This is made possible both by the relative position and the shape of the two antennæ, the coupling between them being reduced to a minimum. This arrangement makes for greater economy, and at the same time increases the safety of operation, it being possible in the event of a breakdown in one of the antennæ to continue the service at least partially in the other. All the masts are of the spanned framework construction, resting on a ball point at the foot, which is insulated from the earth by porcelain blocks. The large antenna has a capacity of 600 kw., the smaller of 200 kw.

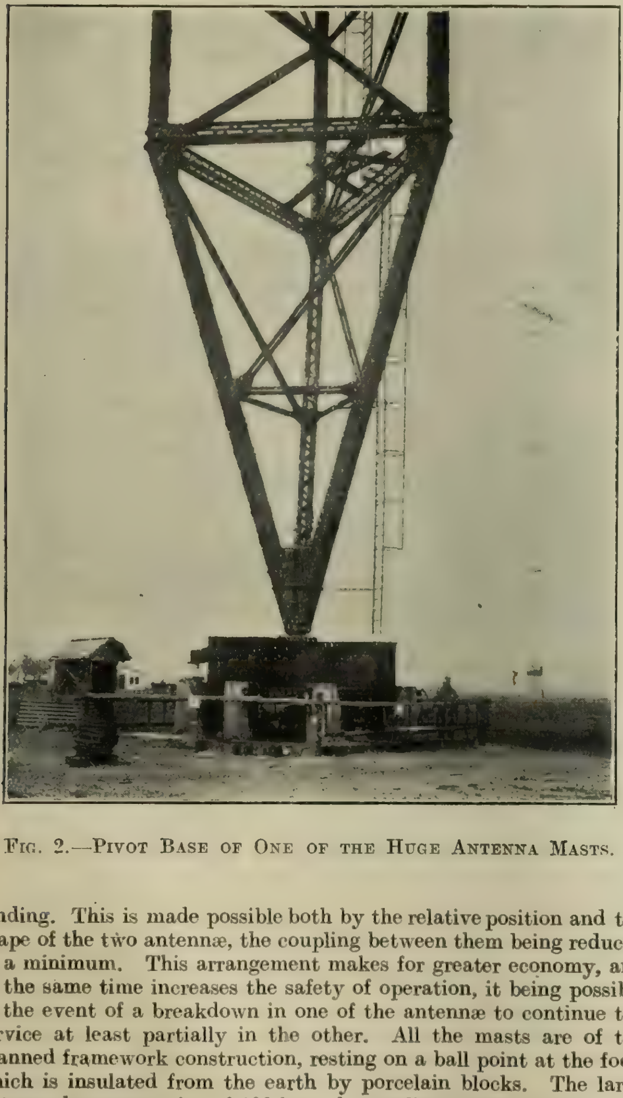


Fig. 2.—Pivot Base of One of the Huge Antenna Masts.

The high-frequency machine used to generate the transmitter energy is designed on the induction coil principle, a 800 h.p. rotor supplying single-phase alternate current of such frequency that it can be stepped up to 24,000 periods by two sets of stationary transformers. The antenna gives out the wave-length of 12,500 metres, corresponding to this frequency.

At the annual general meeting of the Liverpool Wireless Association last week it was reported that the funds in hand amounted to £10 6s. 7d. The following officers were elected for the coming year: President, Prof. E. W. Marchant, D.Sc.; vice-presidents, Dr. S. S. Richardson, D. Jackson, C.C.; with a committee of 12. The hon. engineers are Messrs. Grindon and Lowey: hon. treasurer, J. Wainwright; hon. secretary, J. Coulton. At the next meeting, on the 22nd inst., to be held at the Liverpool University, members will have the opportunity of inspecting the University wireless apparatus.

Reviews.

A Course of Modern Analysis. By E. T. Whittaker and G. N. Watson Third edition. (Cambridge University Press.) Pp. 608. 40s. net.

We welcome a new edition of this classical treatise. It is primarily intended for mathematicians, and is therefore characterised by extreme accuracy of statement, and only rigorous proofs are given. If a theorem has a failing case, although this case may hardly ever occur in practice, yet it is always specially mentioned and the limitations are investigated. To the mathematician, "pathological" cases are always of extreme interest, but their study generally bores the mathematical engineer.

Consider, for instance, the case of Fourier's theorem. The engineer assumes that it is true, and attempts to analyse the wave form of an alternator into harmonics, so that he will be able to judge of the magnitude of its effects in producing interference with neighbouring telephone wires and of the risks incurred by some of the harmonics producing resonance. Unfortunately, he finds that, although much has been written on the subject of the arithmetical evaluation of Fourier's integrals, yet, owing to the limitation that only a finite number of ordinates can be measured in practice, there is always uncertainty about the limits of error. He would like, therefore, to read an investigation of the methods used in the mechanical quadrature of the Fourier integrals and the limits of their accuracy. To the engineer such an investigation would be of great value; but, strange to say, it appears to present little interest to the mathematicians, who have expended an infinite amount of labour in evolving an accurate definition of a Fourier series.

To the mathematical electrician the most important chapters in the book are those on Bessel and Elliptic Functions and the new chapter on Ellipsoidal Harmonics. In the chapter on Bessel's functions references are given to the British Association tables of the *ber*, *bei*, *ker* and *kei* functions, but no definitions are given of them, and none of their interesting properties are mentioned. This is a pity, as they are used when discussing high-frequency currents in wires and eddy current losses in cylindrical cores.

To those who are engaged in simplifying or extending the formulæ for the inductance of helical coils, the chapter on elliptic functions will be a boon, as it gives an admirably concise *résumé* of the main theorems on the subject. A good deal of work has been done recently in this field by Andrew Gray, Nagaoka and Rosa. When reading the mathematical proofs given it has to be remembered that simpler proofs can sometimes be given. Landen's transformations for elliptic integrals, for instance, follow at once from elementary electrical considerations.

To everyone who is a thorough mathematician we can recommend this book. The ordinary mathematical engineer or physicist, however, will probably find books giving graphs of the mathematical functions and tables of their values more directly useful. Alexander Russell.

Telephonic Transmission: Theoretical and Applied. By J. G. Hill. (London: Longmans, Green & Company.) Pp. xvi.+398. 21s. net.

This hand-book on telephone transmission will undoubtedly rank for many years as the standard work on the subject. The work opens with an elementary mathematical introduction and a full treatment of the propagation of direct current which is shown to be identical in principle with the more complex conditions for alternating current speech waves.

The complete theory of telephonic propagation in finite lines with known terminal conditions is given and the various graphical, hyperbolic and other methods of calculation are entered into, and in this connection the student will be aided by the presentation of examples worked out in detail. The theory and practice of loaded lines is very fully dealt with and particulars given of the application of coil and continuous loading to G.P.O. underground, overhead and submarine lines.

The principles of duplexing and multiplexing are gone into and references made to the methods adopted for rectifying capacity unbalance in cable lines. In this connection further details might have proved valuable, but the author was probably deterred by considerations of space, and this also applies to the information on thermionic repeaters and to multiplexing methods. These subjects, however, are still in a state of flux, and anything written in much detail would probably require considerable revision in a short time.

The methods in general use for the measurement of telephonic currents and of the various line and apparatus constants are dealt with and in the chapter on the standard cable and its use the practical methods of standard cable measurements are entered into, and the design of a transmission scheme is touched on. A chapter is devoted to cost problems and a number of minimum cost formulæ given.

The most serious general criticism that can be made is the paucity of foot notes giving references. Much of the information embodied in this book is to be found in the published works of Kennelly, Pupin, Heaviside, Campbell, &c.; and the value of the book would have been considerably enhanced by foot note references to the above and other authorities' work. A full bibliography is also very wisely becoming the custom in modern text books, and it is unfortunate that this should be omitted. It is to be hoped that these defects will be remedied in future editions.

This volume represents a great deal of laborious work on the part of the author, and forms the first published manual of a series which should prove of considerable value to the telephone and telegraph engineer. B. S. C.

An Elementary Treatise on Differential Equations and Their Applications. By H. T. H. Piaggio, M.A., D.Sc. (London: G. Bell & Sons.) Pp. xvi.+216+xxv. 12s. net.

The author's object, as stated in the preface, is to give an account of the central parts of the subject as simply as possible, at the same time indicating its several directions of development. It may be said at once that he has been remarkably successful in achieving these aims.

An initial glance through the table of contents reveals an unusual order of treatment, and the inclusion of matter which one does not expect to find in an elementary treatise. A similar glance through the 114 miscellaneous examples at the end of the book raises a doubt whether such a wide range of equations, appearing to include pretty well every type that the ordinary student, either of physics or of the more elementary portions of the theory of curves and surfaces, is likely to meet with, can possibly be dealt with by a student whose knowledge of the subject is derived entirely from this little volume. For instance, examples 37 and 38 contain J_n in their enunciation, although the book contains no formal development of the Bessel functions. But turning back to an example at the end of the concluding chapter, we find J_e defined as Bessel's function of order zero, and a note referring to the treatment of cases of Bessel's equation. And we note that if the student has worked out example 8 at the end of that chapter, he will have obtained the three types of Bessel function, and, moreover, quite simply. It is typical of the author's method, and a perusal of the work shows that the student by the time he has worked through the book, excepting the final miscellaneous examples and two chapters marked for omission on a first reading, will find that he has been led by an exceptionally easy path to a position from which he can deal with all but a few of the more difficult problems left over for a second reading. G. W. de T.

The Telegraphists' Guide. By James Bell and S. Wilson. (London: S. Rentell & Company.) Eighth Edition. Pp. xv.+258. 5s. net.

The full title of this book is "The Telegraphists' Guide to the Departmental and City and Guilds Examinations in Telegraphy." Actually, the book covers the ground of the Post Office examination, but fails to cover completely the ground of even the first grade of the City and Guilds syllabus. Apart from the misleading title the Guide contains a number of errors which, though small in themselves, are liable to confuse the student.

Some of these errors should have been eliminated in the proof stage; for instance, on p. 23 a statement is made with reference to accumulators, that a charging current of 43 amperes amounts to a little over 1 ampere per plate in a 5-plate cell. On p. 147 it is stated that the signalling of a letter *E* by a Wheatstone transmitter will now be described, the ensuing description is that of a letter *C*. There are a number of other such errors as: *E* for *C*, angle for axle, cell for coil, in various places.

There is also a tendency to place the cart before the horse. The student who adds the water to the concentrated acid when making up a bichromate cell as directed on page 6 will doubtless agree. Instances of this failing are the use of Ohm's law on page 22 and its subsequent explanation on page 37. On p. 162 a cable transmitter is described and dots and dashes referred to without pointing out that dots and dashes are not distinguished by their length, as in Morse code. Surely some description of the code used should be given before describing the apparatus used and the "shaping" of signals, &c.

In a few cases descriptions are so badly given as almost to convince the reader that the authors are not wholly conversant with the particular subject described. A case in point will be found on p. 148 in the description of the speed regulating device of the Wheatstone transmitter.

It is only fair to add that the strong feature of the book is the complete description of duplex, quadruplex, office connections, concentrator switches, &c., and the careful way in which the directions of the currents in duplex working are traced out under all possible conditions. Office connections and wiring are evidently the "forte" of the authors.

Correspondence.

ELECTRIC VISION.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In the course of my recent Presidential Address to the Institution of Electrical Engineers I referred to the question of electric vision, and indicated briefly the methods by which I think success might be obtained at the present time.

My friend Mr. Campbell-Swinton has called my attention to an address delivered by him in 1911 to the Röntgen Society, dealing also with the subject of electric vision, and proposing methods of working substantially identical with that suggested in my address. I am glad to find in a conversation I recently had with Mr. Swinton that he agrees with me that the development of wireless transmission and the valve amplifier carries the proposal a long way towards practicability.

I desire, however, to call attention as early as possible to Mr. Swinton's work in this direction.

London. L. B. Atkinson.

December 14th, 1920.

A QUESTION OF NOMENCLATURE—WIRE RADIO.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In the evolution of a new art, a question generally arises about the proper choice of nomenclature. Frequently some confusion is caused by the variety of names by which different authors designate a new invention or discovery. A notable example is that of the three electrode vacuum tube, which for some time has been known under different names—audion, valve, triode, electron tube, &c.

A similar condition prevails at present in the designations used by different writers for wire-radio. The system of wire-radio is now coming into general use throughout the world, a great deal is being written on this subject, and, because of the lack of an accepted universal name, the system is designated differently in different countries. It will suffice to mention only the following:

Germany: High-frequency telephony and telegraphy;
Japan: Wired-radio;
Canada: Guided wave telephony and telegraphy;

United States: "Carrier-current" telegraphy and telephony; and popularly the system is generally known as "wired-wireless."

It is hardly necessary to emphasise the desirability of having a suitable and universally accepted name for this new branch of the art of electrical intercommunication. I would suggest the name "wire-radio." In my judgment, the term "wire-radio" is suggestive, and at the same time sufficiently comprehensive; it conveys the idea of transmitting signals of radio character over a wire, or rather guided by a wire.—I am, &c.,

Washington, D.C., November 27. George O. Squier, Major-General, U.S.A.

KELVIN *v.* KAPP.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: Under the above alarming title Mr. Sayers states very clearly one important point of criticism of my Paper to the I.E.E.

In cases where one can base the choice of cable sections on Kelvin's law, much of what is said in the Paper concerning the working of distribution systems, is of no economic importance. Therefore, Mr. Sayers suggests in paragraph 4 that one must know at what points the economy law has to give way to heating considerations.

Kelvin's law is based on a number of factors which differ widely in different schemes. To take a definite example, however, I find that at the present prices of cable, assuming capital charges equal to 10 per cent., the cost of power lost in the cables is ½d. per unit, and the load-factor is about 30 per cent. Kelvin's law gives a current density of 1,560 amperes per square inch for 6,600-volt cable. That is about the safe current density of a 0·15 sq. in. cable under good conditions of heat dissipation.

As a cable layout must be designed so amply that the safe current density will not be exceeded under the worst conditions of failure of any one cable, the actual current density in normal working is always less than the safe figure. Therefore, a 0·15 sq. in. 6,600-volt cable system could not be designed according to Kelvin's law for the above conditions, but if each cable had a very much smaller cross-section it might be safe to work it up to the economical current density.

It may be surprising to some of your readers that Kelvin's law should give so high a current density, considering that the cost of copper is relatively low to that of coal at the present time. It must, however, be remembered that in addition to the cost of the copper, the cost of lead, insulation, &c., varies with the cross-section, and this latter cost has increased more than the former.—I am, &c.,

London, Dec. 11th. Reginald O. Kapp.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: At the end of his letter to you in your issue of the 10th instant, Mr. Sayers points out that Mr. Kapp's Paper to the I.E.E. gives no guidance for evaluating the constants in a heating curve of the type referred to.

The following formula may be of interest to your readers: If a heating curve is plotted, and any three readings with an equal time interval between them taken from this curve are called θ_1, θ_2, θ_3, the time interval being called Δ, the final steady temperature is

$$\frac{\theta_1\theta_3-\theta_2^2}{\theta_1+\theta_3-2\theta_2}.$$

Proof: The relation between time and temperature is given approximately by the law. $\theta=\theta_0(1-\varepsilon^{-\frac{t}{c}})$, so that $(\theta_0-\theta_1)=\varepsilon^{-\frac{t}{c}}$; $(\theta_0-\theta_2)=\varepsilon^{-\frac{t+\Delta}{c}}$; $(\theta_0-\theta_3)=\varepsilon^{-\frac{t+2\Delta}{c}}$ from which

$$(\theta_0-\theta_1)(\theta_0-\theta_3)=(\theta_0-\theta_2)^2$$

which simplifies to the expression given.

The time constant c can also be obtained from the three readings θ_1, θ_2, θ_3, by the following formula

$$\frac{\Delta}{c}=\log_e\frac{\theta_2-\theta_1}{\theta_3-\theta_2},$$

which follows from the equations given above.

I find that by continuing the curve freehand through the points obtained on test, it is not possible to obtain sufficiently accurate values of the time constant, or the steady temperature, whereas the above formula gives very fair accuracy if Δ is taken equal to about 0·75 of the time constant.—I am, &c.,

London, Dec. 10th. C. G. Carrothers.

INSTITUTION OF ELECTRICAL ENGINEERS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: With the Council and the Press adopting the attitude of "you scratch my back and I scratch yours," it is not surprising to read your one-sided report of the Special Meeting of the Institution, although one hardly expected the usually sober Electrician to resort to "catch-penny" methods to discredit the opposition.

Your report states that "I had evidently not read the notice convening the meeting." I would reply that your reporter was evidently asleep when I dealt with this point. What I stated was that the instructions as to returning the proxy papers were tucked away in the President's letter, whereas I contended they ought to have been clearly stated on the proxy paper, as the procedure under Company law was rather limited and not fully known.

As to your criticism of my "flat rate increase," I pointed out in my remarks that there was as much to be said for a "flat rate increase" as for a proportionate increase all round, (the Council's proposals are neither), and, in fact, I had a further amendment on the latter basis ready to hand in. I put forward the former one first, as it was simpler, realising that whichever I proposed would be found fault with by my opponents.

Your closing comment as to my "spirit failing" is about as untrue a statement as could possibly be made. I was eager to fight to the end and withdrew my demand for a poll only after the President had stated unofficially that the Council had a majority of 14 to 1. To have still persisted would have been to have challenged the President's word, and I would not have been guilty of taking such an extreme course.

You refer to the small support accorded me at the meeting. Naturally (and provincial members will doubtless take note of it) London members can always dominate the meeting, and what concerned them most was that my opposition was delaying them getting away to dinner.

As to the "annoyance" referred to by Mr. W. E. Warrilow in his letter this week, I do not propose to dwell on the reasons prompting his attack, or his unseemly interjections at the meeting, but sufficient is it to say that those of us who know him can place the true value on his remarks.

As to my letter which you have kindly inserted this week, I was much puzzled at the mysterious letters "E.M.C." after my name, until I realised that they were the initials of my typist who signed the letter on my behalf.—I am, &c.,

West Ham, Dec. 11. Fredk. W. Purse.

[We apologise to Mr. Purse and to his typist for the unwarrantable inclusion of the latter's initials, the more so as we are sure Mr. Purse's views are entirely his own. We refer to the remainder of his letter in our "Editorial Notes."—Ed. *E.*]

We learn that the Ediswan Staff Association, which is under the patronage of the managing director (Mr. C. E. Hunter) and one of the directors (Mr. E. Gimmingham), has been in existence about 18 months and is making great efforts to fulfil its objects, viz., to promote social intercourse between the members of the staff. A series of entertainments has been arranged for the winter months, consisting of whist drives, concerts, &c. At a concert on the 4th inst. at St. James's Hall, Ponders End, an excellent programme was provided by "The Mauves," a concert party consisting of members of the staff, many of whom distinguished themselves.

Western Electric Labour Saving Appliances.

A notable example of the household electric appliances manufactured by the Western Electric Company is their vacuum sweeper, which is distinguished by being filled with a motor-driven brush. The results aimed at in the construction of this machine are (1) simplicity as regards switching, adjusting the brush and fixing and detaching accessories; (2) reliability—so successful has this been that it is claimed it is almost impossible to damage the apparatus accidentally; and (3) light weight. The machine, in sweeping order, only weighs 14¾ lb.

The motor-driven revolving brush was introduced to save the exertion, entailed, as is necessary in many other suction sweepers, in making the brush revolve by pushing the machine along the floor, and, moreover, the rate of revolution found most desirable (1,400 revs. per min.) is secured by means of gearing, which effects the necessary reduction from the fan speed of the motor (7,000 revs. per min., and the brush, with the motor-driven system, has a tapping action on the carpet, thus raising the nap and loosening the grit, while the suction provided does the rest. The brush is driven by a completely protected belt from an extension of the armature shaft through a brass worm gearing. The pinion which meshes with the worm on the motor shaft is made of raw hide, firstly to avoid noise, and secondly in order that it may strip in case of excessive overload on the motor. The brush need not always be put into action, as the suction alone, which is equal to 1,600 cubic feet per minute, and will pull a vacuum of 14 in. on a water gauge, is quite capable of dealing with fine dust, and the brush need only be engaged for loosening grit and material of a thread-like nature from the carpet. We saw lumps of cotton wool disappear into the machine without any clogging of the brush, and we understand this is avoided by the use of wide spacing between the bristles and the high polish on the steel spindle.

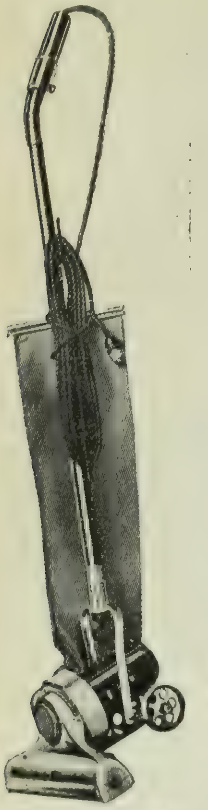


Fig. 1.—General View of the Western Electric Vacuum Sweeper.

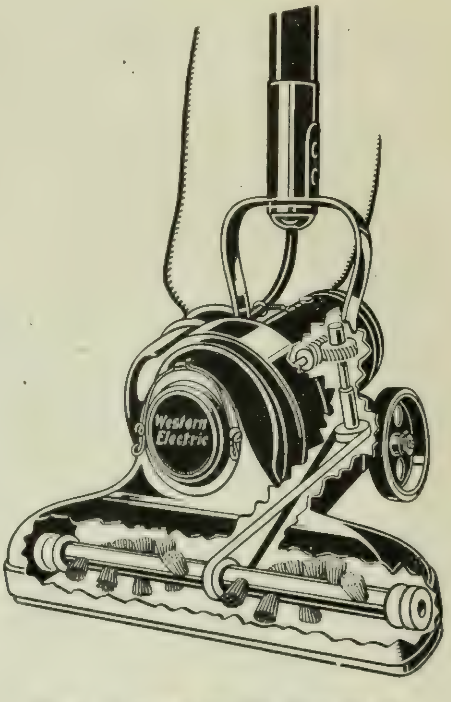


Fig. 2.—A Diagrammatic View of the Sweeper showing Method of Drive.

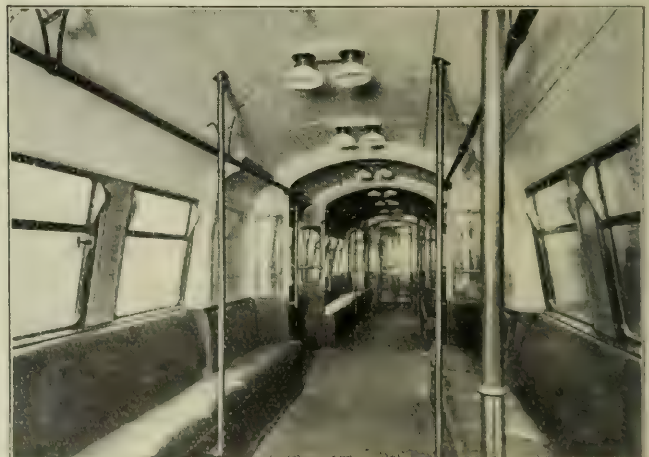
The motor is of a Universal type, and is suitable for any pressure between 30 and 250 volts. It is air cooled, and we are informed that the 1921 model will have a fan at the end of the shafting at the rear of the motor to make the air cooling even more efficient. Everything in the use, and in the preparation for use, of the apparatus is extremely simple. Oil holes are provided for oiling, there is a rotary switch in a convenient position for switching the motor off and on, and a tilting device for getting over the fringe of a carpet. The bushes at the ends of the brush spindle require no oil, and the brush can easily be readjusted, though this is not usually necessary until after two years use.

There are seven "tools" which connect on to the front of the machine, and are used in connection with operations other than floor cleaning: 1) A connector, which is snapped on in a second; (2) a flexible tube; 3) a long, straight, rigid tube; (4) a bent rigid tube; (5) a short wide nozzle for removing dust from curtains, upholstery, electric lighting bowls, &c.; (6) a flat narrow nozzle for cleaning radiators, the crevices of carved furniture, &c.; and (7) an ordinary-looking oblong-shaped brush, which is adjusted at one end of the long rigid tube, which in turn is connected to the machine by the flexible tube. By means of this arrangement a person of average height can reach a cornice of average height without a step ladder. The dust is disturbed by the bristles, is then sucked through an orifice in the brush into the tubes, and finally into the dust bag, which, by the way, is made of dustproof material, and has a double funnel inside to prevent egress of dust. There are 24 ft. of flexible supplied, and the end connected to the sweeper protected by a steel spiral spring. The price of the apparatus is £18 10s., with an addition of £3 10s. for the accessories or "tools." The above illustration shows the worm gear, the raw-hide cog-wheel, the belt with its cover removed and the brush.

Another speciality of the Western Electric Company is the No. 2 lock-stitch, rotary-type, electrically-driven portable sewing-machine, which sews a maximum of about 1,200 stitches a minute, the high speed being due to the rotary as compared with a vibrating motion. The automatic tension in this machine makes it possible to use any size of thread without readjusting the tension, and bobbin winding and shuttle threading are also automatic. The total weight of the machine is 35 lb.

New Rolling Stock on the London Electric Railway (Piccadilly Line).

A Press inspection and trial run of one of the new trains on the Piccadilly Line took place on the 8th inst. The cars composing the train are part of a contract for 40 of the same type being carried out by Messrs. Cammell, Laird & Company. Each car seats 44 passengers, and there will be no strap-hanging—in the literal sense—straps being replaced by hand-poles, vertical and horizontal, within reach of any passenger. The length of the new car is 50 ft. overall. The door arrangements are a special feature of the new stock. Each car has one double and two single sliding doors, giving greater facility than the old cars of entrance and exit. The double sliding door is a new feature. The doors are operated by air, with electrical control. If a door in closing comes in contact with a passenger its action is reversed, and the train cannot start until every door is closed. Above the waist of the car the interior is painted in cream colour, so as to give a good reflecting surface. An elliptical roof replaces the clerestory roof of the older stock, and roof advertisements will be restricted so as to give more light-reflection. The electric lamps run down the centre of the roof for the whole length of the car. Emergency lighting is supplied from a storage battery, and comes into operation automatically in the event of any failure of the ordinary car-lighting. The cost of the 40 new cars will be approximately £120,000. The new rolling-stock will relieve congestion by expediting the working of the trains. It will also gradually build up a six-car train service, as each new train replaces and releases a five-car train of the older stock. These older five-car trains can then be divided, and can be added, car by car, to other five-car trains of the older stock to make them into six-car trains. This will mean an all-round strengthening of the services, and an all-round lightening of the overload. The 40 new cars will mean an addition of more than 26 per cent. to the existing car-strength of the Piccadilly Line. The new cars represent a total gain of 1,760 seats, and 1,760 seats × 12 journeys (during the six "rush" hours of the day) will total up to 21,120 extra seats during those hours.



Interior view of the new "Piccadilly" Railway Rolling Stock.

Modern Electrical Coal Cutters.

The proper design and construction of electrically-driven coal cutting machinery is one of great importance at the present time, when labour costs are so high, and increased output is so necessary. Great interest has therefore been taken in the complete exhibit of this equipment which was shown by Messrs. MAVOR & COULSON at the Glasgow Shipbuilding, Engineering and Electrical Exhibition.

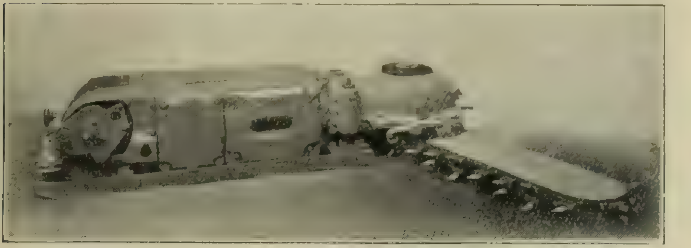


FIG 1.—M. & C. CHAIN COAL CUTTER WITH D.C. ELECTRIC MOTOR.

This included cutters of the bar, chain and disc types, all of which are standardised, the first two being identical except in respect of the cutting members—bar, or chain and jib—and the parts of the gear head directly associated with them. Thus, by removing from the bar coal-cutter the lower part of the gear head or "banjo" which carries the cutter bar, and substituting for it a corresponding part carrying the chain jib and chain, and changing the relative gear wheels, the machine can be converted to a chain coal cutter. The advantages of this interchangeability at collieries where both bar and chain machines are required are obvious.

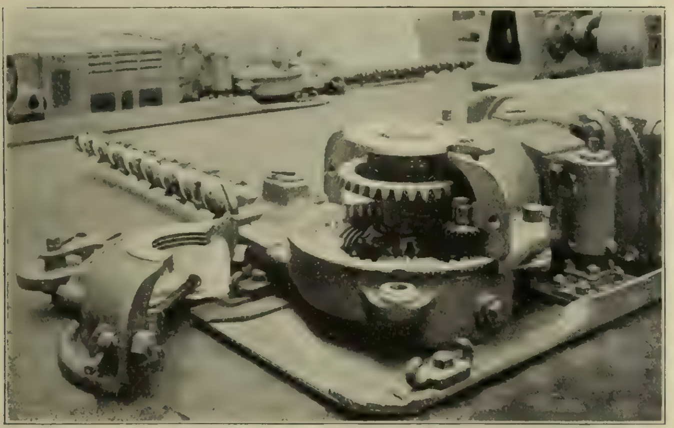


FIG. 2.—GEAR HEAD WITH BACK COVER OFF SHOWING BAR AND GEAR.

Another important feature is the standardisation and interchangeability not only of the working parts, but of the principal components. The machine may be said to consist of four principal parts: (1) The cutting member (bar or chain) and its structural support, (2) the gear head, (3) the motor, and (4) the haulage gear. The motors, whether three-phase, direct-current or compressed air, are all of the same external dimensions, and occupy the same position in the structure of the machine. The three-phase and direct-current motors enclose in their casings the starting switches and their connections with the windings, so that the motor with starter is a self-contained unit.

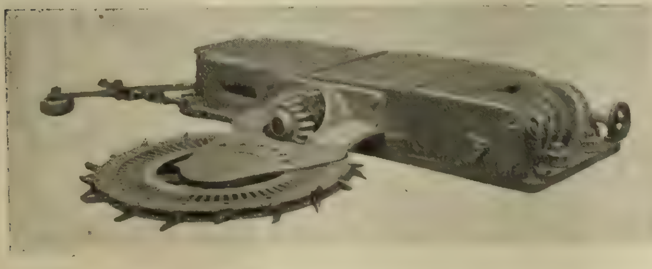


FIG. 3.—SAMSON DISC COAL CUTTER WITH D.C. ELECTRIC MOTOR.

The reduced length of these coal cutters and the addition of a two-speed haulage gear enables them to be adapted for long wall, for short wall and for bore and pillar working, and also for driving narrow places singly or in pairs.

The slow and variable-speed haulage feeds the machine while it is cutting, and the high speed haulage of 50 ft. per minute traverses the machine from heading to heading. No flitting truck is used, the machine is mounted permanently on its own sledge, and is hauled along the floor of the roadways. This method has proved to be the best suited to the underground conditions in this country.

Mention may also be made of the firm's Samson disc coal cutter, a special feature of which is the simple device by which the cutter wheel may be disengaged from the gearing, so that the wheel may be at rest while the motor is in motion.

Illustrations of these cutters are given herewith.

The Valve and Long-distance Telephony.

One of the most interesting of the applications of the electro-thermionic valve is its use in telephony to improve transmission over long-distances, and so to diminish the cost of line construction. In THE ELECTRICIAN for May 7, 1920, and in two subsequent issues we gave an account of a long Paper read by Messrs. B. Gherardi and F. K. Jewett before the American Institute of Electrical Engineers on this subject, wherein they dealt in a most exhaustive fashion with the various historical and technical questions. Those engineers in this country who are interested in this subject have now an opportunity of seeing at the showrooms of the WESTERN ELECTRIC COMPANY, at 62, Finsbury-pavement, London, E.C., a demonstration set of these so-called repeaters working on artificial cables. The demonstration is designed to show the two chief types of repeater and terminal equipment involved in long-distance telephone cables and aerial systems—*i.e.*, the 22 type and the four-wire equipment, details of both of which were given in the Paper to which we have just referred.

For purposes of demonstration artificial lines which attenuate transmission by amounts corresponding to average practice in the spacing of each type of repeater are provided. The demonstration circuit terminates at each end in a local battery set. The first section of the artificial line has an equivalent of 5 standard miles, and the second section an equivalent of 7 standard miles, at which point the first repeater is inserted. Between the repeaters is a line of 14 standard miles, while beyond the second repeater the make up of the circuit is similar to that up to the first. It should be pointed out that 12 miles is by no means the maximum gain which these sets are capable of giving, but only in isolated cases with circuits of very good impedance characteristics is it practicable to work up to 18 or 20. Factors which must be carefully taken into account in designing such systems are the uniformity of the circuit, the balancing networks, the spacing of the repeaters, the passive impedance of the repeaters, the gauge of the circuit, the cut-off frequency of the loading and the terminal line impedance.

The repeater sets used are of the panel type, so designed as to be mounted in relay rack bays. A special signalling panel is also installed, which is fitted with various kinds of equipment necessary to illustrate three types of signalling at 16-cycle relayed, at 135-cycle relayed, and at a 135-cycle amplified. An interesting set shown in connection with this apparatus is the gain measuring set, which indicates the actual amplification introduced by a repeater set between two artificial lines to an accuracy of a quarter of a mile. A series of four wire repeater sets are also shown, these being similar in design to those employed in the United States for four-wire trunk cables of moderate length. A description of these was also given in our account of Messrs. Gherardi and Jewett's Paper.

Wireless and Air Services.

The half-yearly report issued by the Air Ministry on the Progress of Civil Aviation states that the wireless direction finder apparatus installed at Croydon has proved its value in enabling aircraft to correct their course in thick weather, while the equipment of aircraft with the wireless telephone is found to be of considerable assistance to navigation. Stations for both wireless telegraphy and telephony are now in being at Croydon, Lympne, Castle Bromwich, Manchester and Renfrew. Electric landing lights for indicating the direction of landing are being installed at Croydon aerodrome and trials are being made at the same place to test the value of powerful searchlights as a means for helping to locate aerodromes.

Telephone Charges.

The Select Committee on Telephone Charges has concluded the taking of evidence and will issue its report in a few days. It is reported that its findings will follow closely the recommendations of the Departmental Committee. It will recommend the abolition of the flat or unlimited service rate, the introduction of a fixed annual charge for installaton and a uniform charge for each effective local call; the same rates will be charged for supplying the telephone service to private residences as to business premises, and a uniform message fee of 1½d. per call will be adopted throughout the country.

The following is an abstract of the evidence of the later witnesses heard by the Committee:

Ald. T. Malcomson, of Reigate, said that the councils he represented strongly protested against the proposed curtailment of the London area to a radius of five miles from Oxford-circus. That centre had nothing to commend it from a business point of view, and a rigid line of five miles therefrom would have the result of including parts of some populous districts and excluding other parts of the same district. A speedy and efficient service was essential to outlying towns like Redhill and Reigate, where large printing and publishing businesses had been established, and assisted to relieve congestion by placing the works and workpeople well outside the Metropolitan area.

Sir Charles Owens, a director of the L. & S.W. Railway Company, and chairman of the London Telephone Advisory Committee, stated that the committee, which consisted of representatives of the Port of London Authority, London municipal authorities and other bodies, had considered the report of the Departmental Committee, and he had taken steps to ascertain the opinion of the members of the London Chamber of Commerce regarding these points. To the *questionnaire* there were 1,759 replies, and it seemed clear that, given an effective service and improved facilities, some increase in charges would not be seriously opposed. There was a very large preponderance in favour of the maintenance of the unlimited rate. If the flat rate were abolished and message rate established there should be a big discount to large users. But the general view was largely in favour of some addition to the charges for the existing system rather than the abolition of all but the message rate. With regard to public boxes, the general opinion was that these should not be subsidised at the expense of the regular subscriber, but it was thought that with efficient management the cost of the public call should not exceed 3d. His view was that, as it at present cost 5d. to the Post Office, and as the telegraph and postage rates had been doubled, the present public call office charge should also be doubled. As to the suggested inner and outer London areas, a reduction of the existing area was a retrograde step. The tendency was to place works and factories farther out, and the proposal of the Departmental Committee would undoubtedly inflict hardship on those who had offices in London and works outside, though within the present London area. There was an extremely strong feeling against placing any portion of the Port of London outside the area. There should be three alternative rates—the unlimited, or flat rate, the measured rate and the message rate.

Lieut.-Col. W. A. J. O'Meara, R.E., supported the views of Sir Charles Owens, and said the automatic was the coming system. It was at least as effective as that at present in use and cost less to operate. But, as it was not possible to rip up the present installations to substitute automatic, the latter could only be gradually introduced. He thought the outlook of the Post Office at the beginning was not sufficiently wide, and its internal organisation rather cramping. That had prevented the free and full development that should have taken place. The existing Telephohe Department did not look sufficiently far ahead, with the result that subsequent installations cost more than they need. There were other ways of meeting the difficulties of increased charges for labour and material than increasing the charges, and he suggested that a committee of experts to inquire into and effect economies and map new trunk routes should be a permanent part of the telephone organization.

Sir Evelyn Murray, Permanent Secretary to the P.O. Telephone Department, was recalled in order to reply to statements made by witnesses opposed to the proposed telephone charges. He considered the suggestion that the telephone branch of the Post Office should be a separate department was impracticable, and if practicable, would lead to inefficiency and extravagance. The telephones and telegraphs were essentially allied services, involving in many respects the same technical problems, using the same plant and offering alternative means of communication between two points. Telegraph and telephone wires were placed on the same poles or in the same underground channel; the same wires could be, and in fact in some cases were, used simultaneously for the transmission of telegrams and for conversations by telephone. The engineering establishments must be common to both services, and the the same applied to other technical and administrative staffs. If the headquarters control of the telephone were divorced from that of the Postal and Telegraph Services, a similar separation would have to follow in the local administration; the supervising staff would be duplicated, *personnel* and overhead charges would be largely increased and co-ordination would be replaced by administration in watertight compartments.

The tariff of the Departmental Committee would yield an increase on existing rates of 67 per cent. and if the anticipated reduction in the calling rate was realised the increase would be 57 per cent. Throughout his evidence Col. Webb adopted the "station" as the unit of comparison. The result would be misleading unless the ratio of "stations" to "lines" was the same on both sides of the comparison. If the difference in the proportion of extensions were eliminated and the comparison based on "lines" the rates in America would work out at nearly 13 per cent. higher than Great Britain instead of 6 per cent. cheaper, notwithstanding "the intensive development" in America. In Montreal and Toronto a business subscriber would not be able to get service for less than £12, while under the P.O. proposals he would obtain it for £8 and upwards. The minimum charge of £12 in Montreal and Toronto would in this country cover 640 calls. About 40 per cent. of the provincial subscribers made less than this number. The charges for business connections in Montreal and Toronto were higher than the Post Office tariff at every point, except for subscribers making from 700 to 2,900 calls. As to the proposed rates in New York and London, he said the London charges would exceed those in New York only for subscribers using between 400 and 1,200 calls per annum, while the New York charges for the big users were considerably higher. Nearly 30 per cent. of the London subscribers (those who made fewer than 416 calls per annum) would be less than the New York minimum. If Col. Webb's proposed tariff had been in operation in 1920-21 it would have produced an increase of £1,789,000, or 23 per cent. more than the present rates, but £4,105,000 less than the proposals of the Departmental Committee, and would leave a deficit of £1,770,000, which would increase rapidly with each year.

He said that the policy of the Government was to make the telephone services pay, but not to make more than a working margin of profit. If there were a considerable surplus they might reduce the rental-charges; if a very large one they might reduce the cost per call. In reply to the chairman as to whether he found an instrument might be found which could be put into a subscriber's house, near his telephone, on which all his out-going calls could be recorded, the witness said that the Post Office were always experimenting with these instruments, but had not found one yet that was really satisfactory. It was possible that such an instrument might be invented, but it was open to doubt whether the subscriber would pay for it to be installed.

London—Geneva Wireless Test.

A successful demonstration of wireless telephony between this country and Geneva was given by the Marconi Company on Sunday morning in connection with a gathering of newspaper correspondents who are engaged in reporting the proceedings of the first Conference of the League of Nations. The event was invested with special interest owing to the fact that Dr. A. Graham Bell sent a wireless telephone message of greeting from London to Geneva, and Lord Burnham, C.H., also spoke to Geneva from London. Both speakers used an ordinary desk telephone in a director's room at Marconi house. This instrument was connected by a P.O. line direct to the wireless apparatus at the Company's Chelmsford station. This apparatus automatically and instantaneously relayed the message to Geneva, so that, in effect, the speakers were in direct communication with Switzerland, operating the wireless plant by means of their voices. Lord Riddell and Senatore Marconi also sent messages, which were spoken on their behalf into the transmitter at Chelmsford. All the messages were then repeated in French.

The voices of Lord Burnham and Dr. Graham Bell were reported by Geneva to be very clear, that of the former being instantly recognised, whilst Lord Riddell's "Good luck to you all" brought forth loud expressions of "Merci" from the French journalists present. The demonstration concluded with the playing of two gramophone records, Kreisler's "Caprice Viervois" and the Allies' National Anthems. At Geneva the messages and music were intercepted by the aerial at the Marconi receiving station and carried over several miles of land-line to the Conference Hall of the League. The journalists there were able to hear every word by means of ordinary telephone receivers. The clearness of the speech heard at Geneva astonished the correspondents, who had not had previous experience of wireless telephony; but even more striking evidence of the value of this means of communication was forthcoming when the telephone receivers were discarded and a stentorphone was connected to the receiving apparatus.

Home Counties District Joint Board.

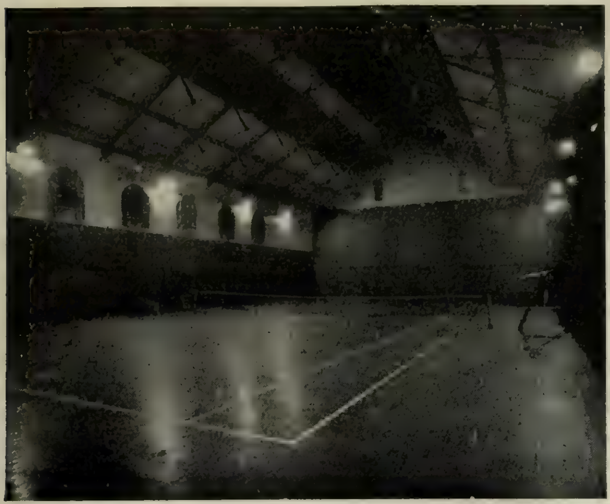
A meeting of the undertakings of the Home Counties (No. 9 Area) Joint Industrial Council was held on the 8th inst. at the Ministry of Labour, when it was resolved to set up a District Joint Board for the purpose of dealing with matters relating to the conditions of employment and remuneration of the technical staff. The following gentlemen were elected to act as the employers' side of the District Board:—

Municipal.—Ald. A. Wilkinson (Luton), Ald. Geo. Radford (Southend), Councillor Legg, J.P. (Reigate), R. N. Torpy, M.I.C.E., Robt. W. L. Phillips and C. A. Blascheck (borough electrical engineers at Tunbridge Wells, Bedford and Canterbury). *Company.*—G. W. Spencer Hawes (Reading Electric Supply Company), T. Hesketh (Folkestone Electricity Supply Company), J. Eustace (Electric Supply Corporation), W. E. Brandreth (Wycombe (Borough) Electric Light & Power Company), A. J. Wray (Banbury & District Electric Supply Company) and G. W. F. Horner (Leatherhead & District Electricity Company).

The Lighting of Covered Lawn Tennis Courts.

The satisfactory illumination of covered lawn tennis courts has always presented a difficult problem to engineers, and an account of an attempt which has been made to solve it will be of interest. The system under review at Queen's Club at West Kensington will therefore be of interest. At the Queen's Club there are two courts side by side, each approximately 40 ft. wide by 120 ft. long, the height of each building from the floor to the tiebeams being about 20 ft.

The floor and walls are all finished dead black so that the white balls may be readily distinguished, and in view of the bad reflecting properties of these black surfaces, direct lighting by means of gas-filled lamps in steel reflector fittings was decided upon. It was found impossible to have the lamps directly overhead because balls are frequently "skied" amongst the girders, and after various experiments the choice fell upon 500 watt Osram gas-filled lamps mounted in G. E. C. angle-type steel reflector fittings. Five of these are mounted 18 ft. high along the sides of each court. The arrangement is clearly shown in the accompanying photograph. A feature of this installation is the uniformity of the illumination, the maximum value being 3.4 ft. candles and the minimum 3 ft. candles.



The Lighting of the Covered Lawn Tennis Courts at Queen's Club.

The installation was planned by the Illuminating Engineering Department of the General Electric Company, Ltd., 67, Queen Victoria-street, E.C., in co-operation with Mr. Ross, the electrician of Queen's Club. We are indebted to Mr. E. B. Noel, Secretary of the Club, for permission to publish the photograph and description of the lighting arrangement.

Labour Movements.

By ARTIFEX.

Mr. Frank Hodges denies that any difficulty is being experienced in carrying into effect the new terms relating to output and wages.

The Welsh tinplate workers have decided to accept a sliding-scale wages arrangement. Wages will now be regulated by the price of steel.

Mr. Tom Mann is relinquishing his post as general secretary of the Amalgamation of Engineering Trade Unions, having reached the retiring age of 65.

The Industrial Court has disallowed the claim for a flat rate of 2s. 6d. per hour, made by roll turners. It advised the favourable consideration of a tonnage-basis scheme, proposed by the employers.

The claim of the Scottish paviors to be recognised as affiliated with the building trades, and, as a consequence, that their wages rise and fall with the wages in the building trades, has been disallowed by the Industrial Court.

The Executive Committee of the National Union of Scottish Mine Workers has decided to co-operate with the mine owners in considering the scheme agreed upon between the Mining Association, the Coal Controller, and the Mining Federation of Great Britain for increasing output.

The Newcastle Corporation has agreed to adopt the rates paid according to the grading of the Joint Industrial Council, for manual workers in the City Engineer's office. Those employees already receiving a higher scale than this grading shall continue to receive their present pay.

Should manufacturers' figures of cost and profit be open to examination by joint industrial councils when a wage claim is refused? An affirmative decision to this question was given by delegates to the conference of the National Federation of General workers, representing 1,500,000 trade unionists, last week. Failing this, they demanded that disputes and wage claims should be referred to courts of inquiry, open to the public.

The F.B.I. and Taxation.

The burden of taxation is now so serious and the effects of the Excess Profits Duty are so disastrous to trade and industry that the Federation of British Industries has been devoting particular attention to these questions of late. Naturally, they formed the principal subject of discussion at the recent annual meeting of the Federation here.

The President, Mr. W. Peter Rylands, who was re-elected for the ensuing year, said that industry could no longer bear any special taxation. Earlier in the year the Taxation Committee asked for a modest flat rate tax on profits of, say, 2s. in the pound, which would have been a reasonable substitute for E.P.D. at 40 per cent. Unfortunately the Chancellor of the Exchequer was carried away by the trade returns of the previous 12 months, and increased E.P.D. to 60 per cent., and, in addition, imposed a Corporation Tax of 1s. in the pound. In July, the F.B.I. pointed out the danger to the commerce of the country of carrying E.P.D. up to the last day of prosperity, for at any particular moment there was an accruing liability of something like £500,000,000, but the Chancellor refused to re-cast his budget. Government economy was an urgent necessity.

At the Dinner given by the Federation after its general meeting, Mr. Lloyd George said he was glad that the great business community, the directing brains of industry, were coming together, federating, combining and co-ordinating. The causes of the period of depression into which we were getting were not peculiar to our country; they affected the whole world. Before the war we sold to Europe £246,000,000 worth of goods, equal to £600,000,000 or more at present prices. We must have public and private economy of the most constructive and relentless kind.

At a subsequent Conference of Manufacturers' Associations affiliated to the F.B.I., the following resolution, moved by Sir Algernon Firth, was unanimously adopted: "That this meeting, representing the organised industries of the country, while recognising the necessity of special direct taxation upon production as a temporary expedient in time of war, is unanimously of opinion that under existing conditions such taxation is fundamentally unsound and cannot be continued without endangering the stability of the nation's industries, and urged upon His Majesty's Government the necessity for an immediate withdrawal of the E.P.D. and the corporation taxes."

Referring to Mr. Lloyd George's speech of the previous day, Sir Algernon Firth said it reminded him of an American story in which the children in a certain family suggested that to effect economy father should work harder. Those who were providing the enormous income were in the position of father, and the Government represented the children. The taxable capacity of the country did not exceed £900,000,000.

On Friday last a deputation from the Federation waited upon the Chancellor and made further representations on the subject.

The New Motor Freight Exchange.

As already announced in these columns, the "Transport World," the new weekly to be published by Messrs. Benn Brothers, Ltd., on January 5, will embody a novel journalistic feature to be known as the Motor Freight Exchange. We have also indicated that special facilities would be given to our readers for the use of this new aid to business, and we are now in a position to give more exact details of these facilities. The Motor Freight Exchange will be divided into two main parts, the one giving information as to freight, awaiting transport, and the other announcing transport facilities as available for freight. A manufacturer having goods to send from, say, Nottingham to Bradford, will announce that fact in the previous week's "Transport World," in order that motor owners whose lorries may be on that road on the date stated, may place themselves at the service of the manufacturer. Conversely, a motor transport contractor, or a private lorry owner, who is sending a load from Liverpool to Carlisle, and is faced with the prospect of an empty journey from Carlisle to Liverpool, will give particulars of the facilities which he can offer to a Carlisle merchant in order that he may find a load for his return empty journey. All this information will be given in the most succinct and briefest form. A single line will, in most cases, suffice to name the starting point and the destination, the amount of freight or the capacity of the lorry, the date of the projected journey and the name, telegraphic address, and telephone number of the advertiser. By the publication of large masses of information of this description, a new prospect opens up both to lorry owners and to freight users. The publisher of the "Transport World" has prepared slip forms for the convenience of advertisers under both these heads, and a supply of these will be gladly forwarded to any who may desire to avail themselves of the facilities offered.

This brings us to the special facilities which we have mentioned as available to readers of The Electrician. For the month of January only, Benn Brothers, Ltd., are prepared to publish in the "Transport World" information under either of the above heads, free of charge, so that every opportunity may be given to our readers of availing themselves of the new service and testing for themselves its capabilities and usefulness. In order to take advantage of this offer, readers should write to The Publisher, the "Transport World," 8, Bouverie-street, E.C. 4, stating that they are subscribers to The Electrician, and asking for a supply of the necessary free form. The first issue of the "Transport World and Motor Freight Exchange" will be published on Jan. 5, and free advertisements asking for freight facilities or motor loads should, therefore, have reference to the week beginning Jan. 7.

Commercial Topics.

The Madrid Postal Convention.

The international Postal Conference concluded its labours at Madrid on the 30th ult., when the Madrid Postal Convention was signed. One outcome of the Conference was the elaboration of a Pan-American Postal Union, which will include the United States, the whole of the Latin American republics as well as Spain. When the Union has been ratified postal matter will circulate anywhere within it at the internal postage rates in the participating states. This will give the United States an advantage in commercial matters as it will get the benefit of lower rates for letters, catalogues and samples sent to South America and Spain than those charged for postal packets from Great Britain. It is to be hoped that the British Government may be able to adhere to the new Convention as the benefits would greatly outweigh any loss of revenue. Under the new International Union the transit dues remain as before, but as they are payable in gold this is equivalent to an increase proportionate to the depreciation of the currencies in the various countries.

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British Agents in New Zealand.

In connection with the rapid electrical developments in various parts of New Zealand and the advances made in the application of hydro-electric power to various industrial purposes, Mr. R. W. Dalton, H.M. Trade Commissioner, thinks there is an increasing prospect of United Kingdom manufacturers of electric plant and supplies obtaining contracts and this prospect is likely to improve in future. In a recent communication to the Department of Overseas Trade he states, in regard to tenders invited in connection with this electrical development, that in many cases no time is given to send details home, except by cable. It is quite possible, however, for purchasing authorities to get satisfactory tenders in New Zealand from agents for overseas firms. Taking into account the urgency for the delivery of plant for almost all the works proposed, it is practically impossible for firms in the United Kingdom to secure a great deal of the business, unless they are represented in New Zealand by agents who are capable of tendering. Mr. Dalton has been in communication with the Public Works Department and other authorities regarding the period allowed for sending in tenders in the case of the larger schemes, and steps are being taken to secure adequate time being given in those cases for the consideration of tenders from home, but in the majority of cases it must rest with British firms to see that they are in a position to tender through agents in New Zealand if they want to secure contracts for the smaller schemes.

In view of the large number of small schemes (that is, up to £50,000 in value) the amount of business represented by contracts is considerable in the total, but the time given for tendering is often too short to allow of offers being sent from home. It is, therefore, desirable that firms should have agents who can tender for these on the spot.

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Japanese Commercial Depression.

An interesting report on the present condition of trade in Japan has been furnished by Mr. E. F. Crowe, C.M.G., Commercial Counsellor at Tokio. According to Mr. Crowe, who has recently had interviews with many leading business men, there is no hope of improvement before the spring, but he adheres to the view that the country as a whole is financially sound. For the period up to the end of August, the value of the imports was Y1,897,000,000, and of exports Y1,467,000,000. The returns for trade with the United Kingdom stand at Y150,000,000 imports, and Y75,000,000 exports. Notwithstanding the heavy adverse balance the yen is worth nearly 3s., instead of 2s. 0½d., the par rate of exchange. This fact, coupled with the large and steady imports of gold, which exceed Y120,000,000 since the commencement of the year, prove that Japan's finances are on a sound basis. In cotton and other branches of industry there has been very rash speculation, and the importation has been much in excess of requirements. Prices have fallen and trade difficulties have supervened, necessitating Government intervention. In regard to most industries there has been a failure to gauge the consumptive capacity of the country. Dishonest brokers, when confronted with losses, refuse to fulfil their contracts, and attempt to get assistance from the Government in order to be kept on their feet. It does not appear to be in accordance with Japanese custom to prosecute these brokers; and where foreigners are concerned it is often thought that they are imposed upon when they are urged to effect a compromise.

Some months ago there was a great outcry about the lateness of the delivery of British textile machinery. All interest in this question has now vanished, many machinery contracts have been cancelled, and such machinery as arrives is left lying in the open in the Customs compounds. One of the largest items in the import trade is that of metals. During the war large fortunes were realised by the importers, and the shortage of iron and steel was so great that many new iron works were commenced and big sums werre expended on the purchase of plant. It is said that to-day not one of these new iron works is paying its way, several have had to close and the others are carrying on at a heavy loss. There are two special factors connected with the metal trade, one is the heavy importation of galvanised sheets and tin plates by concerns inexperienced in the business who now find themselves burdened with enormous stocks much depreciated in value. The second is the surprising manner in which Japan, which is a copper producing and exporting country, suddenly began to import copper. In normal years Japan exports about 40,000 tons of copper and imports none. For the first half of this year she exported only 3,500 tons and imported 20,000 tons. There was no domestic demand to justify such figures, a heavy drop ensued with the result that the copper had had to be reexported at a loss.

Electricity Supply.

Blackpool Corporation has received sanction to a loan of £42,250 for new boilers at the electricity works.

Swindon Council has increased the salary of the electrical engineer, Mr. F. Newey, from £450 a year to £500 as from October.

The Urban Council of Willesden proposes to apply for sanction to borrow £35,000 for extensions and house services.

Buckingham Corporation has asked the Lighting Committee to report upon the question of acquiring the local electricity undertaking.

Houghton-le-Spring Urban Council has appointed a committee to report upon the proposal to adopt public electric lighting.

Horsham Urban Council has decided to obtain authority to borrow £12,000 for extensions of the electricity undertaking.

The Birmingham Housing Committee have decided to install the electric light in houses to be erected under the Municipal Housing Scheme.

Accrington Electricity Committee has instructed the electrical engineer (Mr. A. W. Clegg) to proceed with the scheme for extending the electricity works.

Heston & Isleworth Urban Council has been authorised to raise a loan of £4,900 for laying a feeder cable along Woodlands-road and St. John's road to the Isleworth recreation ground.

Under the revised scale of salaries of the National Joint Board the chief assistant electrical engineer at Burnley will receive £547 per annum, assistants £354, and junior assistants £252.

The Ebbw Vale Steel, Iron & Coal Company are sinking two shafts for a new colliery at Aberdeeg, near Newport, which will be worked entirely by electricity generated at the company's works at Ebbw Vale.

Mr. J. H. Clothier, electrical engineer of St. Annes-on-Sea, has reported that the maximum demand for electricity considerably exceeds the highest yet recorded, and it will, therefore, be necessary to increase the boiler plant before next winter.

Warrington Corporation has received sanction to borrow £20,351, the estimated amount required to cover capital expenditure for the next three years. A tender (at £103,190) for two additional turbo-alternator sets, each of 6,000 kw., has been accepted.

Crieff Corporation are applying to the Electricity Commissioners for an order to generate and distribute electricity. Loch Turret is to be utilised for water power, and Mr. J. E. Macewan, A.M.I.E.E., is consulting engineer for the Council.

Leicester Corporation has increased the charge for electric current for lighting by 1d, per unit, making a total increase of 100 per cent. on pre-war rates. The charge is now up to the statutory limit, but owing to increased charges (£10,000 for coal and £10,000 for interest, &c.) the advance in the price was necessary.

Accrington Electricity Committee recommend that the new scale of salaries for the staff approved by the District Industrial Council be adopted. The Borough Electrical Engineer has been instructed to prepare a report regarding the installation of further plant at the electricity works. The charge for electricity has been increased by a further 5 per cent.

In connection with the demand for an adequate supply of electricity in Barrow and surrounding districts, the Electricity Committee is considering the question of employing hydro-electric plant. It is thought to be feasible to utilise the waters of the River Leven, which come from Windermere Lake at Backbarrow. The estimated expenditure is £80,000, and a report will be submitted by Mr. H. R. Burnett, the borough electrical engineer.

Edinburgh Corporation Electricity Department has appealed to consumers to be economical in the use of electrical energy between 3.30 p.m. and 6.0 p.m., owing to delay in the erection of a 4,000-kw. turbo-alternator and three boilers. It will be a month to six weeks before these are ready for use, and at present both stations are running without adequate spare plant. It is especially asked that the use of electric radiators be reduced to a minimum between the hours mentioned.

Keighley Corporation has decided to provide a transmission line (mainly overhead) from the nearest high-tension main in the borough to Eastburn quarries, for the purpose of a general supply of extra-high-tension electricity to Steeton-with-Eastburn and Sutton, and for boosting up the voltage on the trackless trolley lines, at an estimated cost of £3,000, subject to Messrs. Dixon & Company entering into an agreement to take a supply at Eastburn quarries for not less than five years.

At an inquiry held at Harrogate last week into the application of the Corporation for sanction to a loan of £22,000 for the electricity undertaking, the Inspector (Col. T. C. Ekin) referred to the accumulated items carried forward year by year to the amount of about £5,000 and suggested that these sums should be wiped off altogether. Mr. G. Wilkinson, Borough Electrical Engineer, said the undertaking was turning out 35 per cent more electricity than last year, and they were very much pinched for boiler room.

Eastbourne Corporation has authorised the borough electrical engineer (Mr. J. K. Brydges) to prepare plans of plant required at the electricity works. It is estimated that the cost of a Brush "Ljungstrom" turbo-alternator will be £33,380, compared with £30,530 previously reported, and a new boiler, coal and ash-handling plant, extension of buildings and railway siding, two new feeder cables, enlargement of sub-stations, switchgear and transformer equipment, &c., will bring the total expenditure to £66,000.

The repeated breakdowns of the tramway and lighting system in Belfast culminated on the 6th inst. in the collapse of the lighting and power supply. Factories, mills, &c., were left in darkness and the tramway service stopped. The reason given by the electrical engineer (Mr. Bloxam) was that the very heavy fog which prevailed had resulted in the condensation of moisture on the windings of certain generators which had not been running since Sunday, and which were cold at starting time. The machines had to be dried by electrical radiators and other apparatus before a full supply of current was available. Such a condition has arisen only twice previously in twenty years.

Nottingham Corporation has sanctioned an additional expenditure of £324,000 on the new power station, bringing the total expenditure on the first section to £1,193,000. The original estimate provided for two 10,000-kw. sets, and the installation of an additional 20,000-kw. set was recommended on the ground of economical production. A further sum of £30,000 is to be borrowed for the extension of underground mains. The chairman of the Electricity Committee (Ald. Huntsman) explained the reasons for laying down additional plant and said that the annual amount allocated for the extension of mains, &c., had already been expended, extra high-tension mains having been laid to several large factories and warehouses.

Owing to the breakdown of one of the alternators at the Dalmarnock power station of Glasgow Corporation, the supply of energy for power has had to be curtailed for a few days, and it is reported that no electric power was available for industrial purposes between 2 p.m. and 5.30 p.m., except in cases where the stoppage of operations would involve wastage of material required in carrying on continuous processes. The breakdown occurred in the alternator of the first set of the five 20,000 kw. turbo-alternators to be erected at Dalmarnock. The present demand requires plant capable of producing 77,000 kw., and as the existing facilities are fully taxed, the breakdown of such a large unit meant a serious disturbance of the supply arrangements. The breakdown was due to the alternator having been burnt out, and the engine had to be immediately shut down. As soon as the accident occurred, Mr. R. B. Mitchell, manager of the department, made arrangements for continuing a restricted service through the other stations at Port Dundas, St. Andrew's Cross and Govan. A number of shipyards and engineering works closed their departments where electricity is essential for power purposes at two o'clock, and inaugurated a system of night work. A second turbo-alternator set was nearing completion at Dalmarnock, and this alternator was substituted for the alternator which broke down. and the full service has now been restored.

Electric Traction.

Sunderland Corporation is making arrangements with the Sunderland District Tramways Company for the through running of tramway cars and the Ministry of Transport will be asked to sanction the scheme.

Application has been made to the Ministry of Transport by the London Electric Railway Company for an extension of time for the construction of the railway which will link up Edgware and Hendon with the Golders Green and Charing Cross line.

Before proceeding with the work of converting the Pilrig-Nether Liberton tramway route to electric traction, Edinburgh Tramways Committee has decided to consider the details of the estimates of the cost of the various routes proposed to be electrified.

In view of the deadlock in the negotiations between the employers and employees in the tramway industry over the recent demands for an increase of wages, the Ministry of Labour summoned the National Joint Industrial Council for the Tramway Industry to meet under the chairmanship of an officer of the department on Wednesday. The outcome of this fresh conference was unsatisfactory as no agreement was arrived at.

The London County Council has approved an estimate of £6,311 for the installation of the selector telephone control system on the northern section of the Council's tramways. On the 26th ult. the official inspection took place of the portion of the new tramway between Lee-green and Eltham, and the new line was opened for public traffic on the 29th ult. The tramway is partly on the overhead and partly on the conduit system of traction.

A White Paper issued by the Ministry of Transport on tramways, light railways, and trackless trolley undertakings covers the year ended 31st December, 1918, for companies, and 31st March, 1919, for local authorities. Returns for the years 1919 and 1920 will be issued early next year. The present White Paper embraces some new features. In addition to the net receipts from the operation of tramways particulars are given of the income derived from other sources and the total net income. The total capital expenditure on tramways in the United Kingdom to the end of the financial year 1918-19 was £82,842,722, an increase of £1,864,884, or 2.3 per cent. compared with the year 1913-14. The total gross receipts during 1918-19 were £24,635,266 and the working expenses £17,751,277, leaving net receipts of £6,883,989. Though the maintenance and renewal work undertaken during the year was inadequate, the ratio of working expenses to receipts was 72.06 per cent. compared with 64.35 per cent. in 1913-14. The number of car miles run was 9.59 per cent. less than in 1913-14, but the number of passengers carried (4,567,640,078) increased by 320,378,376 33 per cent. The car miles run by local authorities was 244,162,588 (decrease 18,512,575) and by companies 76,215,788 (decrease 15,488,721). The passengers carried were: Local authorities, 3,632,525,882 (increase 935,766,818) and companies, 925,114,196 (increase 195,400,068).

Institution Notes.

At the annual meeting of the Birmingham and District Electric Club on Saturday, Mr. A. C. Wynne was elected president, Mr. H. F. Steventon and Mr. N. Deykin vice-presidents, and Mr. J. W. Mayall secretary. The club membership is 141, compared with 109 at the end of last session.

An interesting afternoon was spent by the King's College Engineering Society on the 8th inst., when the members visited the works of Automatic & Electric Furnaces, Ltd., of Gray's Inn-road, W.C., and witnessed demonstrations of the Wild-Barfield automatic steel hardening furnaces.

It is announced that the London Branch R.E. Old Comrades' Association is to be affiliated with the Old Comrades' Associations of the 1st and 2nd London Divisional Engineers and the London Electrical Engineers. Communications should be addressed to the secretaries of either of these associations at 10, Victoria Park-square, E. 2; the Duke of York's H.Q., King's-road, Chelsea; or, 108, Heathwood-gardens, Charlton, S.E. 7.

We have received from the British Electrical & Allied Manufacturers' Association a pamphlet in which is given a general survey of the electrical instruments of all kinds manufactured by members of the section. This indicates in no uncertain fashion the range of measurement and degree of accuracy obtainable by their means. The pamphlet is intended to serve an educational purpose, particularly among overseas buyers, who have not the same facilities for keeping in touch with British progress and development as have the residents in this country. Members of the section responsible for this publication have adopted the collective trade mark "Beama-Satis." We are glad to learn that it is the intention of the Association to send a copy of this pamphlet to all important overseas technical training colleges and any of these institutions who have not received a copy are requested to apply for one. We hope to refer in a more detailed way to the contents of this pamphlet in a later issue.

Obituary.

Telegraphy suffers a severe loss by the death of Dr. Alex. Muirhead, F.R.S., which took place at his residence in Shortlands, Kent, on Monday last. He took out many patents relating to telegraph and electrical instruments and apparatus, and was for some years a member of the old firm of Latimer, Clark, Muirhead & Company, Ltd. Subsequently he founded the firm of Muirhead & Company, Ltd., and continued his activities in telegraphy and wireless telegraphy. He was joint inventor, with Sir Oliver Lodge, of the Lodge-Muirhead system of wireless telegraphy. Dr. Muirhead, who was 72 years of age, suffered from ill-health in recent years.

We regret to announce the death of Mr. W. Woodward, electrical engineer, which took place on Tuesday. He was educated at Marlborough, and graduated B.Sc. at Manchester. Subsequently he served an apprenticeship to the Westinghouse Company at Trafford Park. Subsequently he was with the Lancashire Electric Power Company for a short while before going to Siemens Bros.' Dynamo Works, at Stafford, where he was engaged principally on the testing of a.c. and d.c. turbo-generators. He left there to take charge of the power station at Tal-y-bont for the Aluminium Corporation. Later he was engaged by the Lancashire Dynamo & Motor Company, and was in charge of their test bed. Two years ago he went to the Aircraft Mfg. Company, at Hendon, in whose employ he was at the time of his death. Electrical men who knew him admitted his capacity and sound knowledge, and he will be missed by a large circle of friends and acquaintances.

Little attention was paid in the lay press to the death of that distinguished industrialist, Mr. Jacob Higson, M.I.M.E., M.I.Mech.E., M.Ins .C.E., who died at Northwood, Middlesex, on Nov. 18. The eldest son of Peter Higson, of Lancashire, he was one of the earliest inspectors of mines under the Act of 1851. Mr. Higson was born in 1837 and educated at Owens College, Manchester. After seeing service in the Crimean War, he returned to Manchester and founded the firm of J. & P. Higson, mining engineers, of which he continued the senior partner. He assisted in laying the first electric cable between the British Isles and America in 1858, but his work lay chiefly in his special field of mining. He was prominently connected with the Lancashire coalfield and with the collieries of South Wales, and was a director of many mining companies with interests in Spain, Portugal, North and South America and South Africa. He was keenly interested in the welfare of all who worked under him and he was ever ready to help them.

We regret to record the death of Mr. George Leask Black, assistant chief engineer and manager of Glasgow Corporation electricity department, which took place suddenly at Port Bannatyne on the 8th inst. Mr. Black was a native of Aberdeen, and was educated at the Gordon Technical College in that City. He entered the service of the Corporation 22 years ago as district mains superintendent for the Western area. In 1917 he succeeded Mr. R. B. Mitchell as mains superintendent, and in the spring of the present year he again succeeded Mr. R. B. Mitchell as assistant engineer and manager. Mr. Black held a lectureship in the Royal Technical College, Glasgow. He was an Associate Member of the Institution of Electrical Engineers, and a Member of the National Research Committee on Buried Cables. He was also a member of the Committee appointed by H.M. Office of Works to draw up rules for a Scottish mode of measurement for electrical work, and was chairman of the Engineering Society of the Glasgow Corporation Electricity Department. Mr. Black, who was well known in electrical engineering circles, was held in high esteem by all who knew him.

Imperial and Foreign Notes.

An agreement has been made between the interests represented by Sir William Mackenzie, the City of Toronto and the Ontario Hydro-Electric Commission, by which the City of Toronto and the Hydro-Electric Commission acquire the Electrical Development Company, which operates the transmission service between woronto and Niagara Falls, the Toronto Electric Light Company, which competes with the civic electric plant, and the Metropolitan, Scarborough and Port Credit Radial Railway, which terminates in Toronto. The agreement has been approved by the Provincial Government and by the City Council, subject to a vote of the ratepayers. The total price for the Metropolitan Radial Railway, the Electrical Development Company and the Toronto Electric Light Company is $32,734,000 (£8,183,500). The City contributes to the purchase $7,811,000 (£1,953,000), for which it acquires the Toronto Electric Light Company and the Radial railways centring in the city. The balance of the amount is assumed by the Hydro-Electric Commission.

An important scheme of Hydro-electric Development in British Columbia is projected by the Bridge River Power Company, Ltd. It is proposed to utilise the power furnished by the Bridge River, and this will necessitate a tunnel through the Mission Mountian, discharging on the shores of Seton Lake, which is about six miles from Lillooet. In that distance a fall of 1,240 ft. will be obtained, and the total estimated horse power obtainable is 400,000. Mr. H. Holgate, consulting engineer, of Montreal, has furnished a memorandum on the scheme to H.M. Trade Commissioner in Montreal, who reports that the project combines all the features desirable in building up a great commercial enterprise. There are two transmission lines from the Bridge River Power site, one running beside the G. E. Railway, and the other beside the Canadian Pacific Railway. Every effort will be made to induce the development of big industries in British Columbia, and from the limitless supplies of mineral, &c., to be found there it is believed that a prosperous future lies before the Province. It is believed that the Provincial Government will be willing to render material help in the way of exemption from taxation, &c. Two maps indicating the location of the power site together with reports on the scheme by Canadian engineers, may be seen at the Department of Overseas Trade, 35, Old Queen-street, S W 1.

H.M. Consul-General at Quito has recently received inquiries from local firms for electrical material and tools, distilling machinery and machinery for the manufacture of confectionery, &c. He suggests that catalogues should be forwarded to the inquirers, whose names will be furnished to United Kingdom firms by the Department of Overseas Trade, 35, Old Queen-street, S.W. 1.

According to the "Electrical Review" of Chicago, the Pacific Gas and Electric Company, of San Francisco, transmit energy from their new Pit River hydro-electric works at an exceptionally high voltage The energy will be transformed at the station by 16,667 k.v.a., 127,000-volt single-phase, water-cooled, outdoor type, Westinghouse transformers connected in star to obtain 220,000 volts. There will be two banks of three of these transformers, making a total rating of 100,000 k.v.a.

Arrangements have been completed for the construction of the Grand Canal d'Alsace and its power stations. The canal will connect Huningen with Neuhof, a suburb of Strassburg. There will be eight locks, and it is estimated that the water power at each will be sufficient to drive four 100,000 h.p. electric power stations. The portion between Huningen and Brisach will be constructed first, and the estimated cost of the stations and lock on this portion is 600,000,000 f. If the canal is to pay its own way it is calculated that the price of electricity will be about 4 centimes per unit.

It is announced that an amalgamation has been formed for a period of 80 years of the Siemens & Halske and the Siemens-Schuckert Electrical Companies, the Gelsenkirchen Mining and the Deutsch-Luxemburg Mining & Iron & Steel Companies. The combination, which will be known as the Siemens-Rhine-Elbe Schuckert Union, is to issue 6 per cent. preference shares, having single votes for an amount of up to the equivalent of their existing ordinary capital. The combined ordinary share capital is 460 million marks. The preference shares are not to be offered for subscription, but will be interchanged between the companies, although they will form the means of raising fresh money in case of necessity. It is hoped in this way to prevent the danger of the control over any of the individual undertakings passing into foreign hands.

In their report for the year ended July 31 last the directors of the Allgemeine Elektrizitats Gesellschaft of Berlin state that the turnover both in quantity and value was greater in the previous 12 months, and they recommend out of the net profit of 45,707,000 marks a dividend of 14 per cent. on the share capital of 200,000,000 marks, compared with 27,031,000 marks and 10 per cent. in 1918-19. All the departments were exceptionally well employed, and manufacturing extensions were necessary, while the working up of copper was resumed on a large scale at the cable factory. A number of large ship engines were built by the turbine department, particularly oil engines, and work was started at the electric steel and rolling mills with two electric steel furnaces. A demand has developed in direct trade with Belgium, France, England and Italy for large generator units for industrial power stations, the driving of rolling mills and the electrical equipment for industrial establishments. A substantial decline took place in the requirements of the electric tramways, owing to the unfavourable working results, but business in the electric railway branch is beginning to develop, particularly in relation to other countries, and a number of electric locomotives have been delivered to Sweden and others are on order.

Miscellaneous.

H.M. the King has been pleased to grant his patronage to the forthcoming International Building Trades Exhibition.

On Dec. 3 the Royal Assent was read to the following Acts of Parliament:—Falkirk & District Tramway Order Confirmation Act, and Dumbarton Burgh & County Tramways Order Confirmation Act.

The Department of Overseas Trade has issued a booklet explaining how the Department assists the British exporter, and how information is distributed. Particulars are also given of the organisation of the staff and special missions to study overseas markets.

By putting up the remarkable speed of 66·97 miles per hour on Brooklands track, Mr. D. R. O'Donovan has captured the flying kilometre record in both the miniature classes A. and A.1. He was mounted on a 2¼ h.p. velocette two-stroke motor-cycle, equipped with the C.A.V. light-weight magneto.

Arrangements were made at a conference between the Engineering and National Employers' Federation and representatives of the Amalgamated Engineering Union, which terminated at York last week, for inaugurating a shift system for the absorption of the unemployed in the industry. The system which will be applied nationally will be the subject of consultation with the works committees in each case. Each shift is to have a half-hour break for a meal. The first shift's week will consist of 43 hours, for which 47 hours will be paid: the second of 37½ hours, for which 47 hours will be paid; and the third of 37½ hours, for which 50 hours will be paid. The provisions apply to workmen employed on engineering work in engineering, boilermaking and foundry departments.

A device for running 30 c.p. and 100 c.p. pointolites on alternating-current circuits of any voltage or frequency has just been completed in the Ediswan lamp laboratories. The device consists of a small transformer and ballast resistance coupled with a small synchronously-driven commutator. The commutator is started by a slight twist with the fingers. Both half waves of the alternating current are rectified by the commutator, and the arc is thus fed with a unidirectional current pulsating with double the frequency of the supply. The device is compact, being only 7 in. by 5 in. by 12 in., and simple and reliable in its working. It has the further advantage of being applicable to other uses where a rectifier of small power is used in small cell charging or electrolytic work. This device will be on the market shortly. Experiments are being conducted for adapting the device to pointolites of 500 c.p. and 1,000 c.p.

A practical joke which had a fatal result was the subject of a charge at the Linlithgow Sheriff Court recently when a young miner named Docherty was brought before Sheriff Moffatt on a charge of having held a piece of electric cable in such a way as to make an electric connection between the fuse controlling the electric light in the "bothy" in a mine and the handle on the door of the "bothy," whereby Alex. Ellis, in taking hold of the handle, received a fatal electric shock. Accused pleaded guilty and it was stated on his behalf that on the Sunday prior to the occurrence Docherty put his hands on the fuse, which was uncovered, and sustained a shock. This fact suggested to him that he might play a joke on his comrades. Prisoner was acquitted of any malicious intent or any wilful attempt to do seriously bodily harm, and he was fined £20, with the option of 40 days' imprisonment.

Business Items, &c.

The Enterprise Manufacturing Company have appointed Messrs. Thos. H. Raines & Company, 10, Neville-street, Newcastle-on-Tyne, to look after their increasing business on the North-East Coast.

The partnership between Edward Howarth, Arthur Howarth and Percy John Worth, electrical and motor engineers, 457a, Stockport-road, Longsight, Manchester, has been dissolved. Debts by Mr. Arthur Howarth, who continues the business as Howarth, Bros. & Worth.

The partnership between Adam Reid, Geo. Reid and John Sim, trading as Adam Reid & Company, electrical and motor engineers, at 9, West Coats-road, Cambuslang, has been dissolved, so far as concerns John Sim. The business will be continued under the same name and at the same address by Adam and Geo. Reid.

The New Showrooms of the Edison Swan Electric Company, Ltd., at 33/35, School-lane, Liverpool, were formally opened on the 6th inst. in the presence of a representative gathering of contractors, who expressed their satisfaction with the arrangements of the new premises. The showrooms are purely for the "Trade" and private customers can only make use of them upon an introduction from their contractors.

Bankruptcies and Liquidations.

The first meeting of creditors of Jas. Wm. Layton, electrician, 5, Noble's Bank, Hendon, Sunderland, will take place on Dec. 17, at 3, Manor place, Sunderland, and the public examination on Dec. 23, at the Court House, John-street, Sunderland.

A meeting of creditors of the Electrical Engineering Society, Ltd. (late Electrical and Mechanical Co-operative Trading Society, Ltd.) (in voluntary liquidation), will be held at the office of Messrs. Glass & Edwards, 5, Cook-street, Liverpool, on Dec. 21. Claims are to be sent to Mr. A. J. Glass, Liquidator, by Jan. 17th.

Claims against Chas. Wm. Dixon, electrical engineer, 1a, Clarke's-buildings, Shaftesbury-avenue, London, W.C., under a deed of assignment executed by him on Aug. 3, 1920, are to be sent by Dec. 23 to Mr. W. A. J. Osborne (Messrs. Corfield & Cripwell), Balfour House, Finsbury-pavement, London, E.C.

Catalogues, Price Lists, &c.

A leaflet on the "Handilite" Magneto Flash Lamp has been issued by the General Electric Company, Ltd. Of new design, it is manufactured at the company's Witton Works, and it is claimed that no "refills" are required, that it is simple in construction, inexhaustible and always ready for use. The company has also issued folder No. H.2,387, which is devoted to an illustrated description of the "Magnet" pedestal electric heater.

Faults frequently occur in underground cable jointing through moisture percolating into the joint box after the compound has contracted. As the compound cools a vacuum is formed and air is drawn into the box through the glands. Through this channel moisture will soon find its way and eventually the insulation is reached. In order to overcome this defect Messrs. W. T. Henley's Telegraph Works Company, Ltd., have placed on the market the "Dickinson" patent cover. In a leaflet recently issued by the company illustrated particulars of this cover are given. It is simple, though of stout construction and requires no actual fitting. It is so constructed that air can enter immediately contraction commences without letting any moisture through and the lid can be replaced immediately after the compound has been poured into the box.

Messrs. Siemens Brothers & Company, Ltd., have published two new leaflets, viz., 538a, which describes the Siemens Dry Battery Lighting Equipments for motor cycle sidecar lamps and rear lamps and for motor scooter lamps, and 538b, relating to lamps for pedal bicycles. Where very powerful lights are not necessary or desirable, these equipments possess notable advantages over other methods of illumination, one of the chief of which is their reliability. The batteries are of the Company's well-known make and, when used with reasonable care, they may be depended upon to give complete satisfaction. Apart from the question of cleanliness this form of lighting requires little attention. The complete sets are compact, neat in appearance, strongly made, easily accommodated, and, all things considered, they are reasonable in first cost and in replacements, both of batteries and bulbs. The latter are of the ordinary flash lamp type such as can be obtained from almost any accessory dealer. The batteries will supply current for the lamps continuously for hours, but the best results are obtained if the period of use does not exceed one or two hours at a time. In order to convey some idea of the capabilities of these dry batteries, it may be mentioned that one battery mentioned in leaflet No. 538a, supplied current to a sidecar lamp for periods of two hours per day for six days per week, and gave an aggregate service of over 50 lighting hours. The firm have also issued a striking showcard, printed in colours, relating to these dry battery lighting sets and they will be supplied to traders on application.

Two new folders have been issued by the British Thomson-Houston Company. One describes and illustrates the Tungar battery charger, an effective and original form of rectifying and transforming device for charging accumulators on alternating current. The Tungar consists essentially of a special bulb which, in the manner of a thermionic valve, gives a uni-directional flow to the alternating current; and a transformer, which, prior to rectification, reduces the voltage to the required value. Tungars are made in several types and sizes for use in private and public garages and battery charging stations. Although, perhaps, their chief use is in connection with the charging of motor-car batteries, they have many other applications. For example, a number of Tungars have been purchased by the Marconi Company for charging the accumulators used in connection with experimental wireless telephony.

The other folder describes the Pyrotip electric lead burner for use on a.c. circuits. Briefly, this device consists of an auto-transformer, connected on the primary side to the ordinary lighting circuit, and on the low voltage side to a spring slip and a carbon pencil fitted into an insulated handle. The spring clip is for attachment to the lead close to the point of work. When the circuit is completed by bringing the carbon into contact with the lead, an intense heat is generated and the lead in the vicinity of the carbon is immediately melted. The Pyrotip burner provides the simplest, most economical and most effective means of burning lead in the repair of accumulators. The folders should prove of interest to every manufacturer, repairer or user of accumulators. Applications for copies should be made to the B.T.H. Company, at 77, Upper Thames-street, E.C.4. Limited quantities of these folders, over-printed with name and address, will be supplied to dealers.

Personal and Appointments.

Mr. A. Peden Rutherford, late burgh electrical engineer at Leith, has been presented by the employees with a revolving office chair.

Prof. James C. Irvine, C.B.E., Ph.D., D.Sc., Professor of Chemistry in the University of St. Andrews, has been appointed Principal of the University of St. Andrews.

Dr. J. N. Pring, reader in electro-chemistry at the University of Manchester, has been appointed head of the physical chemistry branch of the research department at Woolwich Arsenal.

Mr. A. H. Darker, chief engineer and manager of the electrical department of Messrs. J. Stone & Company, Ltd., Deptford, has now returned to London after concluding a business tour round the world occupying some two years and nine months.

Mr. C. R. Webb, of the Cable and Line Construction Department of the Western Electric Company, has accepted the appointment of assistant mains superintendent to Shanghai Municipal Council. As a token of their appreciation and good wishes for his future success his colleagues have presented him with a travelling-clock, silver pencil and autograph-album. Mr. Webb was married on the 1st inst. and sails for the East to-morrow, Saturday.

Tenders Invited and Accepted

Walsall Guardians require tenders by Dec. 30 for lighting the infirmary and the men's day room at the workhouse electrically.

Littleborough Urban Council invite tenders for the supply and laying of h.t. cables and roadwork. Tenders to the Clerk by Dec. 20.

Napier (N.Z.) Council require tenders by Jan. 17 for a 500 kw. gas-electric generating set.

Antwerp municipality require tenders by Jan. 25 for 20 5-ton electric cranes. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

Toxteth Park Guardians require tenders by Dec. 20 for three months electrical and engineers' supplies. Forms of tender from the Clerk, 15, High Park-street, Liverpool.

Paisley Corporation want tenders by Dec. 27 for electric light wiring in connection with the Whitehaugh housing scheme. Plans may be seen at the office of the Master of Works, 13, Gilmour-street, Paisley.

Portrush Urban Council require tenders by Jan. 1 for a gas plant, engines, dynamos, booster and balancer, switchboard, accumulators and underground and overhead mains. Specifications from the Clerk.

Leyton Urban Council require tenders by Jan. 11 for electric wiring in 142 houses on the Barclay estate. Specifications from Mr. J. H. Jacques, 2, Fen-court, Fenchurch-street, London, E.C.3.

Tenders are invited by Jan. 26, 1921, for the supply and delivery to the Postmaster-General's Department, State of Queensland, of telephone apparatus and parts (schedule 509). Tender forms at office of High Commissioner for Australia, 406, Australia House, Strand, W.C.2.

H.M. Minister at Montevideo (Sir C. Mallet, C.M.G.) reports that the Management of the Usinas Electricas de Montevideo is inviting tenders by 11 a.m. Jan. 14, 1921, for the construction and erection of a 10,000 kw. generating plant (steam turbine direct coupled to a 3-phase alternator, with exciter, steam pipes, &c.), and surface condensing plant.

Tenders have been invited for the conversion of the first zone of the Chilean State Railways (from Valparaiso to Santiago) to electric traction. The offers, which are of two classes, will be opened on March 31, 1921. The first class is from those proposing to furnish the electric power, and the second the rolling-stock and equipment.

The Deputy Postmaster-General, Melbourne, requires tenders by Jan. 4 for the supply of switchboards (schedule 1653), and the Deputy Postmaster-General, Brisbane, will receive tenders until Jan. 19 for the supply of testing and telegraph instrument (schedule 517) for the Australian Commonwealth Postmaster-General's Depts. Specification at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The New Zealand Public Works Department require tenders by Feb. 11, 1921, for the supply and erection of steel pipe lines and fittings in connection with the Mangahao electric power plant. The Department also require tenders (by Jan. 21) for steel pipe lines and fittings in connection with the fourth pipe line for the Lake Coleridge power plant.

The Rand Water Board (Johannesburg) invite tenders by Jan. 13 for the supply and erection of a steam boiler, superheater, stoker, economisers, &c. (contract No. 191), at the Swartkopjes pumping station; also steam turbo-driven centrifugal pump, condenser, piping, &c. (contract No. 192). Specifications may be consulted at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The Southland (N.Z.) Electric Power Board invite tenders, by Jan. 18, for supply of plant for the Lake Monowai hydro-electric scheme, including two 3,530 k.v.a. generators, a 105 kw. generator exciter, a 6,600/110 volt, 105 kw.. motor-generator exciter, a battery charging set, a 60 cell battery, two 5,000 h.p. and one 150 h.p. water turbines, transformers, &c. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

The City of Auckland (N.Z.) invite tenders for the supply and erection of one 3,000 kw. and one 5,000 kw. turbo-alternator, rotary converters (1,500 kw. and 500 kw.) switchgear and transformers, also water tube boilers, conveyor pumps, pipework and h.t. and l.t. cables. Specifications, &c., from the consulting engineers, Messrs. Preece, Cardew, 8, Queen Anne's-gate, S.W. 1, and tenders by noon, February 22, 1921, to Mr. Alex. Wyllie, C/o. Messrs. Price Cardew, & Rider.

The Electricity Commissioners of Victoria (Australia) invite tenders for the supply of plant and material required for the Morwell Power Scheme, including 25,000–12,500 kw. turbo-alternators, 600 kw. turbo-alternators, transformers, switchgear, cables, transmission steel towers, steel telephone poles, &c. Tender forms and specifications can be obtained from the Agent-General for Victoria, Victoria House, Melbourne-place, Strand, London, W.C.2, and drawings can be seen at the offices of Messrs. John Coates, & Company, Ltd., consulting engineers, at the same address. Tenders by noon Feb. 24, to Mr. R. Liddelow, secretary, Electricity Commissioners, 673, Bourke-street West, Melbourne.

Sunderland Corporation has accepted the tenders of Ferranti, Ltd., for 72 meters and Furguson, Pailin, Ltd., for h.t. switchgear.

Brighton Corporation has placed an order with Bruce Peebles & Company for the supply of two 1,000 kw. motor converters.

Wednesbury Corporation has accepted the tender of the Midland Electric Corporation for Power Distribution, Ltd., for laying service cables, &c., in connection with the supply of electricity to 113 houses at £6 per house.

The London County Council has accepted the tender of Sir William Arrol & Company, Glasgow, for two transporters or cranes at £31,726; and that of Fraser & Chalmers, Ltd., for weighing machines at £2,025, and for coal conveyors for Greenwich power station at £29,409.

Patent Record.

SPECIFICATIONS PUBLISHED.

The following abstract from some of the specifications recently published have been specially compiled by Messrs. Mewburn, Ellis & Co., *Chartered Patent Agents, 70 and 72, Chancery-lane, London, W.C.*

Whenever the date applied for differs from the date on which the application was lodged at the Patent Office the former is given in brackets after the title.

1919 Specifications.

152,693 Taggart. Negative and positive resistance vacuum tube devices especially for use in wireless telegraphy. (25/7/19. Cognate application, 22,960/19.)
152,811 Western Electric Co. (Western Electric Co.) Modulating and transmitting systems for electric signalling. (7/8/19.)
152,818 Fuller, Fuller & Fuller. Galvanic batteries. (13/8/19.)
152,821 Kjellberg. Assembly of metal parts for electric or other welding, rivetting or like operations. (16/8/19.)
152,843 Railing & Taylor. Electric lamp fittings. (13/9/19.)
152,859 Harrison. Adjustable tension spring in connection with phonopore superimposed or buzzer telephones. (15/10/19.)
152,868 Cutler. Electric water heaters. (27/10/19.)
152,873 Wrighton & Edison Swan Electric Co. Electric bells. (4/11/19.)
152,875 Haddan. (Regan.) Current-collecting shoes for train control systems. (7/11/19.)
152,879 Ashcroft. Electrolytic apparatus. (9/7/19. Divided application on 152,402.
152,896 Maschinenfabrik Oerlikon. Controlling electro-mechanical power sets for propelling vehicles and ships. (3/11/19.)
152,901 Levin. Feeding attachments for electrolytc cells. (31/12/19.)

1920 Specifications.

139,522 Siemens-Schuckertwerke. Heat and measuring appliances for electrical purposes. (12/9/16.)
141,033 Western Electric Co. Amplifying systems comprising thermionic devices (28/3/19.)

Provides means whereby the ratio of amplification can be varied without varying the impedance presented by the amplifier as a whole to the impulses which are to be amplified by the use of an impedance shunted across the terminals of the secondary of a transformer used to step-up the voltage of the incoming currents. The cathode of a vacuum tube of the three-electrode type is connected to one end of this impedance, and a connection is made from the control electrode by means of an adjustable contact to a desired point on the impedance, thus varying the proportionate part of the potential drop across the impedance which is applied between the control electrode and the cathode, and correspondingly varying the amplification in the output circuit of the tube.

144,293 Western Electric Co. Electric signalling systems. (20/9/18.)
145,715 Krupp Akt-Ges. Apparatus for electromagnetically extinguishing the arc which is produced on the breaking of an electrcal circuit. (11/6/19.)
147,590 Krupp Akt-Ges. Electromagnetic chucking device. (23/6/19.)
152,904 Wade. (Booth Electric Furnace Co.) Electric furnaces. (9/1/20.)
152,915 Turner. Wireless telegraph receivers. (13/2/20.)
152,917 Bygrave. Intercommunicating telephone systems. (22/7/19. Divided application on 140,561.)
152,926 Margerison & Shenton & Co. Electric starting and regulating switches. (13/3/20.)
152,933 Railing & Saunders. Multi-pole junction box. (17/4/20.)
152,942 Bakker & Bureau voor Uitvinders. Distributing and draw-in boxes for electrical installations. (17/7/19. Divided application on 134,195. Addition to 134,195.)

APPLICATIONS FOR PATENTS.

June, 30th. 1920.

17,947 Siemens-Schuckertwerke. Vacuum apparatus. (13/8/15, Germany.)
17,948 Siemens-Schuckertwerke. Anodes for Vacuum apparatus. (29/10/15, Germany.)
17,962 Martinetto. Maximum and minimum cut out switch for polyphase circuits (15/10/15, Italy.)
17,967 Romagnoli. Means for fixing wires to insulators.

July 2.

18,013 Krupp (F.) A. G. Apparatus for electro-magnetically extinguishing arc produced on breaking of electric circuit. (11/6/19, Germany.)
18,018 Krupp (F.), A. G. Switch operated by current of air. (27/12/18, Germany.)
18,019 Krupp (F.), A. G. Suppressing spark produced on breaking circuit having self-induction. (23/10/15, Germany.)
18,028 Krupp (F.), A. G. Connections for regulating two part divided current circuit. (2/1/17, Germany.)
18,070 Railing. Electrical indicators.
18,073 Railing & Taylor. Conduit boxes.
18,119 Cox. Electric light fittings.
18,139 Robinet de la Pickardais. Wiring system. (5/2/19, France.)
18,140 Soc. Anon. des Etabs L. Bleriot. Regulation of electrical machines. (20/2/19, France.)
18,153 Siemens & Halske, A. G. Amplifying devices. (25/10/16 Germany).
18,154 Siemens-Schuckertwerke. Electrodes for vacuum apparatus. (7/12/18, Germany.)
18,168 Sachs. Switches. (13/3/19, Germany.)
18,170 Lacknitzer Eisenwerk Ges. Electric machines. (2/12/19, Germany.)
18,220 Orling. Electro-capillary contrivances.
18,223 Parsons & Ball. Apparatus for reception of electro-magnetic waves.
18,235 Krupp (F.), A. G. Continuous current gyroscope motor. (18/11/15, Germany.)
18,241 Krupp (F.), A. G. Overload switches having power storing device. (21/6/17, Germany.)
18,244 Krupp (F.), A. G. Arrangement for excitation of continuous current generators. (6/1/15, Germany.)
18,261 Krupp (F.), A. G. Arrangement for testing electrical gyroscopic firing apparatus. (2/1/19, Germany.)
18,277 Chauveau. Automatic switch for distant control. (13/4/19, France.)
18,313 Siemens & Halske, A. G. Electric amplifiers. (7/7/16, Germany.)
18,314 Siemens & Halske, A. G. Control of relays for wireless telegraphy. (27/5/19, Germany.)
18,316 Siemens-Schuckertwerke. Arc welding apparatus. (11/7/19, Germany.)
18,335 B. T.-H. Co. (G. E. Co.) Electric welding electrodes.
18,387 Simms (General Railway Signal Co.). Electric switch machines and interlocking systems.
18,407 Telephon Ges. Telephonographs. (17/7/19, Germany.)
18,412 Charlet. Electric machines.

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18,430 Sharp. Switches for bells, &c.
18,442 Woodburn. Electric welding apparatus.
18,444 Mautsch. Electro-mechanical starting and operating from a distance. (10/4/14, Belgium.)
18,462 Weston Electric Co. Telephone exchange systems. (29/12/16, U.S.)
18,486 Schember & Joksch. Electric transmission of motion. (11/7/19, Austria.)
18,492 Brydon & Cummings. Galvanic batteries.
18,508 Capener & Rose. Switches.

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18,544 Broadbent. Pendant electric light fittings.
18,567 Electromotors, Ltd., & Greenhalgh. Electric machines.
18,578 Cameron. Incandescent lamps.
18,584 Saunders. Accumulators.
18,607 de Forest. Electric signalling. (17/4/19, U.S.)
18,608 Zoller. Electric lamps. (7/11/13, Germany.)
18,641 Weston Electric Co. Telephone systems. (14/6/19, U.S.)
18,642 Western Electric Co. Method of coating metallic articles. (20/9/16, U.S.)
18,643 Western Electric Co. Radio transmission system. (2/10/16, U.S.)
18,644 Western Electric Co. Telegraphic ciphering and deciphering mechanism. (13/9/18, U.S.)
18,652, 18,656 Radio Corporation. Radio-signalling. (6/1/16, U.S.)
18,653 Radio Corporation. Receivers of electrical oscillations. (18/6/14, U.S.)
18,654, 18,655 Radio Corporation. Wireless signalling-apparatus. (5/4/15, U.S.)
18,657 Radio Corporation. Wireless signalling-apparatus. (2/4/15, U.S.)
18,658 Radio Corporation. Wireless telegraphy. (24/2/15, U.S.)
18,659 Radio Corporation. Receivers of electrical oscillations. (25/2/14, U.S.)
18,660, 18,664 Radio Corporation. Apparatus for radio-signalling. (1/2/16, U.S.)
18,661 Radio Corporation. Vacuum valve detectors. (10/3/17, U.S.)
18,662 Radio Corporation. Vacuum valve devices. (10/3/17, U.S.)
18,663 Radio Corporation. Wireless signalling-apparatus. (1/2/16, U.S.)
18,687 Eureka Vacuum Cleaner Co. Switches. (18/1/17, U.S.)
18,691 Entz Motor Patents Corporation. Electric controllers. (18/7/17, U.S.)
18,702 Siemens-Schuckertwerke. Electric arc welding apparatus. (4/7/19, Germany.)
18,718 Joksch & Schember. Electric steelyard weighing machine. (8/7/19, Austria.)
18,726 Whitehead & Whitfield. Means for connecting electrical conductors.

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18,786 Haines. Automatic distant control of hydro-electric machinery.
18,797 Western Electric Co. Regulating transmission over electric circuits. (10/9/18, U.S.)
18,798 Western Electric Co. Telephone substation circuits. (9/9/16, U.S.)
18,799 Western Electric Co. Wireless signalling systems. (1/12/15, U.S.)
18,831 Hundt & Weber Ges. Starting and stopping device for motors. (8/7/14, Germany.)
18,832 Orling. Relays.
18,837 Siemens-Schuckertwerke. Galvanometer. (2/2/18, Germany.)
18,838 Siemens-Schuckertwerke. Line telegraphy. (18/12/18, Germany.)
18,849 Siemens-Schuckertwerke. Portable electric welding apparatus. (3/5/19 Germany.)
18,860 Siemens-Schuckertwerke. Electric ship compasses. (16/12/18, Germany.)
18,861 Siemens-Schuckertwerke. Electric ship compasses. (9/12/18, Germany.)
18,883 Margerison & Skenton. Switches, &c.
18,892 Colville & Sons & Inglis. Electro-magnetic appliance for handling plates, &c.
18,909 Erskine-Murray. Resistances.
18,910 Weston Electric Co. High-frequency signalling. (3/3/16, U.S.)
18,911 Western Electric Co. Telephone substation circuits. (27/8/17, U.S.)
18,912 Western Electric Co. Telegraph ciphering and deciphering mechanisms. (4/12/18, U.S.)
18,913 Western Electric Co. Telegraph ciphering and deciphering mechanisms. (9/12/18, U.S.)
18,938 Johnson & Phillips, Bowden, Carney & Thompson. Protective devices for a.c. distributing systems.
18,939 Petra A.G. fur Elektromechanik. Transmission of electric impulses. (13/3/19, Germany.)
18,940 Hogan. Receiving radio signals. (27/11/16, U.S.)
18,957 Siemens-Schuckertwerke. Reduction of overhearing, &c., in two or four-wire circuits. (22/3/19, Germany.)
18,958, 18,959 de Miles. Electric furnaces. (25/1/18, U.S.)
18,970 von der Weid. Inductors for magneto-electric machines. (12/6/20, Switzerland.)
18,977 Corbino. Transformer of three-phase currents to d.c. (26/5/17, Italy.)
18,978 Macmillan. Electric machines. (31/5/17, U.S.)
18,987 Schroter. Vacuum fuse for electrical circuits. (29/1/14, Germany.)
18,991 Schroter. Electrical discharge valve. (23/1/18, Germany.)
18,992 Corbino. Transformation of polyphase currents. (28/7/17, Italy.)
18,998 Armstrong. Wireless receiving systems. (29/10/13, U.S.)
18,999 Seibt. Electric discharge tubes. (24/10/13, Germany.)
19,004 Compagnie pour la Fabrication des Compteurs et Materiels d'Usines a Gaz. Transformers for measuring electric currents. (30/6/19, France.)
19,005 Compagnie pour la Fabrication des Compteurs et Materiels d'Usines a Gaz. Transformers for measuring electric currents. (26/6/14, France.)
19,006 Compagnie pour la Fabrication des Compteurs et Materiels d'Usines a Gaz. Rheostat-transformers with adjustable transformation ratio and phase difference. (8/5/19, France.)
19,009 General Electric Co. & Thompson. Electron discharge devices.
19,020 Ziegenberg. Galvanic batteries and electric lamps.
19,063 Radio Communication Co. & Scott-Taggart. Modulation systems for wireless signalling, &c.
19,080 Falksley & Clipstone. Electric lamp controlling apparatus.
19,094 Lightfoot. Electric heating.

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19,104 Bushrod & Thurrowgood. Pneumatically-operated electric switches.
19,107 Barth. Voltage regulator. (4/4/19, Germany.)
19,108 Barth. Terminal connections of dynamos. (5/4/19, Germany.)
19,146 Berthenod. Electric lighting systems.
19,166 Krupp (F.) A. G. Electrical distance control of valve gear of hydraulic gun pointing gear. (4/12/16, Germany.)
19,180 Krupp (F.) A. G. Electro-magnetic chuck. (18/6/19, Germany.)
19,196 B.T.H. Co. Wireless signalling systems. (29/10/13, U.S.)
19,197 B.T.H. Co. Electron discharge devices. (29/10/13, U.S.)
19,198 B.T.H. Co. Amplification of electrical variations. (8/11/15, U.S.)
19,199 B.T.H. Co. Electron discharge apparatus. (5/6/16, U.S.)
19,205 Seibt. Telephones. (1/3/16, Germany.)
19,222 Lewis. Eliminating line resistance losses.
19,228 Silent Valve Motors Corporation. Electric generating apparatus. (15/9/13, U.S.)
19,271 Rail Welding & Bonding Co. Arc welding. (26/1/20, U.S.)
19,304 Vail-Kimes Co. Automatic cut-out for motors.
19,331 Ges. fur Drahtlose Telegraphie. Transmitters for wireless telegraphy, &c, (3/7/14, Germany.)
19,332 Ges. fur Drahtlose Telegraphie. Cathode-tube generators. (15/7/15 Germany.)
19,333 Ges. fur Drahtlose Telegraphie. Wireless telegraph transmission. (24/12/15 Germany.)
19,334 Ges. fur Drahtlose Telegraphie. Production of high power currents of constant frequency. (31/12/15, Germany.)
19,335 Ges. fur Drahtlose Telegraphie. Telegraphy. (9/11/16, Germany.)
19,336 Ges. fur Drahtlose Telegraphie. Electric condensers. (6/3/17, Germany.)
19,337 Ges. fur Drahtlose Telegraphie. Wireless telegraph transmitters. (20/10/17, Germany.)
19,338 Ges. fur Drahtlose Telegraphie. Arrangement for minimising loss in production of oscillations by means of vacuum tubes. (6/12/17, Germany.)
19,339 Ges. fur Drahtlose Telegraphie. Wireless transmitters. (6/12/13, Germany.)
19,340 Ges. fur Drahtlose Telegraphie. Electric condensers. (24/3/14, Germany.)
19,341 Ges. fur Drahtlose Telegraphie. Means for maintaining constant the speed of an electric motor. (9/2/16, Germany.)
19,342 Ges. fur Drahtlose Telegraphie. Coarse and fine adjustment for tuning and coupling devices for wireless telegraph apparatus. (10/11/17, Germany.)
19,343 Ges. fur Drahtlose Telegraphie. Arrangement for locating underground, &c., conducting objects. (23/11/17, Germany.)
19,344 Ges. fur Drahtlose Telegraphie. Cathode tubes. (29/1/18, Germany.)
19,345 Ges. fur Drahtlose Telegraphie. Method for directive wireless telegraphy with separated antennæ. (11/6/18, Germany.
19,346 Ges. fur Drahtlose Telegraphie. Cathode tubes. (10/10/18, Germany.)
19,347 Ges. fur Drahtlose Telegraphie. Frequency multipliers. (26/10/18, Germany.)

Companies' Reports, &c.

EASTERN TELEGRAPH CO., LTD.

The eighty-ninth ordinary general meeting of the Eastern Telegraph Company, Ltd., was held on Wednesday, Dec. 15, 1920, at Electra House, Finsbury-pavement, London, E.C., Sir J. DENISON-PENDER, G.B.E., K.C.M.G., the chairman of the Company, presiding.

The SECRETARY (Mr. A. R. Hardie) having read the notice convening the meeting and the auditors' report,

THE YEAR'S ACCOUNTS.

The CHAIRMAN said: Gentlemen, when I had the pleasure of meeting the stockholders last year I remarked that our gross revenue had reached a figure considerably in excess of any previous year in the history of the Company, and was no less than £1,438,000 more than the pre-war year 1913; but the gross revenue shown in the accounts now before you exceeds that of last year by £694,000, the total of the year under review having amounted to £4,959,000. These are remarkable figures, but we must not overlook the fact that this large income has not been earned without a very considerable increase in working expenses, which were approximately £653,000 more than 1918. Full details are given in the accounts now before you, and as abnormal conditions still prevail, and our expenses have not yet become so stabilised as they were before the war, I will not attempt to analyse them in detail. I may mention, however, that the bulk of the increase is due to extra payments made to the staff, partly in the form of permanent augmentations of the scales of pay, and partly in the shape of temporary payments to meet to some extent the present abnormal conditions of life.

Notwithstanding these exceptionally heavy expenses, our net revenue amounted to £1,851,883, or £40,426 in excess of last year. Therefore, after providing for income tax and excess profits duty payable in England, which I am glad to say is £430,977 less than the preceding year, and interest and dividends on debenture and preference stocks, there is, with the amount brought forward, an available balance of just over £1,316,000. So that, after deducting the amount required to pay a dividend of 10 per cent. free of income tax on the ordinary stock for the year ending Dec. 31, 1919, which, I may incidentally remark, is 2 per cent. more than the dividend and bonus paid during previous years, there is a surplus of £916,000, out of which we have carried to the general reserve fund £500,000, the same amount as last year. No doubt we could have carried a larger sum to this fund and reduced the amount carried forward to the next accounts accordingly; but, as explained in the report, we have decided to carry forward the exceptionally large sum of £416,000, in view of the additional heavy taxation, &c., which we shall have to meet in 1920.

The general reserve fund has been debited with £573,264 in respect of a new cable between Porthcurnow and Gibraltar, and the partial renewal of some of our main line cables, &c.

INCREASE OF CAPITAL.

As foreshadowed at our last meeting, we have in contemplation a heavy programme of cable laying and renewals, and this was further referred to at the special meeting called to authorise the increase in the ordinary capital of the Company by one million pounds. During the current year we have expended about £1,200,000 on additional cables from Malta to Alexandria and from Aden to Bombay.

Last year I addressed you at considerable length, having then considered it necessary to review our position in consequence of the war, and I commented upon the innumerable difficulties which had to be overcome in order to provide the best service possible under the circumstances for all concerned. I then stated that the combined interests of this country and our Allies had claimed our first consideration, and that our regular customers had been subjected to many restrictions in consequence of which their commerical service had been hampered, and that their telegrams had been, and were still, suffering serious delay. Fully realising that as public servants it was our duty to remedy this unsatisfactory state of affairs at the earliest possible moment, every effort has been made on our part to re-establish such a service for commercial correspondence as was generally acknowledged to be second to none in speed, secrecy and freedom from errors in transmission. I am now glad to be able to report that a great improvement has already taken place, and when the whole of the additional cables ordered by this Company and the Eastern Extension Company are laid and working we fully anticipate that our public service will be even better than it was before the war.

Every effort is being made to overcome the shortage of staff, so as to relieve our present employees and reduce the amount of overtime which they are now called upon to perform. Our school originally in this building has been transferred to Hampstead, where we have been able to more than double the accommodation for the training of young men in the particular requirements of our service. Two hundred probationers can be accommodated and trained at a time, and as they qualify and pass out to our stations others are engaged to keep the figure constantly up to that number.

In accordance with the authority given to the Directors at the extraordinary general meeting held on March 3rd last, the issue of 1,000,000 new ordinary shares of £1 each was offered to the ordinary stockholders at par, and was taken up by them to the extent of 933,121 shares. The staff of the Company was given the option of applying for the remaining balance of 66,879 shares, and applications were received from them for over three times the number of shares available. The same action was adopted by the Eastern Extension and Western Companies, but as their staffs are not so numerous as ours, they did not absorb the whole of the unissued balance. Those Companies generously placed the balance left over, after making the allotments to their staff, at the disposal of this Company, which will go some way towards meeting the applications of our own staff, although these additional shares will not meet the total applications received. Gentlemen, with those remarks I beg to propose—

"*That the printed reports and accounts of the Directors for the year ended Dec. 31, 1919, submitted to this meeting, be and the same are hereby received and adopted. That the dividend of 3½ per cent., less income tax, paid in respect of the preference stock of the Company, and the dividend of 10 per cent., free of income tax, paid in respect of the ordinary stock of the Company for the year ended Dec. 31, 1919, be approved.*"

Mr. Francis Alexander Johnston second the motion, which was carried unanimously.

The retiring auditors were reappointed and the proceedings terminated with a hearty vote of thanks to the Chairman, Directors and Staff at home and abroad.

EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH CO., LTD.

The eighty-sixth ordinary general meeting of this Company was held on Dec. 14, under the presidency of Sir. J. DENISON-PENDER, G.B.E., K.C.M.G., the Chairman of the Company. The general manager and secretary (Mr. F. E. Hesse) having read the notice convening the meeting and the auditors' report,

The CHAIRMAN said: Gentlemen, in presenting the report, with audited accounts, for 1919, which, I presume, you will, as usual, take as read, your directors have again to express their regret that, for the same reasons that prevailed in the War years, they were unable to hold the annual general meeting in May. Having, however, recently made certain arrangements for accelerating the adjustment of the traffic accounts, it is hoped that we shall be able to hold our next meeting at a much earlier date. The enforced delay in holding the meeting did not, however, prevent the payment to the shareholders at the usual time of the final dividend for the year 1919, as your directors considered from the estimated figures before them that they would be justified in making a total distribution of 10 per cent., free of income tax, without waiting for the shareholders' approval. This distribution compares with a total distribution of 8 per cent. for 1918. Turning now to the printed accounts, which I think you will agree are highly satisfactory, it will be seen that the gross receipts for 1919 amounted in round numbers to £2,446,000, against £2,070,000 for 1918, showing an increase of £376,000, notwithstanding the fact that the revenue for the latter year was £562,000 higher than in 1917. Comparing the revenue of the past year with that of the pre-war year of 1913, there is an increase of over 300 per cent. For the current year the traffic is being well maintained. The handling of this greatly increased traffic has naturally involved a considerable addition to the working and other expenses for the past year, which, in round numbers, amounted to £961,000, against £620,000 in 1918, or an increase of £341,000. This absorbed most of the increased revenue, but fortunately the reduction from 80 per cent. paid in 1918 to 40 per cent. paid in 1919 for Excess Profits Duty, reduced the expenditure on this account by £455,000.

INCREASED EXPENDITURE.

The principal items of increased expenditure are: Additional payments to staff and other expenses in connection with the war, £109,000. Additional expenses attending the maintenance of cables, £33,000; and war taxation in Netherlands India, amounting to £115,000, or a total of £257,000. The war taxation in Netherlands India was imposed at the end of 1917, and made retrospective from 1914. The final assessments, however, were only delivered to the Company a few months ago owing to delays caused by the Company's endeavours to obtain more favourable treatment than the local authorities were disposed to grant. The payment in question covers six years war tax from 1914 to 1919 inclusive. It has been agreed with the Inland Revenue authorities here that the Company shall receive relief for Excess Profits Duty in England, at the rates applicable to the years in which the liability occurred, and the net payment for the Netherlands Indian War tax amounted to only £31,000. The balance we now have to deal with is £1,041,000, plus the balance of £41,000 brought forward from 1918, making together £1,082,000. Out of this we have distributed £300,000 in payment of the 10 per cent. dividend, and now propose to transfer to the general reserve fund £350,000; also to make a further provision of £200,000 on account of investment fluctuations, which will make up the depreciation shown in the Company's securities at the end of 1919 within a few thousand pounds, and carry forward £232,000. Your directors consider it advisable to retain this large sum owing to the uncertainty prevailing regarding taxation liability, and to the large expenditure required in the near future for developing and improving the Company's service in the Far East. The additional cable which we have arranged to lay between Madras and Singapore, of large carrying capacity, is now in course of manufacture, and is expected to be laid and opened for traffic early next year. The existing two cables between Madras and Penang are, at times, taxed to their utmost capacity. You will remember that the Great Northern Telegraph Company's through route to the Far East materially assisted in carrying the China and Japan traffic up to 1914, when it became interrupted and is not yet restored. Consequently, our cables are still carrying this traffic in addition to the large increases in other directions, and, as I have just mentioned, additional carrying capacity is now much needed. When the Great Northern route is again working, we shall be relieved of some of the traffic, but in any case, the new cable will benefit the telegraphing public, and, therefore, we have no hesitation in incurring the expenditure for the additional cable between Madras and Singapore.

Sir John then referred to the issue of the new share capital, and concluded by moving the adoption of the report and accounts, and that the dividend of 10 per cent. (tax free), paid in respect of the share capital of the Company for the year 1919, be approved.

Col. the Hon. ARTHUR G. BRODRICK, T.D., A.D.C., seconded, the motion, which was carried unanimously; and resolutions were afterwards passed re-electing the retiring directors, Mr. J. C. Denison-Pender, M.P., and Sir A. J. Leppoc Cappel, K.C.I.E., and re-appointing the auditors. Messrs. Deloitte, Plender, Griffiths & Company. A cordial vote of thanks to the Chairman, directors, general manager and staff terminated the proceedings.

THE WESTERN TELEGRAPH COMPANY, LTD.

The eighty-seventh ordinary general meeting of the Western Telegraph Company, Ltd., was held at Electra House, Finsbury Pavement, on December 15, 1920, Sir John Denison-Pender, G.B.E., K.C.M.G., chairman of the Company, presiding.

The SECRETARY (Mr. E. Steer Hodson), having read the notice convening the meeting and the auditors' certificate,

The Year's Accounts.

The CHAIRMAN said: Gentlemen, it is with much pleasure that the Board submit for your consideration what we feel sure you will agree is a very satisfactory statement of accounts. From this you will observe that the revenue from all sources has increased by a little over £719,000, and it is gratifying to know that this represents a greater volume of traffic with all the States of South America which are served by the Company's system of telegraphic cables. The large increase of revenue has not been earned without a corresponding extra cost. The net increase in working expenses amounted to £276,000 and income tax, excess profits duty and corporation profits tax were more by £151,000. The result is that after paying quarterly dividends amounting to 10 per cent., free of income tax, for the year, there has been transferred to the general reserve fund, £450,000; to provision on account of investment fluctuations, £145,000; to maintenance ships' reserve fund, £50,000; and to land and buildings depreciation fund, £50,000. Although £450,000 has been credited to the general reserve fund, I must remind you that £317,000 has been debited that fund, being part of the cost of new cables and renewals and loss on sale of investments. The realisation of these investments was necessary to pay for the new cable manufactured prior to the recent issue of new share capital. The net increase in the general reserve fund is consequently only about £133,000. The provision on account of investment fluctuations represents the difference between the cost and the market value as at the close of our financial year. Referring to the additional share capital, 103,965 shares of £10 each were offered to the Shareholders at par, being at the rate of one new for every two old shares. Of these about 96,000 were accepted. The balance was offered to the staff at par up to a maximum of 20 shares per member to be held for not less than three years. About 5,500 shares have been accepted on these terms.

New Cables.

Our new cable from North Brazil to the Island of Barbados was laid in September last. A short time before, an expedition started to lay the connecting cable, owned by our American friends the Western Union Cable Company, from Barbados to Florida, there to join up with the vast landline system of the latter Company in the United States. At almost the last moment, however, we were all surprised to learn that the American Government refused to permit the Western Union Company to land its cable on American soil, the objection being that the Western Union intended working in conjunction with us, a British Company holding exclusive rights from the Government of Brazil for submarine cable communication. I would impress upon you the fact that we hold no exclusive privileges for international cables and in evidence of this an American Cable Company owns cables from Rio de Janeiro and Santos to Uruguay and Argentina, also a French enterprise has a cable from Pernambuco to West Africa and thence to France; another French Company owns a cable from North Brazil to the United States of North America. Before the war the Germans also owned a cable from Pernambuco to the West African Coast and on to Germany. The rights we hold are for cables connecting Brazilian ports in which Brazil herself is alone interested. A regrettable feature of this unfortunate incident is to us, a British company, the active opposition of the British Minister in Washington, who went even further than the United States Government and issued instructions to the Commander of the British ship chartered by the Western Union Company to lay this cable not to proceed with the work; however, these instructions were not supported by our Foreign Office and the cable was laid, with the end buoyed, outside the United States Territorial waters, at a position agreed upon with the United States Government. It is hoped that communication will shortly be made, these two sections joined up, and a new service of traffic then opened between Brazil and the United States, but it may not be by the route originally contemplated. At the last general meeting I referred to the continued interruption of the original cable between St. Vincent, Cape Verd Islands, and Pernambuco; we have two cables connecting these points—a large portion amounting to nearly 1,000 miles was last month very successfully renewed and the cable is again in good working order.

In the near future we are committed to lay additional cables on the Brazilian Coast between Pernambuco and Maranham, Pernambuco and Maceio, Victoria and Rio de Janeiro, and Rio de Janeiro and Santos. We intend also to afford additional facilities to Santa Catharina and Rio Grande do Sul. These places I have mentioned are all along the Brazilian coast, and will form collecting grounds for our main cable as well as carry local traffic. An order has been placed for the necessary cable to renew the older section between Lisbon and Madeira. The existing cable has been laid some years and would have been renewed before had not the war prevented our carrying out the work. This programme, with cable for stock, will entail a further expenditure of close on one million pounds.

I conclude by moving—

"*That the report of the Directors and the accounts for the year ended* 30*th June*, 1920, *now submitted, be approved and adopted.*"

The Rt. Hon. the EARL OF MIDLETON, K.P., seconded the motion. which was carried unanimously.

The retiring auditors were re-appointed, and the proceedings terminated with a hearty vote of thanks to the Chairman, Directors and Staff.

The accounts of Water Softeners, Ltd., for the past year show a surplus of £5,462, which is to be carried forward.

The directors of the Lancashire Dynamo & Motor Company have declared an interim dividend of 9d. per share on the ordinary shares.

The directors of the Chili Telephone Company have declared an interim dividend at the rate of 6 per cent. per annum, tax free.

The Tees Power Station Company, Ltd., has declared a dividend of 5½ per cent. for the year ended Sept. 30, and £306 has been carried forward.

The Yorkshire (W. Riding) Electric Tramways Company has declared a balance dividend of 3 per cent. on the 6 per cent. preference shares for the half-year ending the 31st inst.

The International Automatic Telephone Company has declared a dividend of 9 1/5d. per share (less tax) on the preference shares, partly on account of arrears, payable Jan. 1.

The directors of Fuller's United Electric Works, Ltd., state that owing to industrial depression they consider it advisable to defer payment of an interim dividend on the preference shares.

A dividend of 3 per cent. has been declared by the Consolidated Signal Company, Ltd., on preference shares for the past half-year, making 6 per cent. for the year. A sum of £1,200 is carried forward.

The Board of Referees under the Finance Acts have increased the statutory percentage not subject to excess profits duty to eight per cent. in the case of the United River Plate Telephone Company, Ltd.

The following companies will be struck off the Register of Joint Stock Companies unless cause to the contrary is shown before Feb. 28. 1921: British Radium Corporation; Electric Wiring & Fittings Company; Radium Lamp.

The preference share and transfer books of the Automatic Telephone Manufacturing Company, Ltd., will be closed from the 18th to 25th inst. inclusive to prepare the dividend warrants on the 6 per cent. preference shares for the half year ending the 31st inst.

The profit of the Barbados Electric Supply Corpn., Ltd., for the year ended June 30, 1920, is £4,617; £3,494 has been written off underwriting commission, preliminary expenses and discount and expenses of issue of debentures, £1,127 charged for repairs and renewals. The capital expenditure was £7,917.

For the year ended July 31, the net profit of the Hughes-Johnson Stampings, Ltd., after making provision for bad debts, depreciation and other charges, is £17,096, and with £1,295 brought forward the total is £18,390. A dividend of 10 per cent. is proposed. with bonus of 1s. per share, after placing to reserve £4,500. The carry forward is £1,290.

The directors of the Burmah Electric Tramways & Lighting Company, Ltd., have declared a dividend of 14 per cent. (14s. per share), less tax, on the preference shares for the period ended Nov. 30. 1920. A sum of £15,000 is carried to general reserve and depreciation fund, £500 to special reserve for depreciation of investments, and £388 forward.

The Delagoa Bay Development Corporation, Ltd., report that for year ended 30th June, the net profit in Lourenco Marques was £23,603. The net loss as per profit and loss account is £10,005, which after deducting amount standing to credit of profit and loss account (£7,918) makes a debit balance of £2,087. The falling off in profits is almost entirely due to depreciation of Portuguese currency. Expenditure on capital account was £10,741.

The directors' report of the India-Rubber, Gutta-Percha & Telegraph Works Company, Ltd., for the year ended Sept. 30, states that, after making provision for doubtful debts and excess profits duty, the net profit is £73,299 13s. 3d. Adding £100,368 6s. 3d brought forward and deducting the dividend on the preference shares .(£12,500 and the interim dividend on the ordinary shares (£18,750), the disposable balance is £142,417 19s. 6d. The warrants for the half-yearly dividend on the preference shares are payable on the 1st prox. With regard to the ordinary shares, although the balance is amply sufficient to pay the usual dividend, the directors feel obliged to defer recommending the payment of a further dividend owing to the present scarcity of cash. This has been brought about by the large cash payments they have been compelled to make to the Government for excess profits duty and income tax, and also to the higher costs of raw materials and labour which have gone to form our present stocks. The directors, however, hope it may be possible later on to pay a six months' dividend to the ordinary shares out of the balance shown at the end of the year.

Mr. Ludwig Breitmeyer, who presided over the annual meeting of the Cape Electric Tramways, Ltd., last week said that during the past year they carried 25,921,529 passengers on the Cape Town and Port Elizabeth systems, earning £325,085—a decrease of 2,071,647 passengers and an increase of £23,293 in traffic receipts. The falling off in the number of passengers was due to the prolonged strike in July and August last year, while the larger receipts were due to the increases in the fares. The heavier labour charges, in addition to the higher cost of all supplies, had increased the ratio of working expenses to revenue from 63·13 to 71·27 per cent. Now that the cost of living in South Africa appeared to be showing signs of a decrease, a general improvement in conditions would take place. Twelve new cars had been sent to Cape Town and would be soon put into operation. After deducting interest and amortisation of debentures the net profit was £36,497, and with amount brought forward the available sum was £47,703. From that £12,000 has been set aside for reserve, and it was proposed to declare a dividend at the rate of 5 per cent., leaving £11,141 to be carried forward. The "B" debenture issue of £150,000 had been redeemed. He was very optimistic as to the company's future prospects, and, given normal conditions, the business would continue to improve. The Municipality had not exercised their purchase powers, which were in abeyance for a further five years. The Municipality, however, had approached the company with a view to purchasing the whole of the Cape Town system.

The net profit of Ferranti, Ltd., for the year ended June 30, 1919, after charging interest on debenture stock, notes and loans, and making usual allocation to depreciation reserve and provision for taxation, including excess profits duty, amounted to £18,251. The net profit for the year to 30th June last, after making similar provisions, was £36,622. Leasehold land and buildings, plant and machinery were valued in April, 1919, and the figures have been adopted as book vzlue of these assets. In consequence £50,000 has been transferred from depreciation reserve to general reserve. Works are now fully engaged upon manufacture of electrical meters, instruments and transformers; a dividend of 6 per cent (less tax) was paid on the preference shares on account of arrears in November, 1919, and a further dividend of 12 per cent. (less tax), being two years' arrears, is payable on the 11th inst.

At the meeting, on Friday, the chairman (Mr. A. W. Tait) announced that all outstanding matters with the Government in respect of munitions contracts had been settled and they were upon the point of making a final payment which would close all accounts between them and the Government. With regard to taxation also considerable progress had been made, and various outstanding points of principle had been settled. The liability up to 30th June, 1917, had been agreed, and in respect of the year to June, 1920, proper reserves have been made for taxation before arriving at the figures shown in the accounts. The net profit for the year to 30th June, 1919, after providing for expenses and charging interest on debenture stock and making the usual allocation to depreciation reserve and provision for taxation, amounted to £18,251, while the profit for the year to 30th June, 1920, after making similar provision, was £36,622. The year ended 30th June, 1920, commenced a new era in their affairs. It was the first full year of the trial of the policy of the company to produce three definite lines of manufacture, namely meters, power transformers and measuring instruments. The results on the whole, considering the difficulties which had had to be overcome, might be regarded as satisfactory, and the output in measure of quantity as well as monetary value showed a very large increase on the figures of any previous year, excluding the munitions period. The output would have been still greater had it not been for the fact that they were considerably hampered in obtaining regular deliveries of raw materials. Those conditions were now improving somewhat, and if the present demand continued they should be able to show a further improvement during the current year. When conditions improved the directors would submit a scheme for the reorganisation of the existing capital, and for providing the additional capital required.

At a meeting of Tube Investments, Ltd., last week the chairman (Mr. A. Chamberlain) said it was a real satisfaction to be able to present so sound a balance-sheet and to report in such a hopeful manner on the position and prospects of the Company. Their dividends were approximately derived as to £155,000 from profits for the year, and £102,000 from profits made in previous periods, and about £70,000 of undivided profits remained in their various companies. After referring to the manufactures of the various companies, he said they had replaced their armament trade with standard and peaceful lines. Already they had had, or could be sure of, six good months of the present year. They anticipated that before they were in the grip of the coming trade depression they would have one more satisfactory balance-sheet. Their order-book was not quite so full, cancellations were not unknown, complaints that customers could not afford to pay the prices demanded were more frequent, and bad debts, a feature of trade that had disappeared during the war, were becoming alarming in their frequency. Anybody would be blind if he could not read the signs and foresee a critical period for our own industry, for our county's industry and the industry of the world. However, he was convinced that they should, as always, get through somehow. The cost of everything was so terrific that an increasing number of people refused to buy; the high prices had stifled demand. Consequently there were large stocks on hand and unemployment; with unemployment would come, first, reduced profits; secondly, reduced labour costs, either by greater output per head or by reduced wages, or both, until prices reached such a level as to once more stimulate demand. Three guilty parties had contributed to making prices higher and unemployment greater than they need have been. First, the Government had most information at their disposal and should show the country a lead. Instead of that they were the greatest spendthrifts and drifters imaginable. Secondly, the capitalists had taken advantage of the demand being in excess of production to exact an appreciably higher rate of profit than in pre-war times. The ability to raise profits was immensely increased by the great amalgamations that had taken place in recent years, and by the greatly increased efficiency of trade associations. The incentive and self-justification for increasing profits was largely due to the conviction that the Excess Profits Duty was a most unfair and injurious form of taxation and the endeavour to pay it by an increased profit, people not realising that that only resulted in a vicious circle of increasing costs that left us where we began and the war not paid for. In his opinion industry as a whole both could and would have to work for a smaller reward than it received, and it would have to do that even if the Government cut down their expenditure to the 800 or 900 millions talked of. The E.P.D. should be abolished or altered, and the corporation tax as at present collected would not do. In the third category were the working classes, who had taken the same advantage as capital of the demand being greater than supply and had exacted their share of the spoil in reduced output or more wages or both, and it had resulted in the same vicious circle and in their being no better off than before. The two last causes of unemployment were in the way of being cured.

New Companies.

AUDENSHAW ENGINEERING COMPANY, LTD. (171,591).—Private company. Regd. Nov. 24. Capital £3,000 in £1 shares. To carry on the business of constructional, manufacturing, hydraulic, electrical, mechanical and general engineers, &c. Directors are: S. H. Whitley, D. Ardern and A. Y. Sutherland. Secretary: H. Whitehead. Reg. office: Denton-road, Audenshaw, near Manchester.

AIREDALE ELECTRICAL & MFG. COMPANY, LTD. (171,825).—Private company. Reg. Dec. 3. Capital £1,500 in £1 shares. To carry on the business of electricians, electrical, motor, mechanical, telephone and general engineers, manufacturers of electrical apparatus, &c. Permanent directors are: J. E. L. Blythe, R. V. Broberg and L. E. Wood. Reg. office: 153, Ryan-street, Bowling, Bradford, Yorks.

DALTON, DOWNES & COMPANY, LTD. (171,937).—Private company. Reg. December 10. £5,000 in 200 preference shares of £10 each and 3,000 ordinary shares of £1 each. To take over the business carried on at Manchester by Amedee A. H. Papillon as Dalton, Downes & Company, and to carry on the business of manufacturers, exporters and importers of and dealers in electrical and general vacuum cleaners, electrical apparatus, lamps, &c. Permanent directors are: Amedee A. H. Papillon, P. Trotman (joint manager) and R. Hall (secretary). Reg. offices: 37a, Fountain-street, Manchester.

FRANCIS LAW, LTD. (171,708)—Private company. Reg. Nov. 29, capital £1,000 in £1 shares, to carry on the business of electrical engineers dealers in electrical goods, motors, &c. Permanent directors are F. H. R. Law (chairman and managing director) and A. English. Reg. office: Tower Buildings, Cowpasture-road, Ilkley.

JAMES & JARRETT, LTD. (171,636).—Private company. Regd. Nov. 25. Capital £25,000 in £1 shares. To carry on the business of civil, mechanical, electrical and general engineers, contractors, &c. Directors are: W. L. James and J. J. Jarrett. Reg. office, Salisbury Chambers, Castle-street, Cardiff.

KENNETH H. KERR, LTD. (11,505)—Private company. Reg. in Edinburgh Nov. 23, capital £3,000 in £1 shares, to carry on the business of electrical engineers, manufacturers of electrical appliances, founders, mechanical engineers, &c. First directors are K. H. Kerr and Wm. Kerr (Dalbeattie, Kirkcudbrightshire) and J. G. Abbott. Solicitors: J. W. Whitelaw & Edgar, Royal Bank Buildings, Dumfries.

LONDON BATTERY & CABLE COMPANY, LIMITED. (171,816).—Private company. Reg. Dec. 3. Capital £5,000 in £1 shares. To take over the business of electrical and general engineers, makers of accumulators and batteries, &c., carried on as the London Battery Company. E. W. Clark is director and secretary. Reg. office: Hesketh-road, Forest-gate, E.7.

LITHANODE COMPANY, LTD. (171,574).—Private company. Reg. Nov. 23. Capital £2,000 in £1 shares. To take over the business of manufacturers of accumulators, dry batteries, electrical fittings and apparatus and general engineers carried on by Lithanode, Ltd., and to adopt an agreement with A. B. Beall. A. B. Beall is first managing director. Reg. office: 190, Queens-road, Battersea, S.W.

MANCHESTER PRIVATE TELEPHONE & ELECTRIC LIGHTING COMPANY, LTD. (171,817).—Private company. Reg. Dec. 3. Capital £20,000 in £1 shares. To carry on the business indicated by title. Secretary: W. Hilton. Reg. offices: 25, Cooper-street, Manchester.

A. MUNDAY, LTD, (171,846.)—Private company, reg. Dec. 6, capital £5,000 in £1 shares, to carry on the business of electric lighting, heating and gas engineers, dealers in electrical appliances, &c., and to adopt an agreement with A. I. Munday, who is permanent governing director. Reg. office, 59, Watling-street, E.C.

NEWCASTLE AND SUNDERLAND OXY-ELECTRIC WELDING AND METALLURGICAL COMPANY, LTD. (171,250).—Private company. Reg. Nov. 5. Capital £5,000 in £1 shares. To carry on the business of welders and artificers in metal and all kinds of engineering works. Solicitors: Pakeman, Son & Read, 11, Ironmonger-lane, E.C.

NORTH-WESTERN ANGLO-SWEDISH ELECTRIC WELDING COMPANY, LTD. (171,795.)—Private company, reg. Dec. 2, capital £30,000 in £1 shares, to carry on business as indicated by the title. Reg. office, 340, Liver Building, Liverpool.

OLIVER PELL CONTROL, LTD. (171,946).—Reg. December 10. Capital £100,000 in £1 shares (25,000 8 per cent. part preference and 75,000 ordinary), to acquire certain assets of Oliver Pell Electric and Manufacturing Company, Ltd., and The Varley Magnet Company, Ltd., and to carry on the business of electrical, constructional, consulting, telegraph, telephone and mechanical engineers, machinists, &c. Directors are: C. Oliver (chairman), W. M. D. Pell, C. H. Barclay, H. Denton and B. Varley. Sec.: W. M. D. Pell. Reg. office: Cambridge Place, Burrage-road, Woolwich, S.E.

PEWSEY ELECTRIC LIGHTING COMPANY, LTD. (171,577).—Reg. November 23. Capital £5,000 in £1 shares. To carry on the business of an electric lighting company in all its branches in England or elsewhere. Directors are: A. J. Phillips, G. B. Nicol, F. J. Kunkler, A. Waylen, A. Rawlins and A. Cook. Secretary: T. Fowle. Office: Power House, High-street, Pewsey, Wilts.

PRINCESS ENGINEERING COMPANY, LTD. (171,718)—Private company. Reg. Nov. 29, capital £2,000 in £1 shares, to carry on the business of motor, electrical and general engineers, &c. First directors are A. Keighley (secretary and managing director) and A. H. Taylor. Reg. office: Princes-road, Wells, Somerset.

G. J. THORNTON ALDER & COMPANY, LTD. (171,811).—Private company. Reg. Dec. 3. Capital £2,000 in £1 shares. To carry on the business of electrical and general engineers and contractors, manufacturers, agents and dealers in all kinds of electrical, mechanical and general engineering appliances, &c. First directors are: G. W. Alder (and secretary) and T. D. Clapham. Reg. office: 53, Victoria-street. S.W.1.

TULLAMORE ELECTRIC LIGHT & POWER COMPANY, LTD. (5,065). —Reg. in Dublin, Nov. 1. Capital £25,000 in £1 shares. To carry on business as indicated by the title. First directors are: P. J. Egan, E. Williams, M. Scally, A. J. Lumley, W. C. Graham, N. Redmond, and P. Smyth. Secretary: T. J. Kelly. Reg. office: Harbour-street, Tullamore.

TWINING MODELS, LTD. (171,378).—Private company. Reg. Nov. 12. Capital £7,500 in £1 shares. To take over the business of a manufacturer of and dealer in mechanical and other models and shades for artificial illumination appliances carried on by E. W. Twining at Dychurch-lane and Kingswell-street, Northampton, as E. W. Twining, Son & Company. E. W. Twining is permanent director.

THOS RIGBY, LTD. (171,820).—Private company. Reg. Dec. 3. Capital £1,000 in £1 shares. To adopt an agreement with T. Rigby, and to carry on the business of electrical engineers and contractors. First directors are: T. Rigby, G. Scholefield and Mrs. A. D. Rigby. Reg. office: 134A, Woodhouse-lane, Leeds.

Prices of Metals, Chemicals, &c.

			TUESDAY, Dec. 14.	
Copper—		Price.	Inc.	Dec.
Best selected.........	per ton	£86 0 0	—	£1 0 0
Electro Wirebars...	,,	£89 0 0	—	£2 0 0
H C. wire basis......	per lb.	1s. 1¼d.	—	¼d.
Sheet	,,	1s. 3d.	—	—
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s. 5¼d.	—	¼d.
Brass 60/40—				
Rod, basis	,,	0s. 9¾d.	—	—
Sheet, basis	,,	1s. 2¾d.	—	—
Wire, basis	,,	1s. 2¼d.	—	—
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£37 0 0	—	—
Lead Pig				
English	,,	£26 10 0	—	£2 0 0
Foreign or Colonial	,,	£24 7 6	—	£2 2 6
Tin—Ingot	,,	215 10 0	—	£3 10 0
Wire, basis	per lb.	0 2 10½	—	½d.

Salammoniac.—Per cwt. 110s.-105s.

Sulphur (Flowers).—Ton £16 15s.

,, (Roll Brimstone).—Per ton £16 15s.

Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s. 6d.

Copper Sulphate.—Per ton £40.

Boric Acid (Crystals)—Per ton £74.

Sodium Bichromate.—Per lb. 10½d.

Sodium Chlorate.—Per lb 5¼d.

Rubber. Para fine, 1s. 1½d.; plantation 1st latex, 1s. 0½d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company, Ltd.

Arrangements for the Week.

FRIDAY, December 17th (to-day).

INSTITUTION OF MECHANICAL ENGINEERS.

6 *p.m.* At Storey's Gate, London, S.W. Paper on "Thermodynamic Cycles in Relation to the Design and Future of Development of Internal-combustion Motors," by Dr. W. J. Walker.

JUNIOR INSTITUTION OF ENGINEERS.

7.30 *p.m.* At Royal United Service Institution, Whitehall, London, S.W. Presidential Address on "Some Reflections on Our Industrial Situation," by Right Hon. Lord Weir of Eastwood.

INSTITUTE OF METALS—SHEFFIELD LOCAL SECTION.

7:30 *p.m.* At the University, Sheffield. Paper on "Some Alloys in the Foundry," by Mr. J. K. Smith, O.B.E.

ELECTRO-HARMONIC SOCIETY.

8 *p.m.* At Cannon-street Hotel, London, E.C Smoking Concert.

SATURDAY, December 18th.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

6:30 *p.m.* At the Technical College, Sunderland. Joint Meeting with the Sunderland Technical College Engineering Society. Debate on "Workman Representation on Directorates."

Benn Brothers Journals.

SOME FEATURES OF THE CURRENT ISSUES.

"Aeronautics."—"The State of Aerial Transport"; "Airship Mooring," by Flight Lieut. F. L. C. Butcher; and "The Hewitt-Crocker Helicopter."

"The Cabinet Maker."—(Special Christmas Number). "A Tale of the Antique Trade"; Concerning the Nature of Material; and "Practical Upholstering: The Renovation of Old Work."

"The Chemical Age."—"The Discolouration of Sulphate of Ammonia: Cause and Remedy."

"Farm and Home."—Report of Smithfield Show (illustrated); "Farmers and the Agricultural Bill"; and "Modern Cattle Feeding."

"The Fruit-Grower."—"Lessons of the Commercial Shows"; "Insurance against the Submarine"; and "Trade Exhibits at Smithfield Show."

"Hardware Trade Journal."—"Profit Sharing for Ironmongers"; "Hints on Drilling"; "Hardware in the Making (II.)."

"The Gas World."—"A Study in Gas Statistics; Annual Meetings of the National Gas Council and of the Federation of Gas Employers; and Summaries of Gas Bills to be promoted next year.

"Gardening Illustrated."—"Some Wild Flowers of Vancouver"; Apple, "Lane's Prince Albert" (illustrated); and "Rock Garden in the Autumn."

"The Transport World."—First issue, January 5, 1921.

Forty Years Ago.

(THE ELECTRICIAN, DECEMBER 18, 1880.)

THE LONDON INSTITUTION.—The lecture on Thursday night was by Dr. O. Lodge, on "The Relation between Electricity and Light."

THE POST OFFICE AND THE TELEPHONE COMPANIES.—At the moment of going to press we learn that judgment in this case will be delivered on Monday next. It is confidently stated that there will be an appeal whatever may be the decision.

THE ELECTRIC LIGHT.—The directors of the South-Eastern Railway have decided to experimentally light their Charing Cross Station with the Brush system of electric light, and the Cannon-street Station by that of the British Electric Light Company.

USE OF THE PHOTOPHONE.—It is suggested by the *Revue Industrielle* that Professor Graham Bell's new instrument may with advantage be used for communication between ships and lighthouses. It is difficult to see how such communication could be carried out with a moving body like a ship.

THE PHOTOPHONE.—As might be expected the photophone is giving rise to many novel experiments and suggestions. A correspondent asks whether intermittent magnetic rays would not in all likelihood produce sound in a body upon which they are directed? He should try for himself. Some ingenuity will be needed to shut off the local noise occasioned by the act of interrupting.

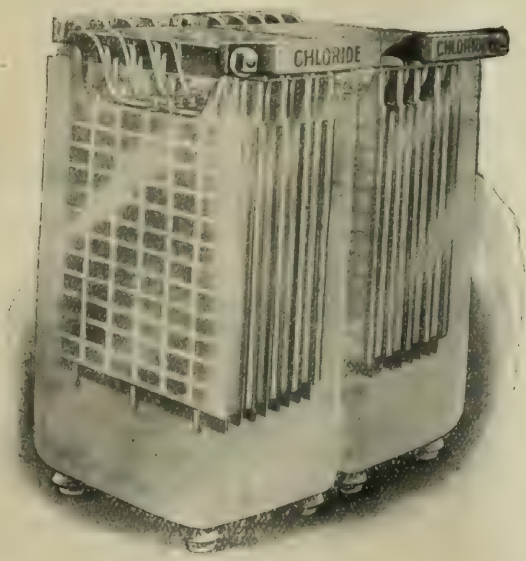
THE BRUSH COMPANY.—The energy displayed by this company is gratifying. The English people will have to adopt the electric light whatever betides. Really it was time some one with a little business tact and push appeared upon the scene. Whether the light be good, bad or indifferent, is not now the question; but if success in business comes by hard work there be those that command it.

The Editorial, Advertisement and Publishing Offices of "THE ELECTRICIAN" *are at* 8, *Bouverie Street, London, E.C.4. Telegrams: Benbrotric, Fleet, London. Telephone: City* 9853 (4 *lines*).

The subscription to "THE ELECTRICIAN" *is* £2. 12. 0. *per annum in the United Kingdom, and* £2. 14. 0. *per annum Abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.*

ACCUMULATORS

FROM THE



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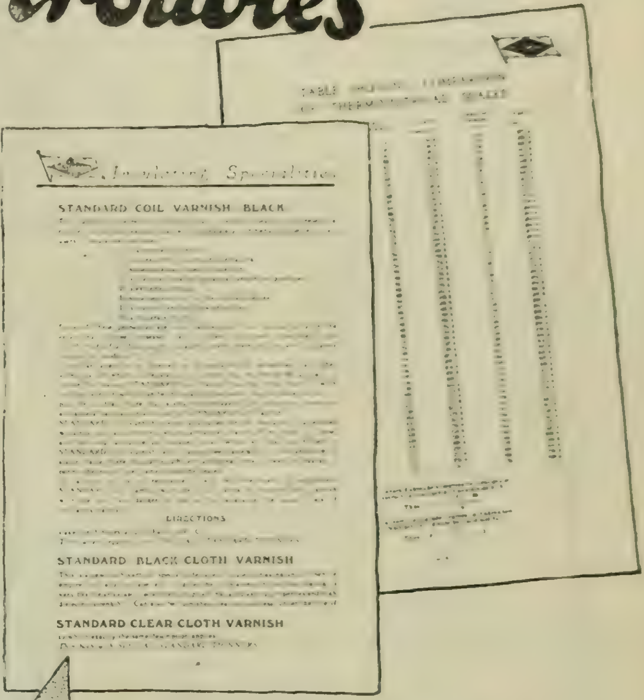

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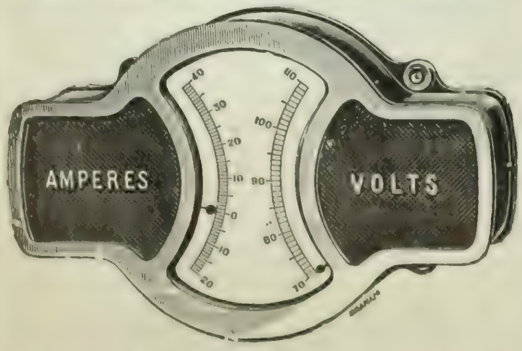

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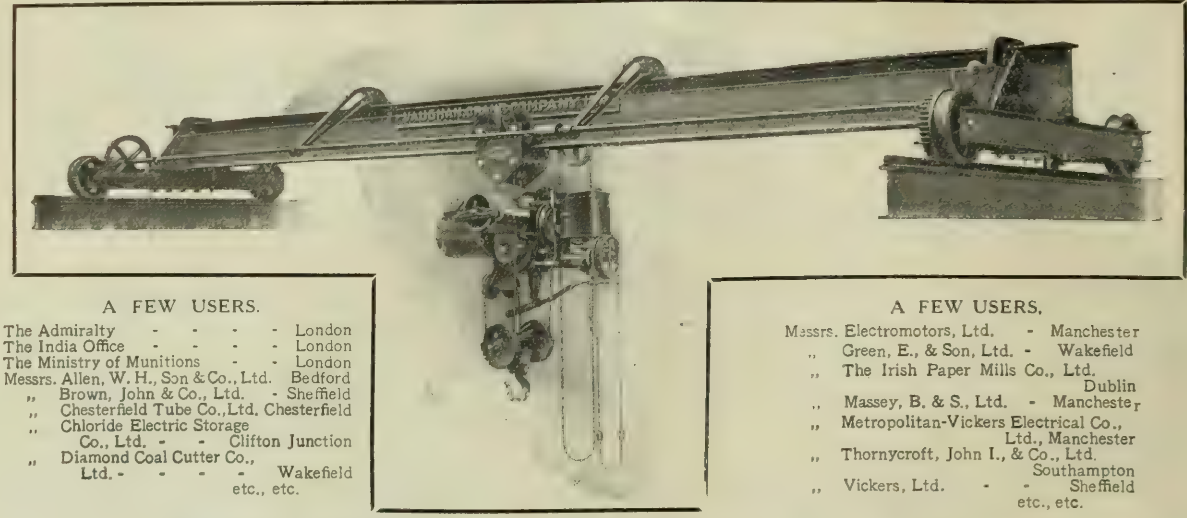

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The Ministry of Munitions - -	London
Messrs. Allen, W. H., Son & Co., Ltd.	Bedford
,, Brown, John & Co., Ltd. -	Sheffield
,, Chesterfield Tube Co., Ltd.	Chesterfield
,, Chloride Electric Storage Co., Ltd. - -	Clifton Junction
,, Diamond Coal Cutter Co., Ltd. - - - -	Wakefield
	etc., etc.

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Messrs. Electromotors, Ltd. -	Manchester
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,, Metropolitan-Vickers Electrical Co., Ltd.,	Manchester
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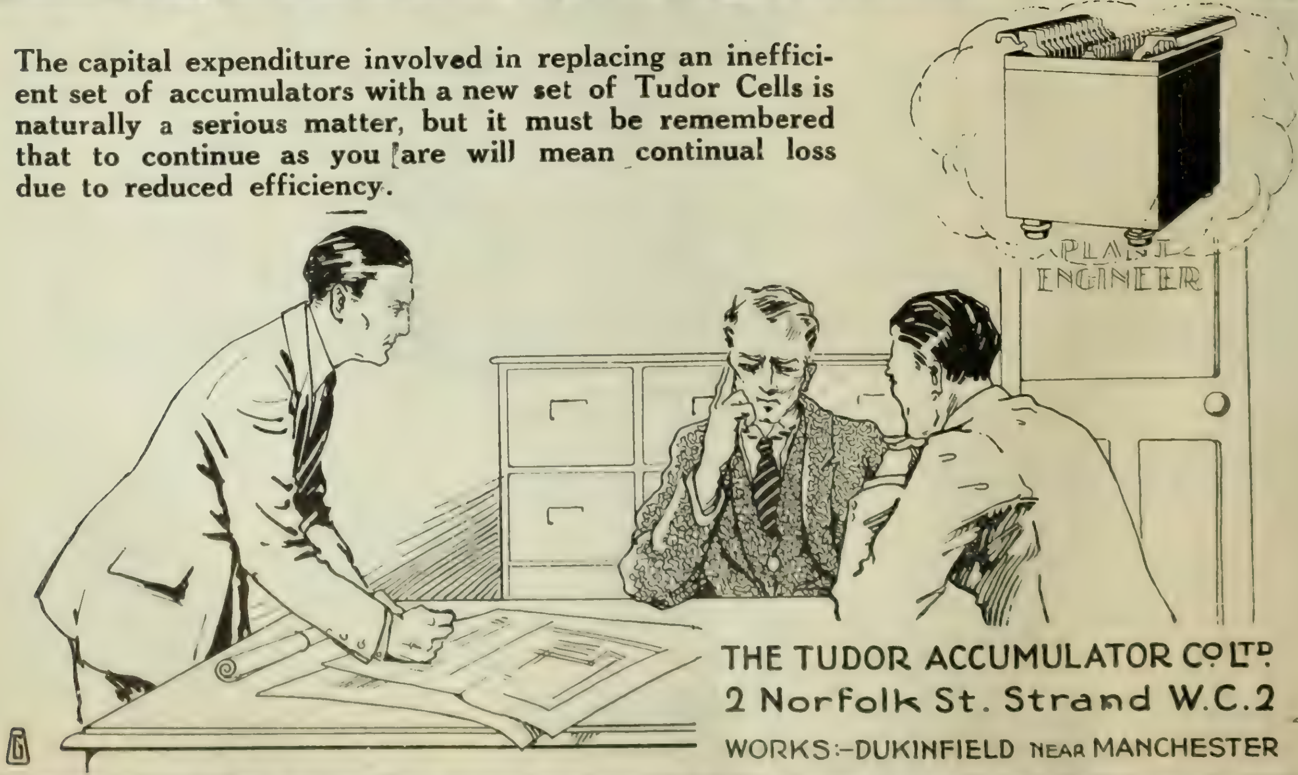

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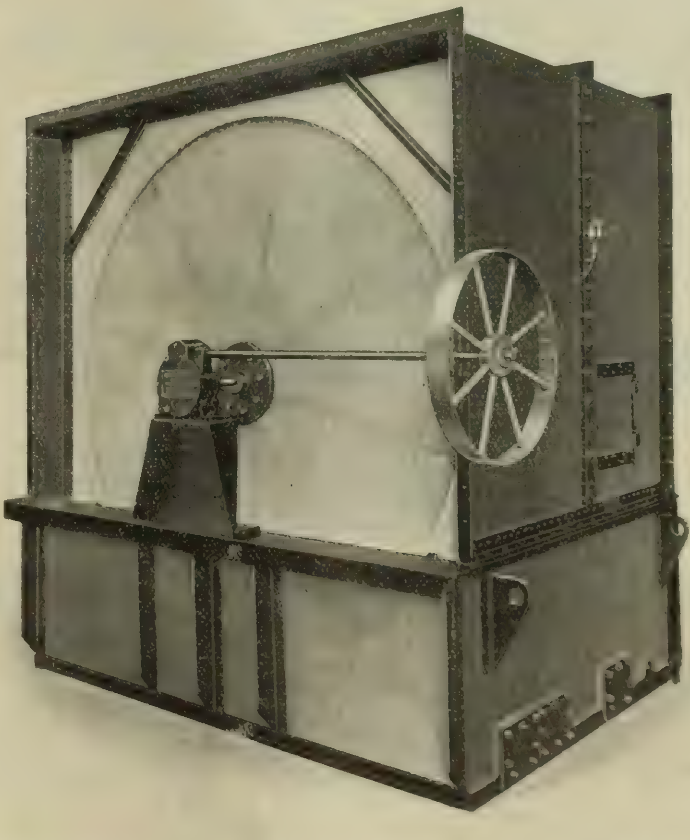

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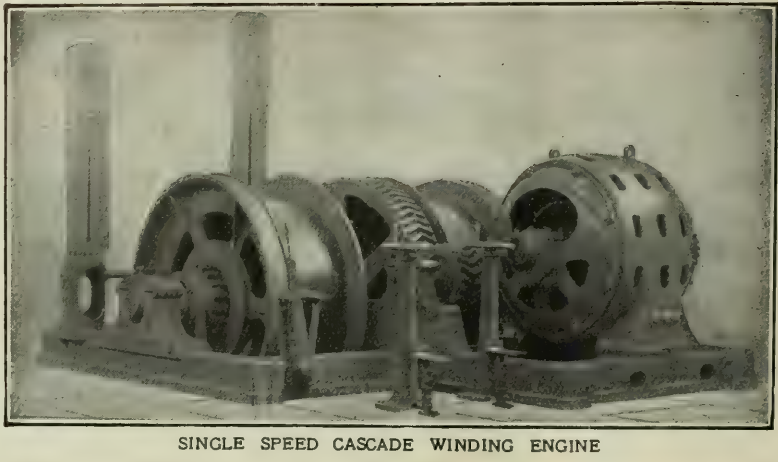

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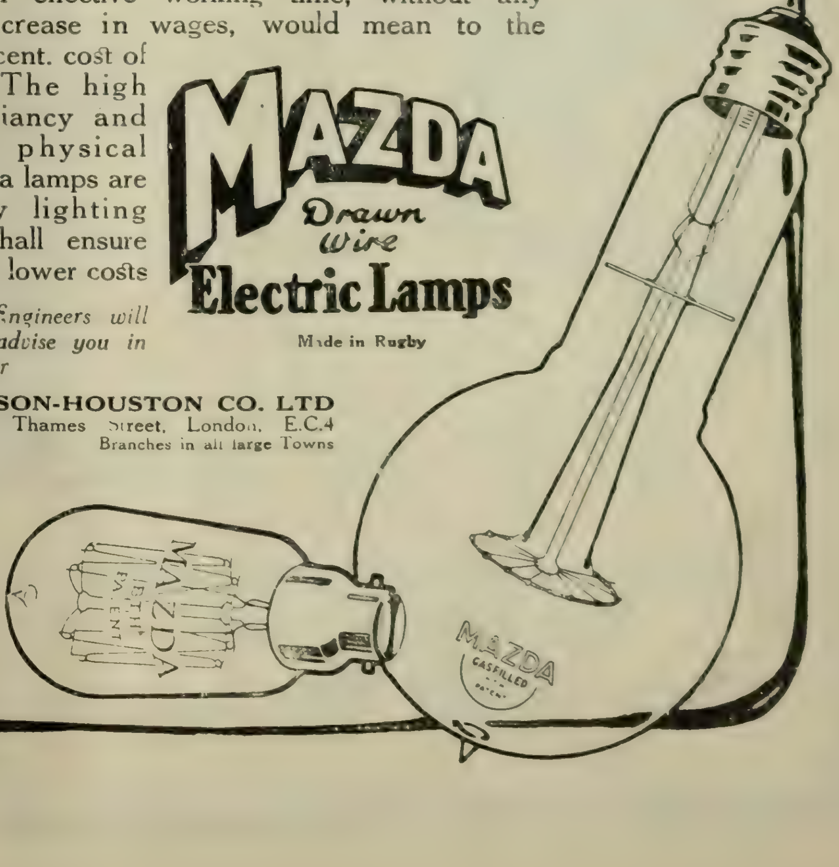

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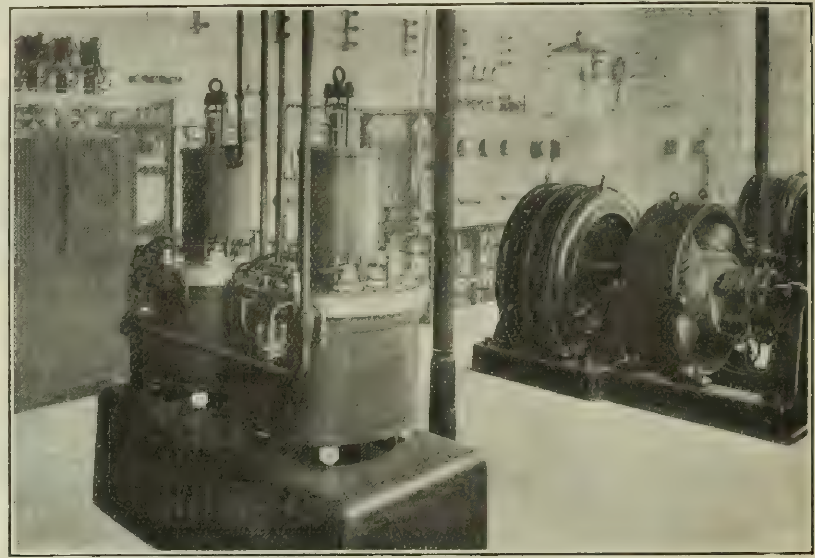

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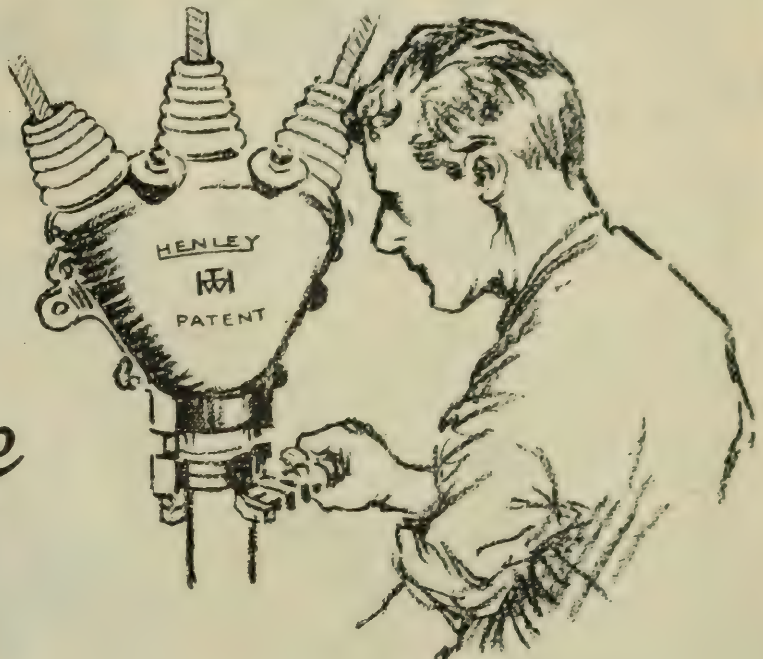

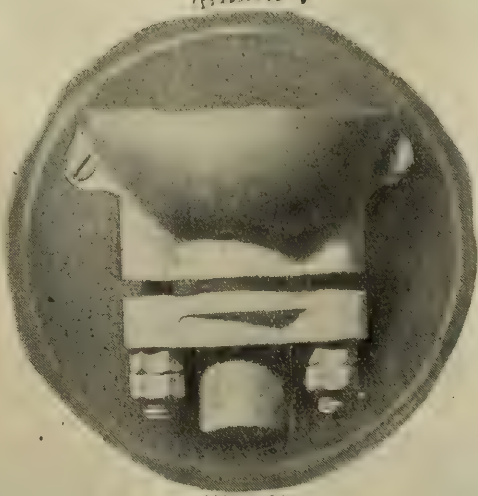

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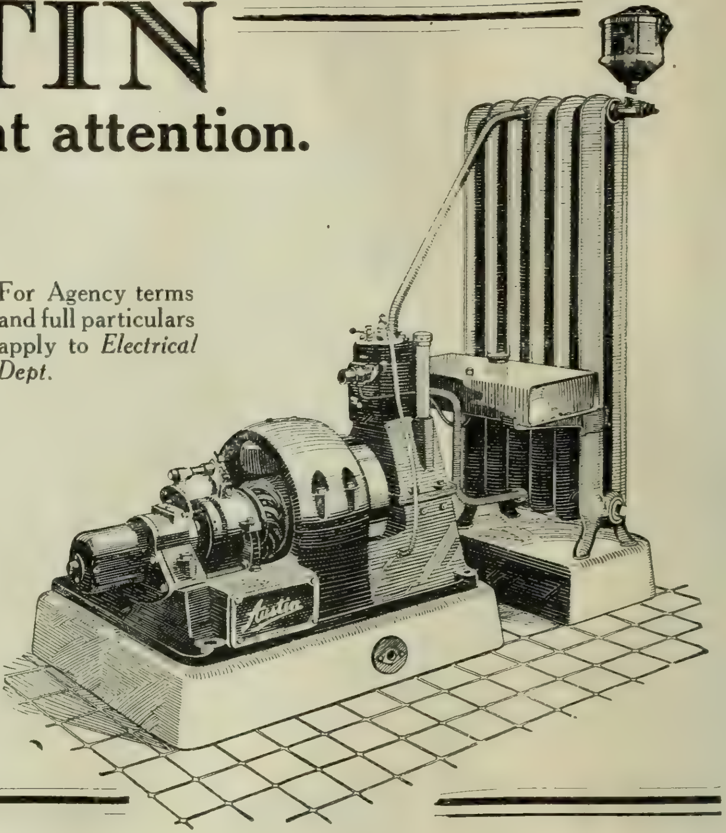

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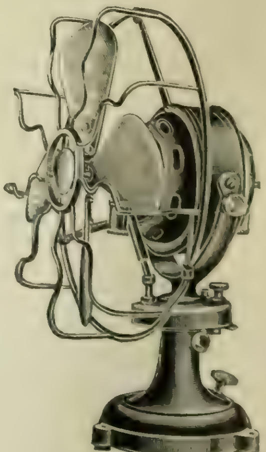

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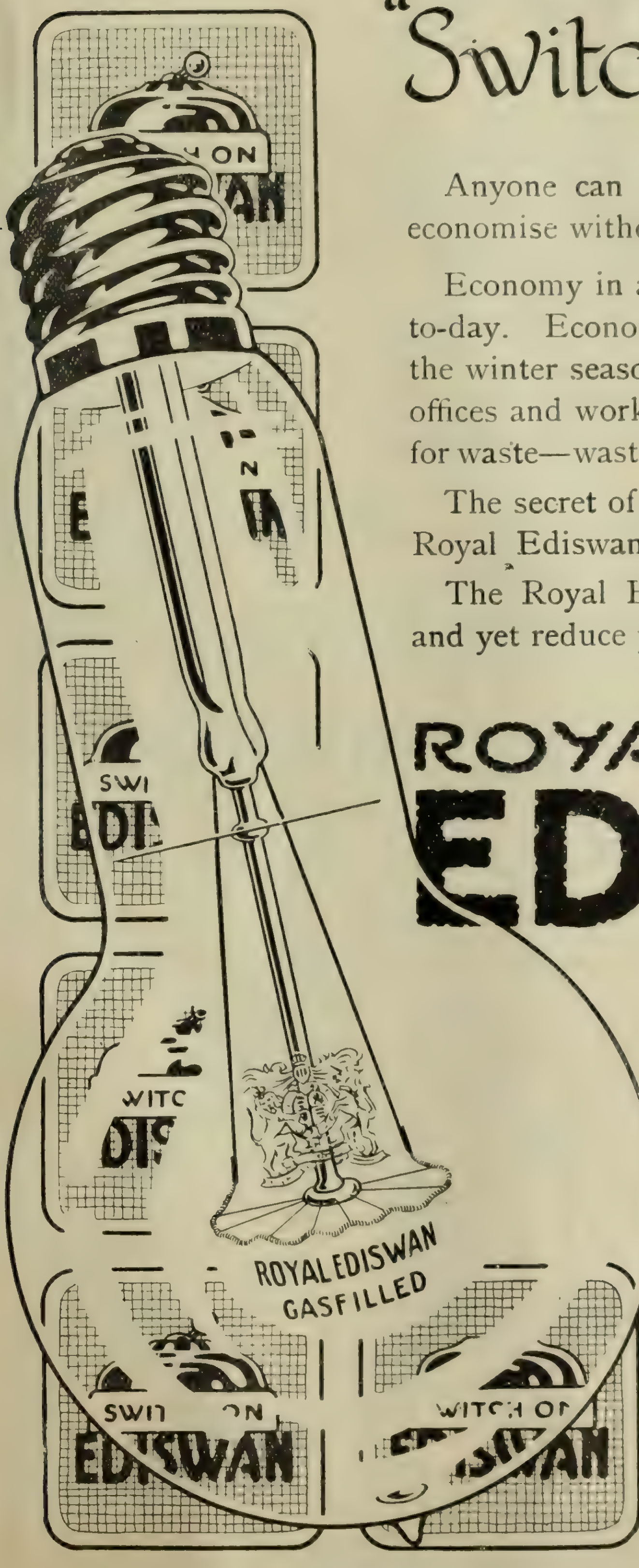

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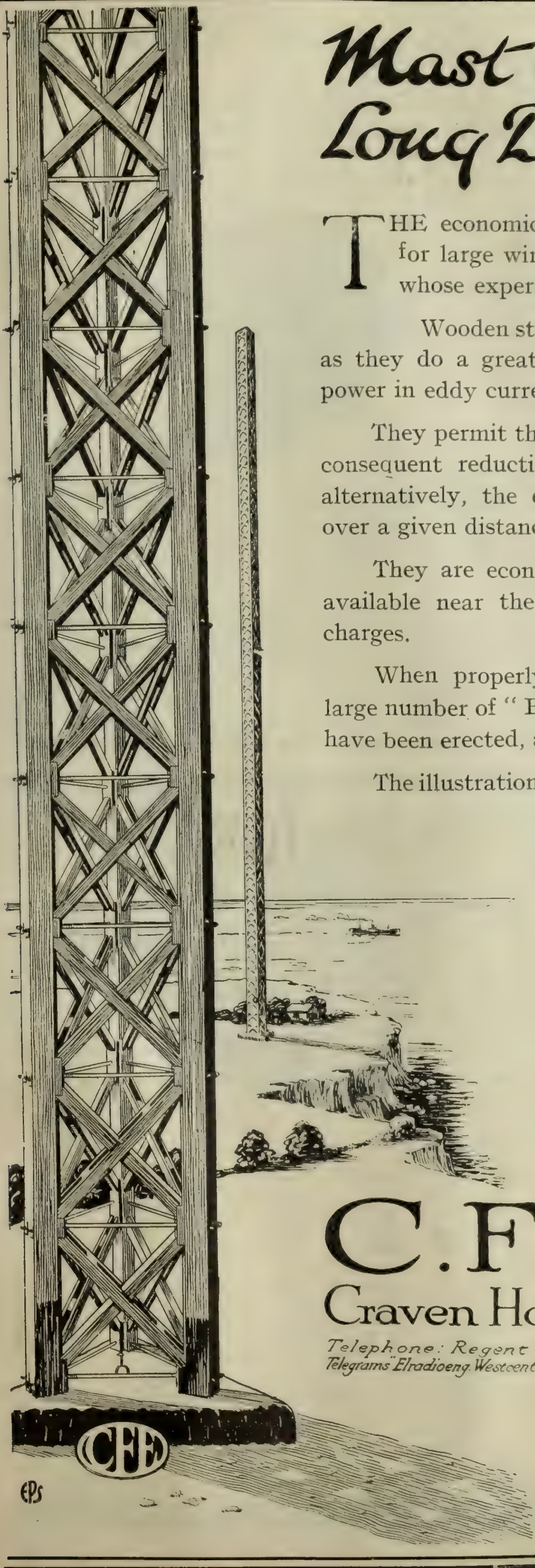

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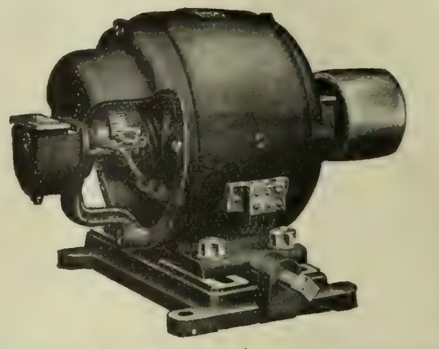

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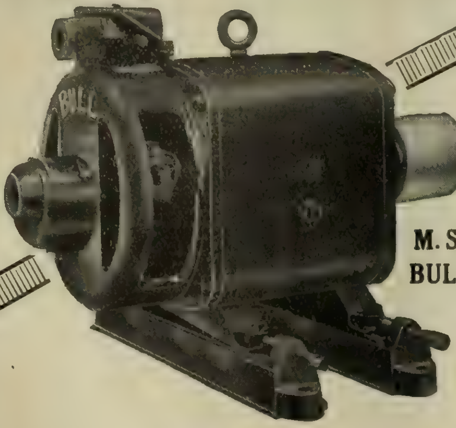

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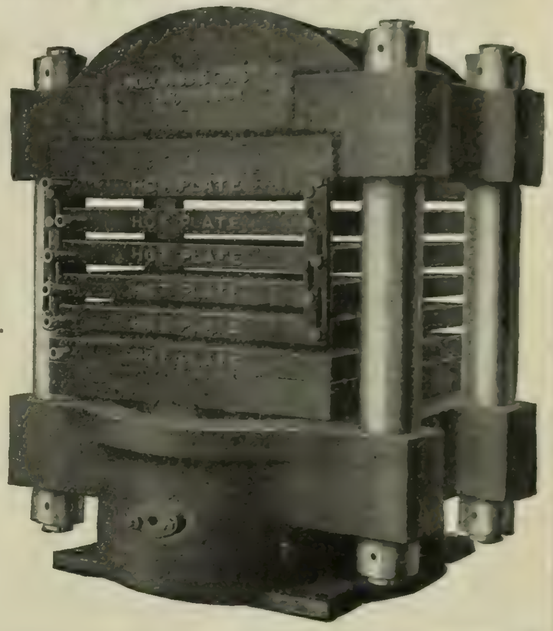

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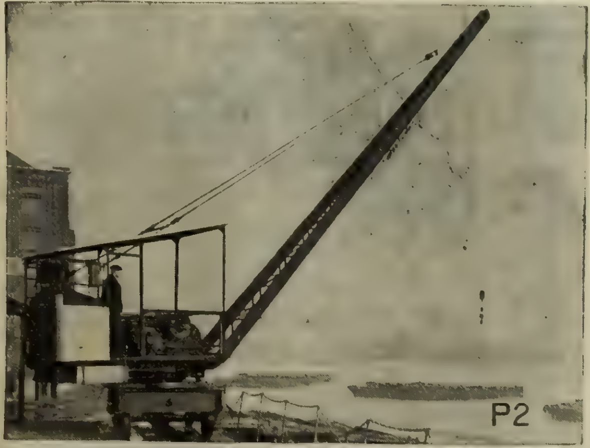

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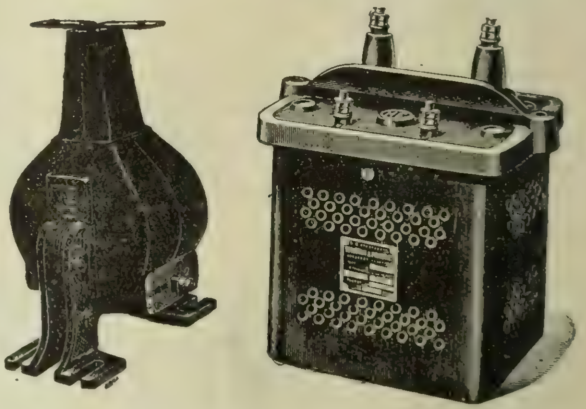

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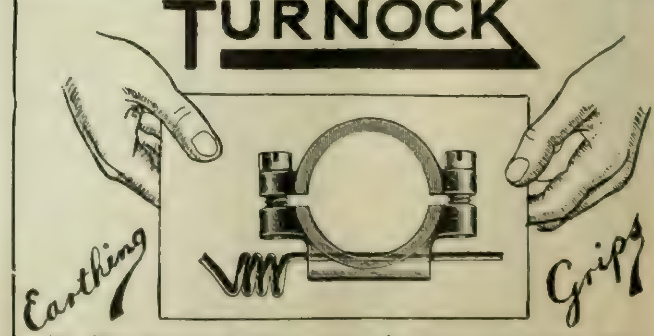

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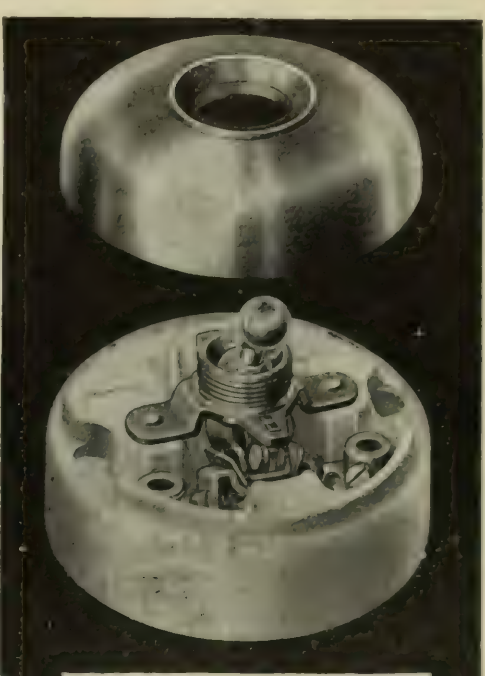

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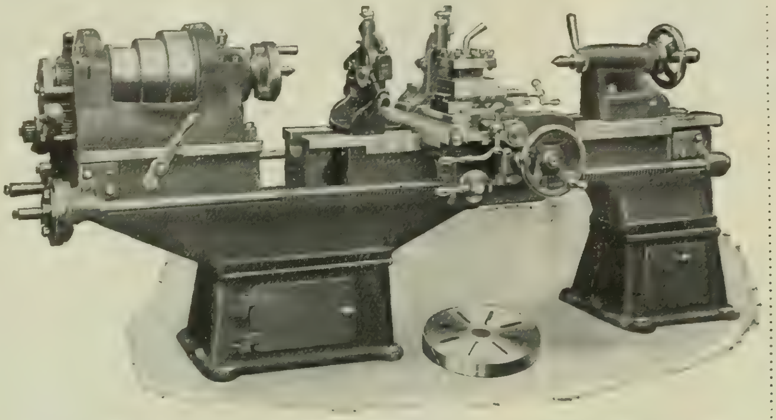

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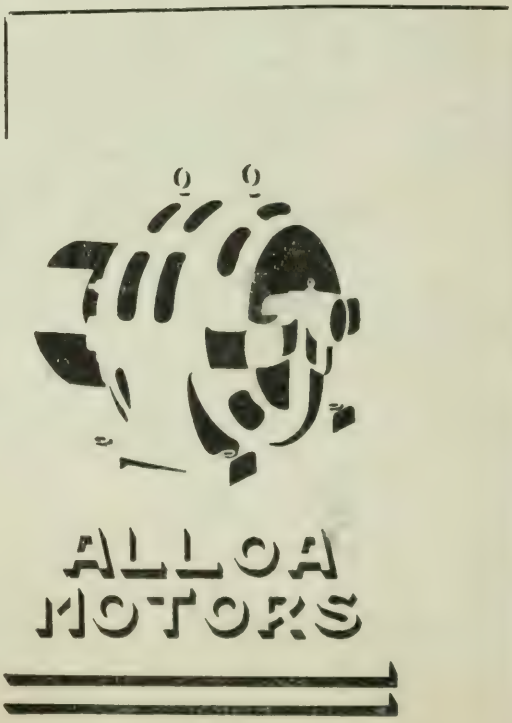

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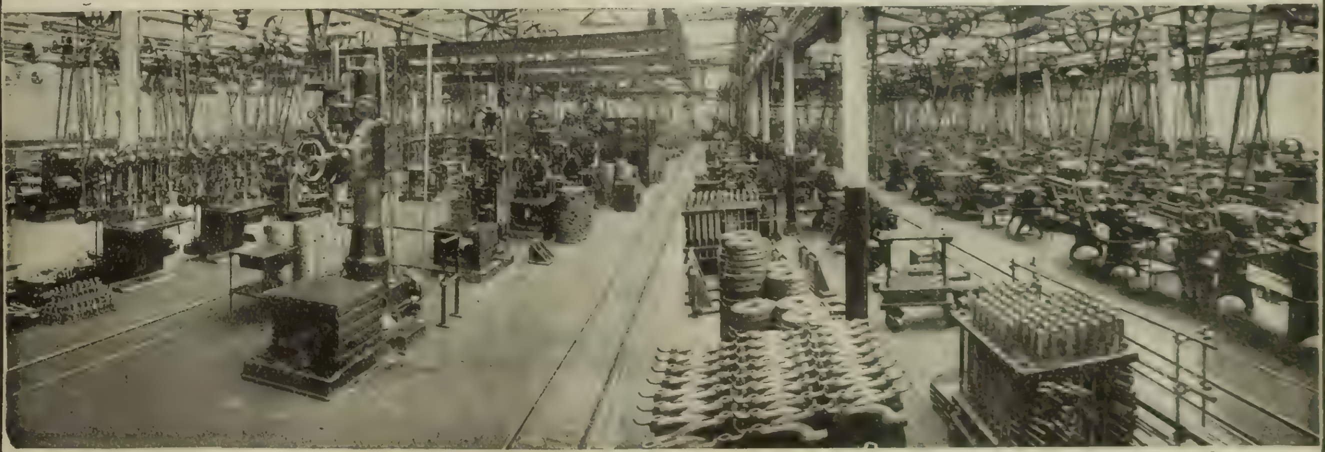

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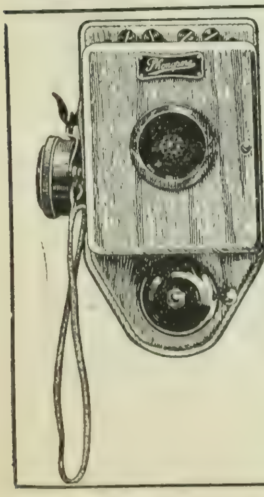

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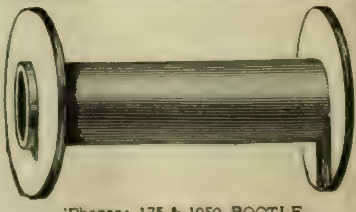

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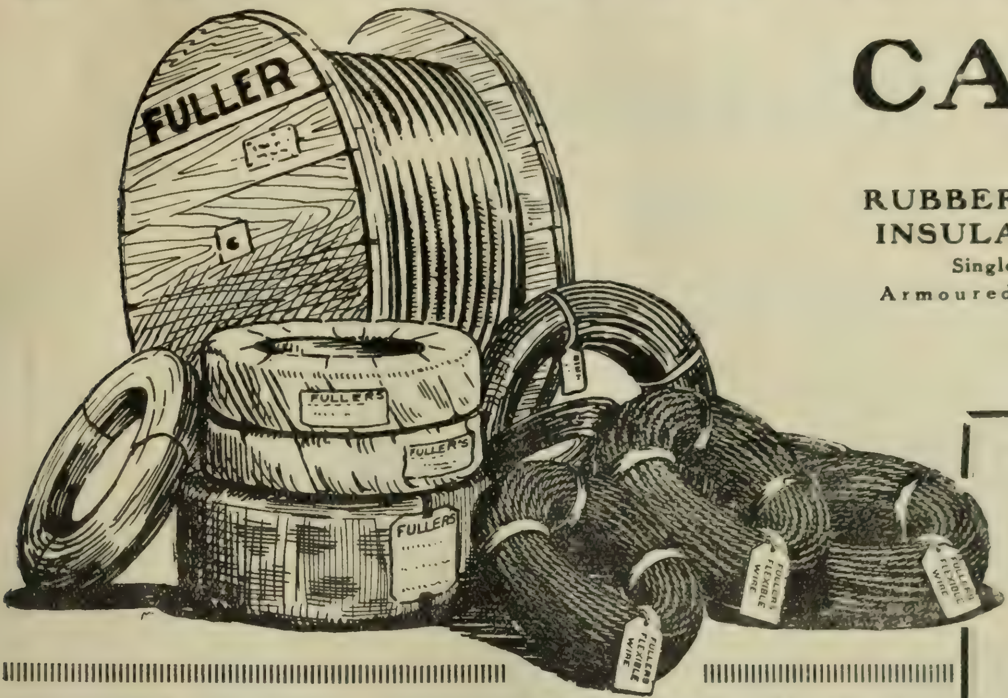

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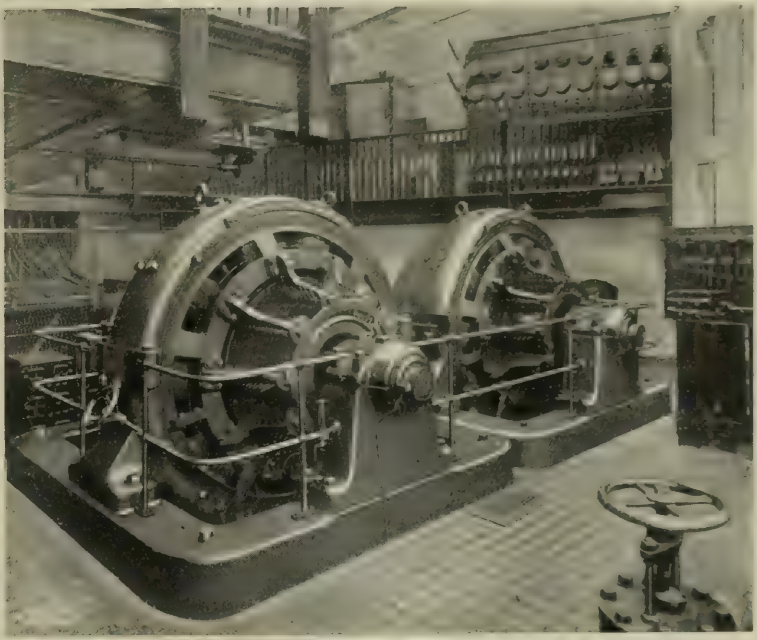

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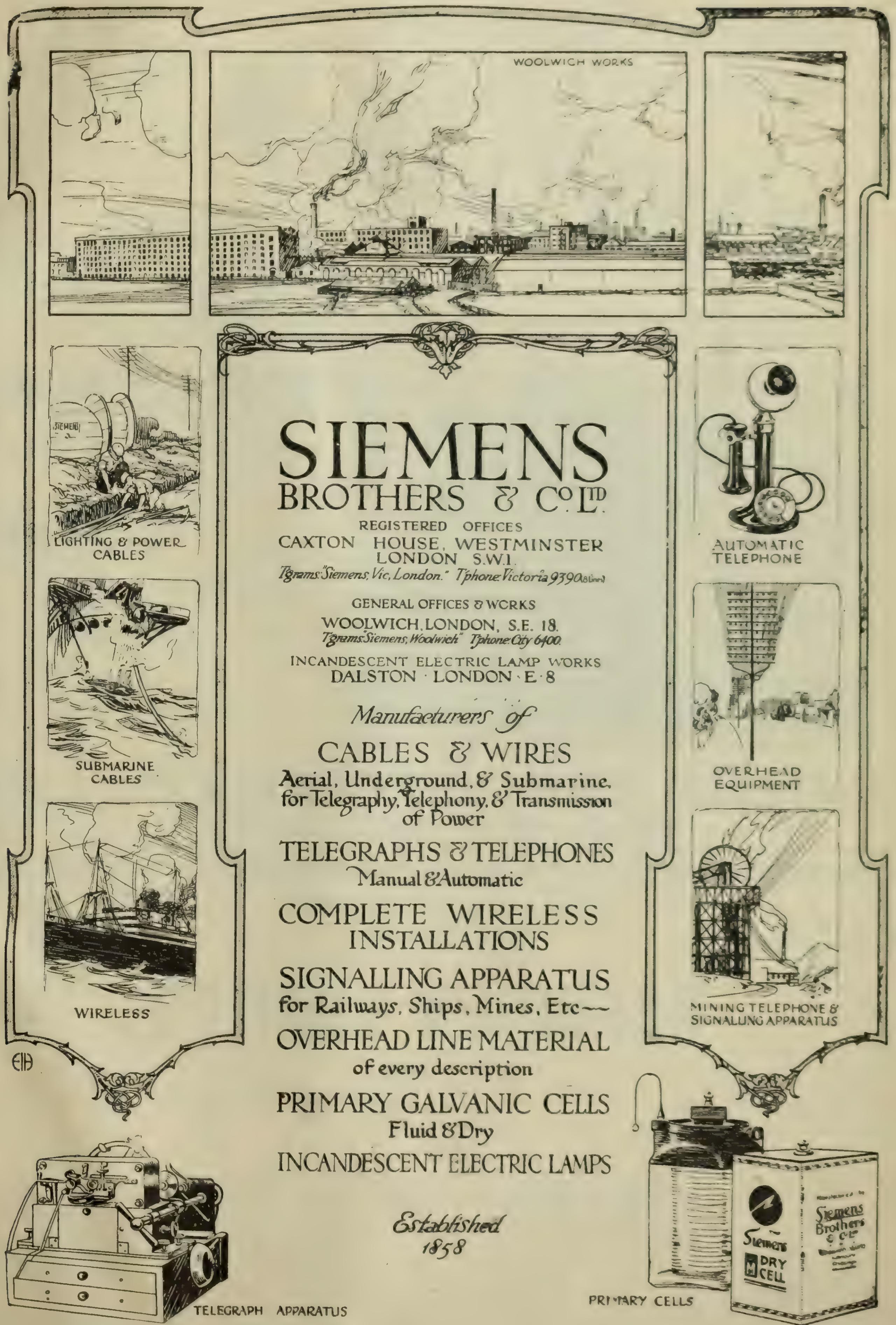

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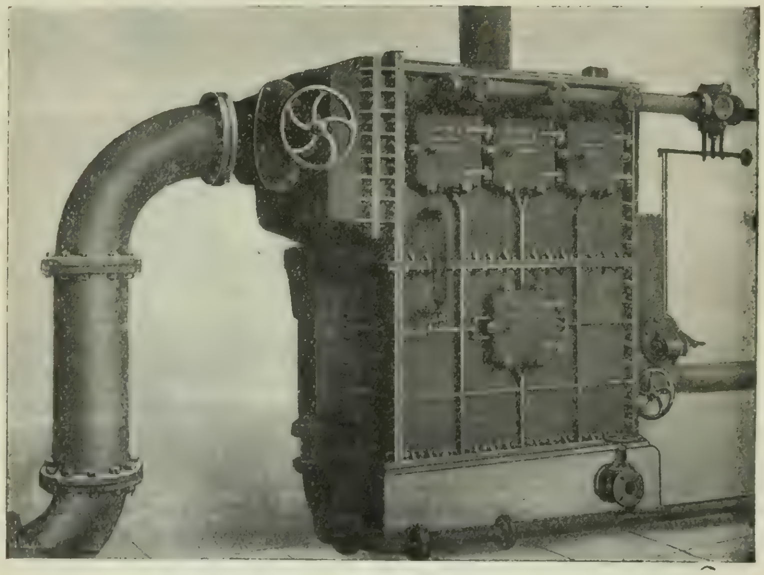

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Notes.

Submarine Cable Progress.

THE fact that the Eastern Telegraph and its associated companies were able to report at the annual general meetings last week record receipts for the year 1919 proves that the submarine telegraph service has not yet been seriously affected by the developments which have occurred in wireless telegraphy, and probably it will be many years before there will be any serious competition between the two systems. In speed, secrecy, efficiency and reliability the older method of transmitting news and intelligence still possesses advantages over its more modern rival, though it is true for various purposes radio telegraph services are employed as feeders for the submarine telegraph companies. It is not surprising therefore to learn that the gross receipts of the parent company, the Eastern Telegraph Company, were £694,000 more than in 1918, and were over £2,000,000 in excess of the year 1913. Similarly, the Eastern Extension Company's gross revenue was £376,000 over 1918 and the increase, compared with 1913, was over 300 per cent.; while the Western Telegraph Company were able to record an increase of £719,000 in gross revenue over the previous year. In each case there was, notwithstanding a heavy increase in the expenses, a larger net income, and dividends of 10 per cent. for the year were declared, compared with 8 per cent. in 1918, after making ample provision for reserve, depreciation of capital investments, &c. This highly satisfactory state of affairs is due to careful management and prudent methods of finance in the past, and judging by the directors' reports and the records of the companies, the Eastern group were never so firmly established and their prospects never before so bright as at present.

New Cables and Repairs.

THOUGH the work of repairing and renewing old cables and laying new ones was held up by the war, in the prosecution of which, by the way, the companies rendered invaluable services, each of them has been seriously at work during the year under review in carrying out renewals and in laying new cables, &c. For some time after the Armistice there were complaints of delay in the handling of commercial messages, especially to the East. This delay, which was due to the heavy Government traffic having priority over ordinary messages, to the bad state of repair of some cables, and to the fact that some of the lines of the Great Northern and Indo-European Telegraph Companies were out of use, has now been greatly minimised, if not eliminated. The Eastern Company has embarked upon a heavy programme of cable-laying and renewals; it has laid a new cable between Porthcurnow and Gibraltar and has effected a partial renewal of some of its main line cables: it has laid additional cables from Malta to Alexandria and from Aden to Bombay at a cost of about £1,200,000. Other improvements and extensions are being carried out and the Eastern Extension Company is also laying a new cable of large carrying capacity between Madras and Singapore. Among other steps taken to improve the service is the equipment of a new cable-laying and repairing ship, the "Lady Pender," which was brought into use during the year. A substantial portion of the heavy cost of these improvements and new cables is being met out of reserve, and it is anticipated that when the whole scheme has been carried out the companies will be able to give even a better service than in pre-war days. The Western Telegraph Company is engaged on a somewhat similar task of expansion and development. A length of about 1,000 miles of one of the cables between St. Vincent, Cape Verde Islands, and Pernambuco has been renewed; additional cables are to be laid on the Brazilian coast between Pernambuco and Maranham, Pernambuco and Maceio, Rio de Janeiro, Victoria and Santos, &c.

Rival Cable Companies.

THE new cable laid by the Western Company from North Brazil to the Barbados has aroused a good deal of jealousy and rivalry in certain circles in the United States. The Western Union Telegraph Company proposed to lay a cable between Barbados and Florida, which would join up with the Western Company's line, but the U.S.A. Government prevented the Company from landing it on the American coast, because it was alleged that the Western Company held exclusive rights from the Government of Brazil for submarine cable communication. Though the Company possesses exclusive rights for certain local services it is difficult to see how it can be maintained that it has a monopoly of international communication, for another American Company and two French Companies own international cables which land in Brazil and we suspect that commercial rivalry may have more to do with the question than the reason given. Anyhow, the cable is at present buoyed at a point outside the territorial waters of the U.S.A., pending the completion of negotiations between the parties. The line would form an important link in an alternative route connecting South America with Europe, and as it would assist in maintaining a regular service of commercial and trade intelligence it is to be hoped that a way out of the difficulty will be found.

International Cables.

The dispute, as well as the difficulty over the allocation of the former German cables, shows what importance is still attached by Governments as well as commercial interests to the maintenance of submarine cable services. We recently referred to the question of the ex-German cables and at that time we were under the impression that a friendly agreement would be made between the interested powers. Apparently we were mistaken, for the Communications Conference, which has been sitting at Washington for over 10 weeks, has now broken up without result and the present handling of the cables will continue until March 15th next, when, unless an arrangement has meanwhile been made, a fresh international conference will be convened. It was found impossible to reconcile the rival claims of the Government of the U.S.A. on the one hand and those of Japan and France on the other. The conference was marked by a series of disputes which on many occasions reached a deadlock. The British delegates endeavoured to act as mediators, the British interest in the discussion being confined to the Halifax-Penzance cable, which Great Britain was willing to give up in exchange for an American cable landing in Canada. In fact, if the other Powers had been willing the British representatives could have settled their part in the dispute early in November and have retired from the Conference, but the cables were treated as one subject. As Japan was opposed to any intervention on the part of any other power in Yap Island, no solution could be found.

The French Attitude.

The French also adhered to their original attitude, although the Americans were willing that France should retain her share of the ex-German New York-Azores-Brest cable if she permitted its extension by the United States to Central and Northern Europe, with a proposed landing in Denmark. France did not object to this, but refused the Americans' demand that messages intended for such destinations, which would only be relayed through Brest, should be handled there by American, and not French, operators. The Italians requested the extension of the Azores cable to some place in Italy, possibly Genoa. But in view of the complications and lack of agreement on the other points raised by other powers no agreement was reached in regard to the Italian demands and the Conference broke up without result. The rivalry displayed throughout the proceedings as well as the activity of all cable companies in carrying out extensions and renewals proves that the submarine cable is still very much alive as a means of international communication.

The Pre War Electricity Supply Contracts.

Electricity supply companies will read with pleasure the report of the judgment, given in another column, of Mr. Justice Lawrence, annulling three agreements which were made in 1904, 1906 and 1911 respectively by the North Metropolitan Electric Power Supply Company for the supply of electricity in bulk to the Stoke Newington Borough Council. The agreements were entered into before the "coal clause" came into general use, and when the company was anxious to increase the number of its consumers. Naturally the company's position was seriously affected by the war; the price of coal increased from 17s. 6d. in 1914 to 58s. 10¾d. per ton in 1920, and wages advanced in a similar ratio. The result was that, according to the company's estimate, they were losing over £2,600 a year by supplying the Council, and, as they failed to come to a friendly arrangement with the latter, they applied to the Court under the Courts (Emergency Powers) Acts of 1917 and 1919 for relief. After a careful review of the facts, the Judge held that there had been such an alteration of trade conditions owing to the war that it would be a serious hardship upon the company to enforce the terms of the agreements, and the case, therefore, came within the ambit of the Acts.

A Power to be Sparingly Used.

We fully appreciate the Judge's reluctance to interfere with contracts. The facts were, however, somewhat peculiar, and at least two of them were the result of agreements made in the early days of power supply, when Power Companies were developing the "bulk" supply demand. At the time the parties did not, and could not, have contemplated such a radical change of circumstances as that brought about by the war, and as the altered industrial conditions were proved to have been the cause of a heavy annual loss to the company, we think it just and equitable that relief should have been given from the onerous conditions of a long-term contract. We agree with Mr. Justice Lawrence that this emergency power is one which should be sparingly used, and, that only under the stress of very urgent causes should the Government interfere in any agreement made by two parties of full legal capacity. However, we think that the position of the North Metropolitan Company, and similarly situated companies, justifies the exercise of such a power. In future the situation will, no doubt, be clear enough, for it is now the custom to introduce coal and wages clauses into all supply agreements, and thus the cost of electricity will go up or down automatically with the increase or decrease of the works' costs.

Progress in Lamps and Lighting.

The opening meeting of the Illuminating Engineering Society each session is customarily devoted to reports of progress and the exhibition of novelties in connection with lighting and photometry. The proceedings on December 14th were no exception to either rule, for the meeting furnished good indications of progress and provided some interesting exhibits. A feature of Mr. Leon Gaster's opening address was the account of work done during the vacation, largely through the agency of joint committees, of which a considerable number have now been formed. At the same time it is evident that the international relations of the Society are being resumed, one item of news being that the section of industrial hygiene operating under the International Labour Office of the League of Nations at Geneva is devoting attention to industrial lighting. This latter subject has been much to the fore lately and seems destined ultimately to be treated on an international basis, as the requirements in all the leading countries are substantially the same. The report presented at the meeting by the Committee on Electric Lamps and Lighting Appliances takes a hopeful view of the present position in regard to the manufacture of metal filament lamps and fittings. It is satisfactory to note, for example, that the production of gas-filled lamps has increased five to six times during the past year. We should, however, like to receive some fuller data regarding the performance of such lamps, especially those of low wattage; while a glance at many of the shop windows in London is enough to show the need for the Illuminating Engineering Society to continue its efforts to educate the consumer in the best methods of *using* these lamps.

The Institution Subscription.

Members of all classes of the Institution of Electrical Engineers must prepare to pay increased subscriptions from the beginning of the New Year, and we have no doubt they will cause a minimum of embarrassment to the Council, the Honorary Treasurer and the Administrative Staff if they pay up both pleasantly and quickly as Mr. Purse has announced his intention of doing. For Mr. Purse is now a reformed character. At the confirmatory meeting on Friday last he explained that he had really only opposed the resolutions of the Council in the Pickwickian sense, and that now having done his duty by his followers he was prepared to support the Council through thick and thin. Nevertheless, the opposition was not entirely silent. Mr. Joseph, whose more appropriate name should surely be Jeremiah, pointed out the need for retrenchment in view of falling prices, and protested against the undemocratic position of the rich life member. The meeting heard him patiently, which was the most that he could expect. We are not at all certain that the most interesting point was not made by Mr. A. H. Allen, who elicited the information that the cost of circulating the proxies for the first meeting was £65, and for the second £55. He wisely refrained from commenting on this and we shall do the same, but apostles of economy might please note.

The Engineers' Club.

The proposal to form an Engineers' Club in London is gradually leaving the realms of the abstract for those of the concrete. From the correspondence that has been received both by ourselves and our contemporaries and from what we have gathered in conversation in many engineering circles, it is evident that there is no objection at least to the principle of such a social institution being inaugurated at the earliest possible moment. We have already said that we are in hearty agreement with the proposal, which we shall support with every means in our power, and we sincerely wish success to the new venture. But in order that that success may be obtained certain pitfalls must be avoided. Membership must not be confined within too narrow limits, any tendency to "cliquishness" must be checked, comfort must not be displaced by inordinate decoration and the cold welcome of the baronial hall, the service must be good and speedy, the subscription must not be too high—nor too low.

A Great Opportunity.

It will be said that this is too idealistic to be possible. But of this we are certain: no Engineers' Club in London can be either a financial or a social success if those responsible for its management are going to follow slavishly all the moth-eaten and wasteful methods which are traditional in so many of similar institutions in the metropolis. This is not a good time for starting clubs, and many clubmen are earnestly considering from how many clubs they can resign, rather than how many fresh ones they can join. This is at once a disadvantage and an opportunity for an Engineers' Club. For though it may make obtaining members difficult at the outset, if the committee follows the policy of doing their best to please members, and the members do their best to coalesce with one another, its waiting list will soon assume extraordinary proportions. And then at last we shall be able to find a comfortable place to have dinner after an Institution meeting, and a place, also, where the hospitality of the engineers of this country may be extended to international visitors.

Electrical Benevolence.

We could almost write an account of the Festival Dinner of the Electrical Trades Benevolent Institution without attending that function. Each year we see the same old faces and hear the same old speakers. Each year regret is expressed that the amount subscribed is not larger, and each year there is the same resolution to do better next time; a resolution which unfortunately is never fulfilled. This year was no exception. The President, Mr. E. Manville, M.P., drew some distressing comparisons between the motor trade, where a sum of £85,000 is available for relieving distress, the civil engineering profession where a fund of £100,000 exists for the same purpose, and the electrical industry which in fifteen years has only been able to scrape together £37,000 for relieving those who through no fault of their own may require assistance. Matters would be even worse than they are were it not that very few demands have so far been made upon the fund. That state of affairs cannot continue to exist; and when it ceases the Fund will find itself in the same position as the celebrated Mr. Montague Tigg under somewhat similar circumstances.

The Need for Greater Publicity.

The position on Wednesday reminded us of the preacher who points out to a meagre congregation the need for regular church attendance. The withers of the non-attendants remain unwrung because they do not feel the blow. Most electrical engineers we feel sure are not ashamed of their lack of support of the Benevolent Fund simply because they are not aware of its existence. This must be changed. As Mr. Fletcher rightly said at the dinner the basis of the Fund must be broadened and some way must be found of tapping the untold thousands who do not contribute to its support. Might we suggest that what is wanted is not sporadic effort centering round a Festival Dinner, but constant pressure from a body of well organised voluntary supporters who would be responsible for the collection of small weekly or monthly subscriptions from each firm or section of a firm in the electrical industry. Without wishing to disparage in any way the hard work and enthusiasm of the present officials we also feel that much more might be done by a proper system of organisation by an expert. Money getting for charitable purposes is now as much a profession as selling lamps.

A Plea for Real Development.

Those who were present at the lunch given by the British Electrical Development Association last Friday were witnesses of two unusual phenomena: The appearance of Mr. Hugo Hirst in the role of a pessimist and of Mr. Gordon Selfridge as a publicity agent, not on behalf of those thousand and one things that he is in the habit of laying so persuasively before the buying public, but on behalf of electricity as a benefactor. Mr. Hirst, on the other hand, told us nothing about the supply of electricity at small fractions of a penny per unit, but insisted that the outlook was dark. We were passing, he said, through an industrial crisis, when both money and goods were short, an unusual and awkward combination which would at least lead to widespread unemployment. Nevertheless, he felt sure that the world would go on and that electricity would play a great part in national reconstruction. It would therefore seem that Mr. Hirst's pessimism was not so black after all and was more closely allied to the optimism of Mr. Selfridge, than would appear at first sight.

The Benefits of Pessimism.

If, however, we had to choose between Mr. Hirst's pessimism and Mr. Selfridge's optimism we should prefer the former. A pessimist is a much derided creature. For one thing people make jokes about him, which they never do about an optimist. But behind much that is exaggerated, and much that is quite wrongheaded in his composition there does lurk a discontent divine or otherwise, with present day conditions. And it is this discontent which contains the germ of future improvements. For this reason we should like to see a little more pessimism and discontent in certain, not in all, quarters of the electrical industry so that from them there might chance to arise a real desire that the use of electricity should be developed in every possible way and to the fullest extent. A determination in fact, as Mr. Atkinson said, to make every town in this country the equal of Amsterdam, where there is not a single house but is equipped with electric light.

We agree that the presence of this desire, at least among certain sections of the electrical industry, is evidenced by the formation of the British Electrical Development Association and by the work that it has been so far possible for this body to carry out. For in a life of twenty months it stands to reason that much of its work has been of a preliminary character, and that progress has been rendered slower by "boom" conditions in the electrical industry. Nevertheless, both from the fact that its growth must be naturally slow and that it is no good waiting until such a body as this is really wanted to start it, its promoters did well to inaugurate it when they did and to engage on such useful activities as housing, tariffs, design of domestic appliances and the collection and circulation of information.

The Work of the Few; the Duty of the Many.

This, as we have said, is all very well, but what has been and is being done is the result of the work and self-sacrifice of the few for the benefit of the many. That sort of thing cannot continue. A body such as the British Electrical Development Association is of no real value unless it represents the industry as a whole, and unless the industry as a whole both supports and uses it to the utmost of its power. If, therefore, such a body as the British Electrical Development Association is necessary to the electrical industry (and we have no doubt we voice the general sentiment when we say it is necessary) its formation, governance and support must not be the task of the few, but the duty of the many.

The largely attended gathering of Friday, the optimistic utterances and the vociferous applause all show that there is enthusiasm for the development idea, perhaps greater after lunch than before it, but still existing. This in itself is a pleasant change. For the time is not long past, if it is altogether past, when electricity supply authorities, as the late Lord Salisbury said of the British Empire and treaties, granted connections with more or less gracefulness rather than sought them in a business-like manner, or looked after them when they had obtained them. Electrical contractors, too have not shown that enthusiasm for development which would have been for their own good, the good of their consumers, and indeed of the whole electrical industry. Even the manufacturers, though better than the other two classes, have, as often as not, followed methods which have not led to real business being done.

Real Development v. Humdrum Progress.

Are we to believe that this state of things is past? We sincerely hope it is. For if it is not we may just as well give up all idea of real electrical development and content ourselves with that humdrum progress from year to year which comes to all old-established firms who supply a long felt want and are not managed too recklessly.

We are too fond of trumpeting what electricity and the electrical industry has done. It would be more to the point now-a-days to find out what electricity and the electrical industry has still to do and compare what has been done with what remains to do. The result would, we are sure, be startling, and would show that if we are to make any impression on that vast untilled field in reasonable time a British Electrical Development Association supported by the whole industry without prejudice is eminently necessary.

Glare v. Chiaroscuro.

For these reasons we prefer the chiaroscuro of Mr. Hirst to the glare of Mr. Selfridge, though we do not see any reason for real pessimism. For, while the slump in other trades cannot, of course, help affecting the electrical industry to some extent, there is every reason to suppose that there will be an equal or even greater beneficial effect. The slump will mean the substitution of economies for lavish expenditure, the search for ways of reducing the high cost of labour, the desire for better organisation and use of material, the paring down of everything that is not an absolute necessity and the determination that every penny of capital shall give its full worth of productive power.

Under all these headings electricity can help. But its advantages must be brought to the notice of those who can employ it for their own advantage. That is the work of the British Electrical Development Association. But in order that it may do this the Association must be supported by the whole electrical industry. This support at the present time contains too large a proportion of lip-service, combined with a good deal of platitude and a wealth of pious aspiration. This is dangerous, for it is liable to obscure that what is wanted most is not these vocal qualities but money, energy and hard work. For these there is no substitute. Without them the British Electrical Development Association must fail, with them it will prosper exceedingly, and so will the electrical industry.

Buried Cables Research.

The value of the scientific rating of electrical plant has been recognised ever since the early days of the profession. For, having produced a machine for a certain cost the engineer soon discovered the necessity of determining the maximum possible output of that machine. Considering the vast amount of capital sunk in underground systems, it is therefore a little astonishing that such scant attention has been paid to obtaining the maximum output from this important part of the plant. And this being so it will be agreed that the Council of the Institution of Electrical Engineers made an opportune move in deciding to finance an extensive research into the subject.

An Opportune Report.

Opportune as was the decision six years ago, when the scheme was launched under the aegis of the Research Committee, the report on the results of the research which has just been published is still more opportune. As will be seen from the abstract which appears on another page of this issue the work has been divided between Mr. S. W. Melsom and his assistants at the National Physical Laboratory, Prof. E. W. Marchant at Liverpool University, and Mr. E. Fawsett at Newcastle. A bibliography of the available literature on the subject was published by Messrs. S. W. Melsom & Booth in 1914, and a programme of the research was formulated by the Committee about the same time with the assistance of the National Physical Laboratory. This gave a starting point for much useful investigation, and since then a large amount of experimental work has been carried out, the results being embodied in the sixteen tables and thirty-eight figures of the report now under notice.

DETAILS OF THE RESEARCHES.

The greater part of the investigation was naturally done at the National Physical Laboratory, where twenty-seven different cables were tested, first lying on the floor of a room, and then laid under the various conditions which are typical of the general practice followed in underground work in this country. The work done at Newcastle consisted in the determination of the effects of depth of burying on current carrying capacity of armoured cable, while at Liverpool a series of vulcanised bitumen cables laid solid in stoneware troughing were examined for temperature rise under various conditions.

The report only claims to be of a preliminary nature, and it is well that this is so, for the impression we receive on reading it through is that not only are there aspects, which have not received attention, but along directions actually investigated there is much that is not brought to a logical conclusion. When all is said and done, the object of a research should be to enable us to say what current a given cable will carry under given conditions, and possibly, to assist us in determining and defining those conditions. Any report purporting to deal with such matters will therefore only have fulfilled its function, when the published results enable an engineer, without jeopardising the supply or unduly shortening the life of his cable, to obtain the highest financial return on the capital sunk in the buried portion of his system. As it stands, the report does not go very far in this direction, though in alleviation it may be said that it is not alone in this respect. For this is not the first time that we have had to criticise preliminary researches having been put forward as finished work.

THE PRINCIPLES OF GOOD RESEARCH.

One of the principles of a good research is that it shall lead to a generalisation of some kind, and, although, Mr. MELSOM and Prof. MARCHANT both comply with these requirements to a certain extent, the useful data with which the report is packed is generally undigested. We feel that it is a mistake to divorce practical results from theoretical considerations in any research, for after all the analysis of results and their interpretation by means of a comprehensive theory should be the true criterion of the value of both investigation and investigator. The omission is so obvious in the heating of Buried Cables Report that we think it would have been better to have limited the scope of the investigation to a narrower field and to have carried one of the branches dealt with nearer to a practical conclusion.

As an example of what we mean, we may cite a paragraph on the effect of armouring in which conductor temperatures with various currents have been obtained for a 10,000 volt cable in both the armoured and unarmoured state. If required for a different size of cable from the one tested or for use with a cable buried, the results in the form in which they are given may be positively misleading, whereas, if they had been carried out to specific constants for the thermal resistivity of the armouring, and made more general, they would have been more widely useful.

WEAK STAFF WORK.

We are afraid the faults of the report are largely due to weak "staff work." Mr. EDISON's prescription of 98 per cent. of perspiration is there, but we miss the 2 per cent. of inspiration. What comparison is there, for instance, between the work on ground temperatures and that carried out by MATSUMOTO at Tokio a few years ago? It is usually accepted as a feature of good research work that only one independent variable should be verified at a time, but violation of this principle, which we admit is difficult—as, for instance, in dealing with seasonal changes of ground conditions leads to confusion of the results. If the temperature and moisture content of a soil are both allowed to vary, the influence of either on the current carrying capacity of a cable can not be deduced with any degree of certainty.

FACTORS FOR CONSIDERATION.

There are many factors to be considered in a research of this kind. Some are of the nature of constants, such as the safe working temperature of the dielectric and values of thermal resistivity of the different materials used in cable making. These are more or less under control, but other variables are quite out of control, and involve intelligent appreciation of the limitations which they impose. Among the latter, are the effect of moisture content on the thermal resistivity of the ground and the correct ground temperature to be adopted as a datum line. It seems to us that the foundation on which the research should have been built is the consideration of the safe temperature at which a cable may be worked. The report throws very little light on this important matter. A few paper samples have been tested for the effect of heat treatment on the tensile strength of this material, but it is not certain that the tensile strength of paper is the criterion which limits the life of a buried cable. Having come to some definite conclusion on this fundamental matter, the next step will be to determine the effect of the other factors, nature, shape and thickness of dielectric, effect of armouring, &c., &c., the effect of each change being compared for a wide range of sizes. Above all, each step must be connected with the fundamentals of the problem by some definite link.

The results of much of the investigation of three-core cables depends on a somewhat complicated formula, which appears to have been accepted without verification, although, to our knowledge, results obtained from it differ considerably from those obtained by the use of a formula published by another acknowledged authority on the heating of buried cables. In any case, it seems doubtful, whether such a formula will apply to a cable in contact with a heat conducting surface, as in the National Physical Laboratory tests "in air." The method of suspending the length adopted by Prof. MARCHANT seems to promise more reliable results.

ITEMS OF INTEREST.

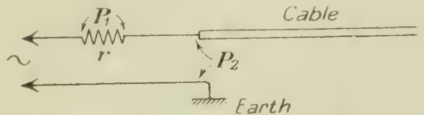
The pertinacious reader, with a certain amount of leisure will find much of real interest in the report. For instance, the increased carrying capacity of a cable obtained by burying is greater with a low tension than with a high tension cable owing to the conductor of the cable with the thinner dielectric benefitting more by the cooling of the soil than the conductor, which is more thickly covered. Also, as the rate of temperature rise of a cable in ducts is more rapid than when laid solid or direct in the ground, it follows that for intermittent loading—the usual case—a cable laid in the ground will be better able to carry peak loads than one in ducts.

Not the least interesting part of the report is the statement on the work outstanding, and, as several investigators have been busy outside our own country since the bibliography of the published work was issued in 1914, we suggest that the research be extended to the preparation of an up-to-date bibliography of the subject. A very comprehensive research has for instance been carried out in Japan, and the Americans are frequently publishing results of the investigations. A list of such references incorporated in the next report would not only be useful to readers, but the information so collected would no doubt be of considerable assistance in actually bringing the research to a successful issue. There is a good deal more work to be done, and now that the Electrical Research Association have taken over the investigation under peace conditions, we hope they will not be long in producing a report which will provide the means for overcoming, most, if not all, of the present difficulties of this important question.

The Impedance of Submarine Cables.

By DOUGLAS C. GALL.

The characteristic impedance of submarine cables is a subject upon which little actual experimental work appears to be available. Probably this is because of the difficulty in getting access to laid cables, for the purpose of testing. This is an unfortunate handicap, for, as recent tests have shown, a very wide field for research lies at the bottom of the sea. In April last a series of tests upon the cables leaving the Eastern Telegraph Company's station at Porthcurno was made, which has given a better knowledge of the impedance of submarine cables than has hitherto existed.



Impedance of Cable. $Z = \frac{P_2}{P_1} \cdot r$

Phase Displacement between P_1 & P_2 measured direct on Phase-shifter of Potentiometer.

Fig. 1.

Dr. Drysdale's alternating-current potentiometer * was used for testing the impedance, the cable being fed from a source of alternating current through a non-inductive resistance, and the potential drop across this resistance, and the potential at the sending end measured upon the potentiometer. Fig. 1 shows the diagrammatical arrangement. For the lowest frequencies for which a suitable phase-shifter was not available a bridge method was used.

Since making these tests Mr. Tinsley, realising the importance of the low frequency testing, has devised a new form of very low frequency sine-wave generator and furthermore has extended its application to a direct reading alternating current potentiometer, with which it is hoped shortly to carry the tests down to extremely low frequencies.

Table I.

Frequency.	Impedance.	φ.
5·0	560·0	41·4
10·0	405·0	40·2
16·6	324·0	39·5
25·0	271·0	38·6
40·0	207·0	37·4
70·0	175·0	34·6
125·0	139·0	30·8
225·0	114·0	26·7
450·0	92·4	20·9

Table I. is a set of readings of the impedance of one of the large core cables whose total length is about a thousand miles and whose constants for the first 50 miles are given in Fig. 2. These constants are those measured by direct-current methods at the time of installation. Table I. gives the actual impedance at various frequencies, measured at the sending end.

Range of Tests.

The impedances of eight cables were tested in this manner, and of these two are here selected as covering the longest range of frequency. The second having the constants given in Fig. 3 measured by direct current methods, at the time of installation, gave values of impedance at the various frequencies shown in Table II. In the particulars of the constants by direct-current measurement of the cables the core-ratios of resistance divided by capacity are given; since these are the only constants known, and it is upon these ratios that it has been the practice to calculate the impedance of the cables, assuming that as the insulation was so nearly perfect and the inductance so very small, they might be neglected. These two cables are each over a thousand miles in length, so that they become for practical purposes infinite to even the lowest frequencies.

The Impedance of an Infinite Cable.

The impedance of an infinite cable is given by the expression :—

$$Z = \sqrt{\frac{r+jx}{g+jb}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where r is the resistance, x the reactance equal to $2\pi fL$, g the conductance, and b the susceptance (f is frequency, L inductance and C capacity).

In the case of the submarine cable it has been usual to contract this to :—

$$Z = \sqrt{\frac{r}{jb}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Since x and g were neglected.

This gives a numerical value to the impedance of—

$$Z = \frac{1}{\sqrt{2\pi f}} \sqrt{K}$$

where K is the core-ratio.

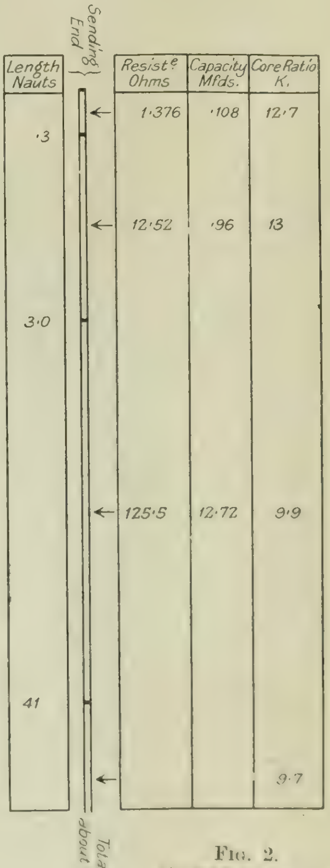


Fig. 2.
Constants of Cable No. 1. By Direct-current Measurements.

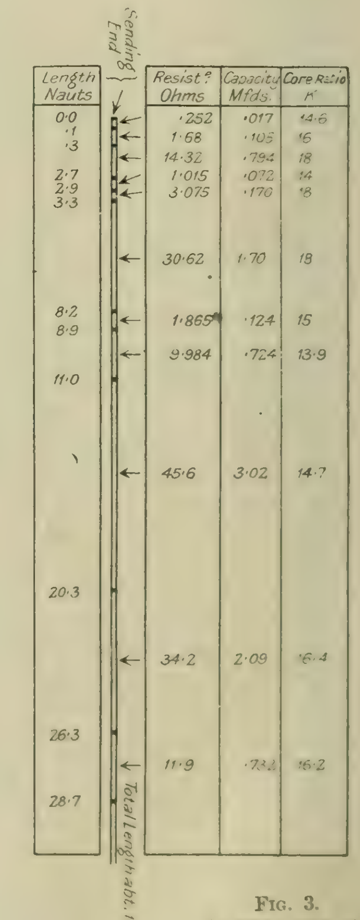


Fig. 3.
Constants of Cable No. 2. By Direct-current Measurements.

Usually K is in $\frac{\text{ohms}}{\text{microfarads}}$ so that the numerical value of the impedance becomes :—

$$Z = 399\sqrt{\frac{K}{f}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The argument of the impedance will be $\sqrt{j}$ or 45 deg. at all frequencies.

In Fig. 4 the locus of the impedance observed in Table I. is

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* See The Electrician, August 1, 1913, May 7, 1915, &c.

Table II.

Frequency.	Impedance.	φ.
5·0	708·0	43·1
10·0	514·0	42·0
15·0	418·0	41·9
16·6	395·0	42·0
20·0	365·0	41·5
25·0	329·0	40·9
30·0	305·0	40·5
40·0	265·0	40·9
50·0	235·0	40·3
60·0	216·0	40·8
300·0	110·0	27·5
500·0	96·0	23·0

plotted, and the frequency marked against the curve. On the same diagram impedances calculated from the usual formula (3) are plotted on a straight line at 45 deg. By plotting in this way the discrepancies between the observed and values calculated upon the usual assumption are readily comparable.

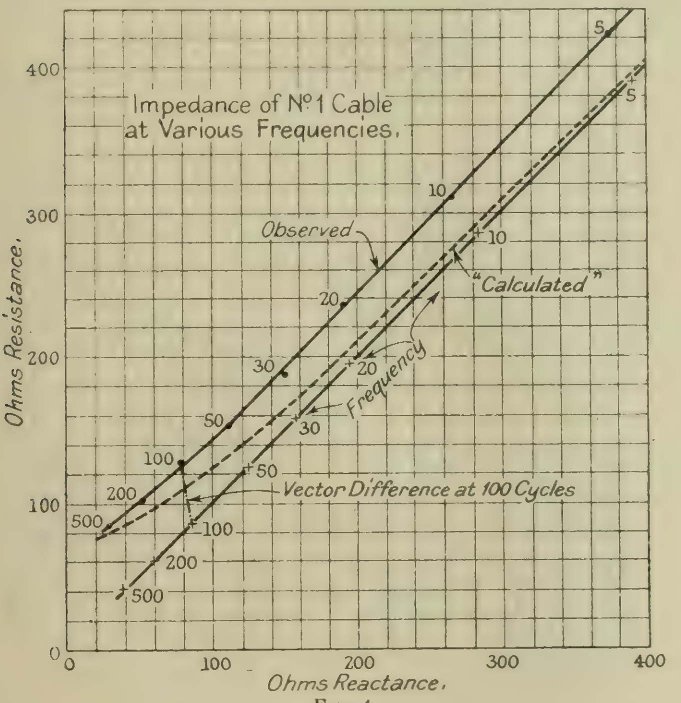

FIG. 4.

If a small amount of inductance is included in the equation (1) the locus of impedance bends up at the higher frequencies as shown in the dotted curve. It is found upon substitution of values of Z in equation (1) that no rational values of the four constants hold for even a small range of frequency. This means that the "constants" of the cable change their values with the frequency, and cannot therefore be regarded as constants for the purpose of numerical calculation over varying frequencies.

RESULTS ON A HETEROGENEOUS CABLE.

Much greater irregularity is apparent in the impedance values of cable 2 than in the former example. If the details of the cables are examined it will be noticed that this second is of very heterogeneous construction, being full of jointings of various size pieces. The cause of the irregular values probably lies in the reflections taking place from the change of core constants occurring at these joints. In the former case the cable is of much more uniform construction, and this effect therefore not pronounced.

The importance of the instability of the cable constants is very great. Its effect is immediately felt in the duplexing of the cable, and various "fakes" and devices have to be added to the artificial line which is constructed to reproduce the core-ratios of the cable found from direct-current measurements. These "fakes" fill in, in effect, the vectors of impedance which lie between similar frequencies in the locus curves in Fig. 4. For instance, in the case of the first cable for impulses of a frequency of 100 a "fake" is necessary which gives the artificial line an additional impedance equal to the distance between the point marked 100 on the observed curve and the point marked 100 on the calculated curve. Not only must it have this numerical value, but produce the phase-displacement of this vector also, if the balance is to be perfect.

The difficulty of adding devices to an artificial line which behaves as a theoretically perfect cable is thus clearly shown, since what is required at one frequency may be quite different from the requirements at another, so that a selective arrangement is essential. This is effected to some extent by placing the "fakes" at different parts of the artificial line—the lower the frequency the more remote the "fake."

The use of the square-topped impulse for signalling introduces a whole gamut of frequencies with each closing of the key, and unless the artificial line offers exactly the same impedance as the cable to every one of these, the recorder at the sending end will be disturbed, and the duplex working very difficult.

SUMMARY OF CONCLUSIONS.

In summarising the conclusions which present themselves in consequence of these tests, the following may be said: The measured impedance of the submarine cable differs in both magnitude and phase-angle from the calculated value, when such calculation is based upon the cable constants of resistance and capacity measured by direct-current methods. This is shown by the change of phase angle with frequency. In general the angle was found to decrease with increasing frequency. Several general tendencies are obvious throughout the tests, but it does not seem probable that the behaviour of any particular cable could be predicted with any degree of accuracy in regard to its impedance and phase-angle at various frequencies, upon a knowledge of its core-resistance and core-capacity measured in a tank, nor from its dimensions—the tests called for in the usual specifications.

Investigation into dielectric losses, shielding effect of brass tape, armour, and sea-water, and the effective increase in the resistance of the core resulting therefrom, and its dependence upon potential, current and frequency, may permit of dealing with greater certainty with the behaviour of new cables, but it is probable that variation in materials, complex secondary phenomena and reflection consequent upon the unavoidable jointing of different cable sizes of different constants would introduce ambiguous effects which from their inherent nature could not be amenable to exact calculation.

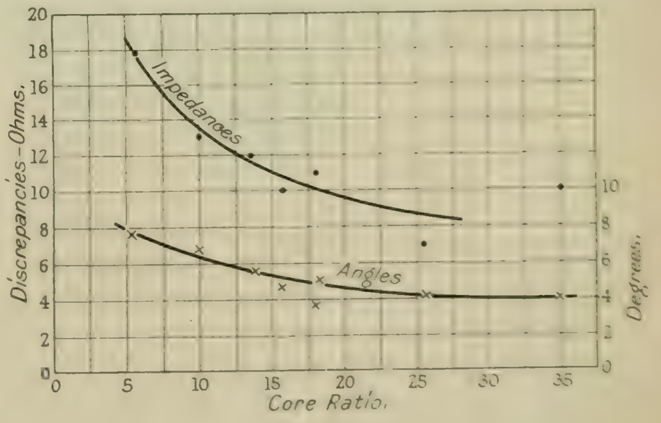

FIG. 5.

For the correct duplexing of any cable, measurement of the actual laid cable would therefore be the only definite method. If the cable behaviour were measured over a large range of frequency covering all those up to the sensitivity of the instrument in balance, and the artificial line constructed to follow the behaviour exactly, the balance would be satisfied.

THE SHORTCOMINGS OF THE ARTIFICIAL LINE.

Constructed to imitate the constants of the cable measured by direct-current methods, the artificial line can be nothing more than an approximation, checked and harassed into a passable performance of its duty by the ingenuity of the man who balances in the devising of "fakes" determined by trial and error, to follow as he may be fortunate enough the deviations of the cable impedance over the gamut of frequencies occurring in every impulse. The separation of the frequencies for the purposes of balancing would probably simplify the "faking" problem.

One thing further is worthy of notice. It is upon the low core-ratio cables that the deviation of the impedances from their calculated values is most pronounced, thus introducing the greatest difficulties of balance where maximum speed is expected. Fig. 5 shows the deviation of cables of various core-ratios from their values calculated from direct-current measurements,

The whole of these tests were carried out by Messrs. Gaye and Wood, of the Eastern Telegraph Company, in conjunction with Mr. Tinsley and the writer, the alternating-current potentiometer, high and low-frequency alternators and general apparatus for the tests being lent by Messrs. H. Tinsley & Company, South Norwood, at the request of the Eastern Telegraph Company, to whom the writer and Mr. Tinsley are much indebted for the facilities afforded and their help and accommodation given during the period of the test.

Research on the Heating of Buried Cables.*

This comprehensive report is divided into several sections. A short summary of the history of the investigation and a statement of work still outstanding is first given. Section I., by Mr. S. W. Melsom and Miss V. Cockburn, deals with work done at the National Physical Laboratory on paper-insulated cables laid under various conditions. Section II. consists of a report by Mr. E. Faussett on work at Newcastle-upon-Tyne on extra-high-pressure paper-insulated cables laid direct in the ground at different depths. Section III., by Prof. E. W. Marchant, summarises tests at Liverpool University on vulcanised bitumen cables laid solid in stoneware troughing.

SUMMARY OF PUBLISHED WORK.

As a first step in this investigation a summary of all published work bearing on the current-carrying capacity of cables laid underground was prepared by the Institution. The American and German mathematical work was fairly complete as far as cables laid direct in the ground were concerned, but some of the tables required redetermination, and inadequate information was available on cables laid either solid in bitumen or drawn into ducts. Accordingly, research was initiated in this direction at the three centres named above, under the original Buried Cables Sub-Committee and the North East Coast Sub-Committee, both now transferred to the British Electrical and Allied Industries Research Association. Other special points such as large variations in the thermal resistivity of different cables, dielectric losses in high-tension three-core cables, and safe working temperature limits have also been studied.

In the original report a list of eight outstanding problems for further investigation is given. As a preliminary it is regarded as essential that the Association should determine—(*a*) maximum permissible temperature rise, (*b*) normal maximum temperature of soil, (*c*) thermal resistivity of the soil, and (*d*) the thermal resistivity of the cables on which a table of permissible currents for cables laid under various conditions should be based. Other points mentioned are the relative rating of high and low tension cables, the effect of running two or more cables in the same troughing, the effect of loading for only a few hours daily, the amount of moisture in soils and the maximum temperature to which a cable may be subjected for an indefinite period without deterioration.

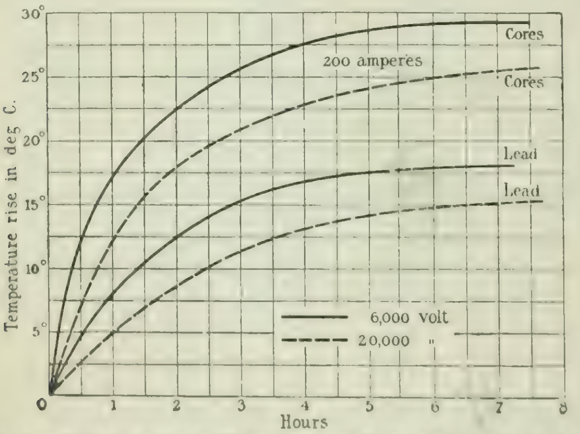

FIG. 1.—CURVES SHOWING TEMPERATURE RISE OF 0·15 SQ. IN. 3-CORE CABLE, TESTED IN AIR.

SECTION I.—PAPER-INSULATED CABLES LAID UNDER VARIOUS CONDITIONS.

CABLES LAID IN AIR.

In these tests the cable core was used as a resistance thermometer, changes in total resistance measured by a Kelvin double bridge, giving the average temperature rise. A similar method was applied to the lead sheath. A necessary preliminary was an accurate knowledge of the temperature coefficients of both lead and copper, for which, after detailed tests, an average figure of 0·00390 at 20°C. for copper was obtained, while for lead the average was 0·00385 at the same temperature, for 1°C.

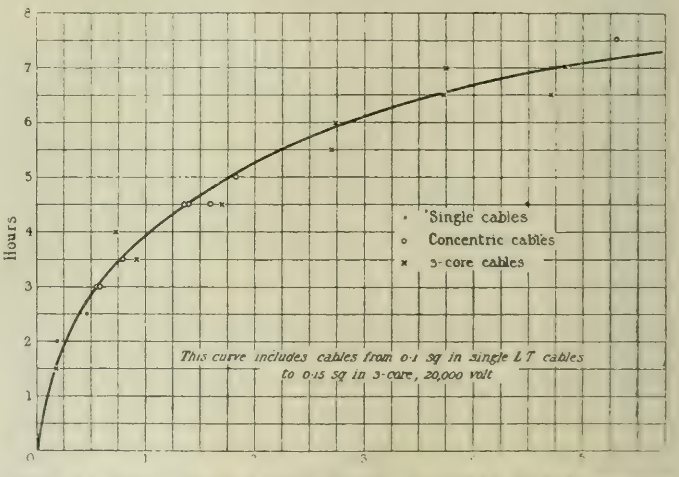

FIG. 2.—TOTAL CROSS SECTION OUTER DIAMETER CURVE, SHOWING THE TIME TAKEN TO ATTAIN THE MAXIMUM TEMPERATURE RISE IN AIR

As a basis of comparison tests of cables in air are first discussed. A series of diagrams are presented showing the rate of heating, of which Fig. 1 is selected as typical. While a 0·1 sq. in. low pressure single cable attains its maximum temperature in 2 to 3 hrs., the larger cables (0·15 sq. in. three-core extra-high-pressure) require about 8 hrs. In Fig. 2 the time required for cables of various sizes to attain maximum temperature is shown. The values obviously depend both on the size of the conductors and the thickness of dielectric; accordingly, the product of the cross-section and the overall diameter is plotted against time.

Curves are next presented relating to current and temperature rise, and it is remarked that distinctly different behaviours may be found even in cables nominally of the same type. Fig. 3 is interesting as showing the effect of different coloured surface The effect of armouring is greatest in the small sizes, but in any case is relatively small. As noted above, colour is apparently of some influence, but it is rather the difference between a bright and dark surface that is revealed in Fig. 3. No appreciable difference has been recorded for direct current and alternating current.

BURIED CABLES.

Under the heading of buried cables are grouped: (1) armoured cables laid direct in ground, (2) cables drawn into a six-way glazed stoneware duct with spigot joints laid direct in ground, and (3) cables laid solid in bitumen in stoneware troughing. Full particulars of the cables examined are given in tables presented in the original report. The depth of laying is 2 ft. to the top of the duct or cables. The ends emerge into two observation huts, 100 ft. apart, and are sunk 4 ft. below ground-level, walls being of 6-in. concrete.

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* Abstract of a report presented to the Institution of Electrical Engineers by the British Electrical and Allied Industries Research Association.

The method used in applying the Kelvin double bridge was to super-impose a small direct current on the alternating current, primary measurements of current being made with a dynamometer type ammeter, working in conjunction with a small transformer; a hot-wire ammeter was also used in circuit to indicate the small direct current passing during observations about 20 amperes were drawn from accumulators as compared with 300 amperes, alternating current. Besides observations on cores the temperature rise of the outside of the cable was noted by observing the temperature rise of the lead sheath.

The effect of exposure of the ends of the cables, at the observation-huts, is discussed. The distribution of temperature in ducts was studied by means of distributed thermo-junctions, and in the original report these results are shown diagrammatically. But the displacement of a junction 5 mm. in either direction may occasion a 10 per cent. change in the observed temperature—which is far greater than the "end-effect." This method was ultimately abandoned as little reliance can be placed on measurements by means of a thermometer pushed into a duct. Subsequently a 0·1 sq. in. cable with a number of potential leads fixed at various points was tried. From various observations the conclusion is drawn that the connecting factor for "end-effect" does not exceed 1·4 per cent. However, the end-effect in cables laid solid in bitumen or armoured, while eliminated for the purpose of tests, is a serious factor in the rating of cables. Thus with 350 amps. in one case the temperature rise of cable in ground was 33°C., but in the rise of the last 10 ft. (5 ft. in soil and 5 ft. in hut) rises as much as 45°C.

Some preliminary observations on forced ventilation have been made and are to be continued. In order to study natural ventilation cables were run alternatively with the duct-holes closed and open. No appreciable difference in the temperature rise was noted in the two cases.

EFFECT OF CONDITIONS OF LAYING.

The effect of conditions of laying is illustrated by a table comparing the current, I_1, required to produce a given temperature rise in air, with the current, I_2, required to produce the same temperature rise with the cable buried. In specified cases with cables laid solid in bitumen, I_2/I_1 varies from 1·25 to 1·23: with armoured cables direct in ground from 1·22 to 1·21, and for cables drawn into stoneware ducts from 0·98 down to 0·95. These were low pressure cables: with high pressure cables I_2/I_1 might be lower, and in one case was approximately unity as compared with 1·21. Further tests of high pressure cables laid direct in the ground are accordingly being made. Some results are shown in Fig. 4.

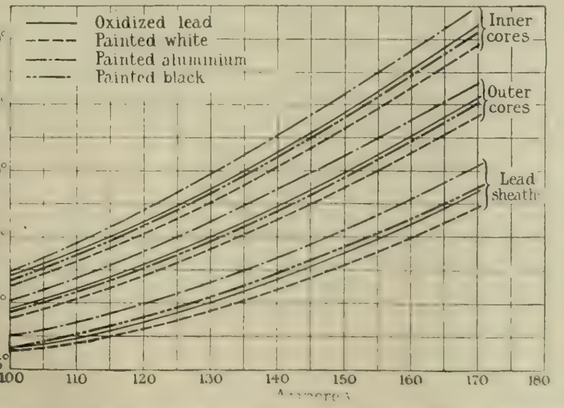

FIG. 3.—CURVES SHOWING THE EFFECT OF DIFFERENT COLOURED SURFACES ON THE TEMPERATURE RISE OF A 0·1 SQ. IN. CONCENTRIC CABLE TESTED IN AIR.

The following table shows the rates at which the temperatures of cables rise when laid under the three systems:—

THERMAL CONSTANTS OF CABLES.

In the original report a comparison is made between observed figures and values calculated from German tables and I.E.E. wiring rules. For 3-core cables the comparison gives the most variable and interesting results, but judgment is deferred until final results with the largest buried cables are available.

TABLE I.

Period.	Percentage of maximum increase.		
	Duct.	Solid in bitumen.	Armoured direct in ground.
After 7½ hrs.	95·0	88·0	85·5
,, 20 ,,	98·0	92·5	91·4
,, 40 ,,	99·0	95·6	93·1
,, 60 ,,	99·8	97·0	95·8
,, 80 ,,	99·8	98·8	97·9
,, 100 ,,	100·0	100·0	100·0

Thermal resistivity of insulating material varies considerably with different cables. Thus in one case the heating effect of a 3-core cable was little greater than for a concentric cable, although 50 per cent. more watts were being put into it. The thermal resistivities* of a number of different types are tabulated in the original report.

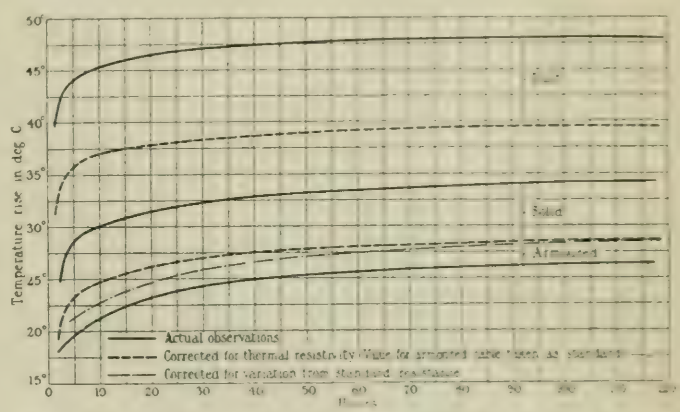

FIG. 4.—CURVES SHOWING COMPARISON BETWEEN 0·1 SQ. IN. CONCENTRIC CABLE, CARRYING 200 AMPS. AND LAID IN THREE DIFFERENT WAYS.

Thus a 0·1 single low tension cable has the value 1,200, a 0.2 single low tension cable 800. For concentric low tension cables values from 620 to 1,160; for 3-core cables values from 420 to 1,050 are recorded. In general the higher values of thermal resistivity are met with in low-tension cables, and this fact deserves further attention.

CHARACTERISTICS OF SOIL.

The natural temperature of the soil may vary greatly, according to the period of the year. Values recorded daily near cables are plotted by the author. After a spell of hot weather in August, 1919, the temperature at a depth of 2 ft. rose to 68°F. Moisture records at Teddington vary from 9-15 per cent., while in Newcastle 20 per cent. was usual in winter. Systematic observations are to be made at each of the three centres for an entire year.

SECTION II. TESTS ON E.H.P. PAPER-INSULATED CABLES LAID DIRECT IN THE GROUND AT DIFFERENT DEPTHS.

Tests were made on three lengths of 0·1 sq. in. 3-core, lead-covered and armoured low-tension cable at various times in the year. The three depths adopted were 1, 2 and 4 ft. from the ground surface to the top of the 2-in. concrete slab over the cable (approximately 1½, 2½ and 4½ ft. to centre of cable). The results show considerable variation between tests at 1 and 2-ft. depths, but a fairly constant difference between those at 1-ft. and 4-ft. depths. The average increase in temperature for the same current at 2 ft. over that at 1 ft. is 4 per cent., at 4 ft. 15·7 per cent. This is equivalent to rating the 2-ft. cable at 2 per cent. and the 4-ft. cable at 7·5 per cent. less current than the cable at 1 ft. for the same temperature rise in core. The results are shown in Fig. 5.

Tests on the moisture in the soil were made at intervals. This was never far from 20 per cent.

SECTION III. TESTS ON VULCANISED BITUMEN CABLES LAID SOLID IN STONEWARE TROUGHING.

A set of four pairs of feeders with nominal sections of 0·1, 0·25, 0·4 and 0·6 sq. in. were laid at a depth of about 3 ft. below ground. The cable was insulated by two layers of fibre served on the conductor, then two layers of bitumen tape. The length of cable tested was 61 ft. between end pillars, and was supported by porcelain bridges in stoneware troughs, filled with bitumen and covered with flat tiles. Tapping points were connected to the cable at intervals. The Kelvin double-bridge method was used to measure the resistance of cables and resistance between tapping points. A special low-voltage 1,200-ampere generator was used for the tests. Most of the heat tests were of about six hours' duration. Mean ground temperatures were taken continuously and were, in general, 5°C. throughout the winter, rising to about 14°C. in mid-June. The temperature coefficients at 10°C. was determined as 0·409 per cent. for the copper cables, which agrees with the value given by the British Engineering Standards Association.

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* Thermal resistivity is expressed in terms of the difference of temperature in degrees C. required to cause the flow of one joule of heat per second between opposite faces of a centimetre cube.

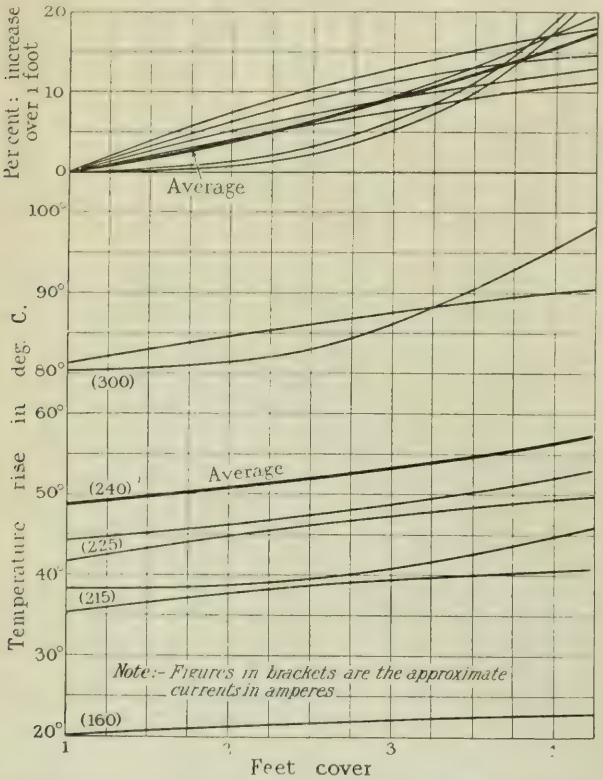


Fig. 5.—Curves showing Temperature Rise with Varying Amounts of Cover.

In the original report the method of testing temperature rise is described in detail, shunts of manganin, compared with N.P.L. standards being used. Temperature rise was measured in terms of increase of resistance, and the accuracy of the bridge was such that the resistance could be found, if necessary, to one part in 10,000. Variations in current were of the order of 0·25 per cent., coresponding to variations in heating of 0·5 per cent., so that this accuracy was ample. Successive tests on the same cable under similar conditions yielded results agreeing within 1 per cent.

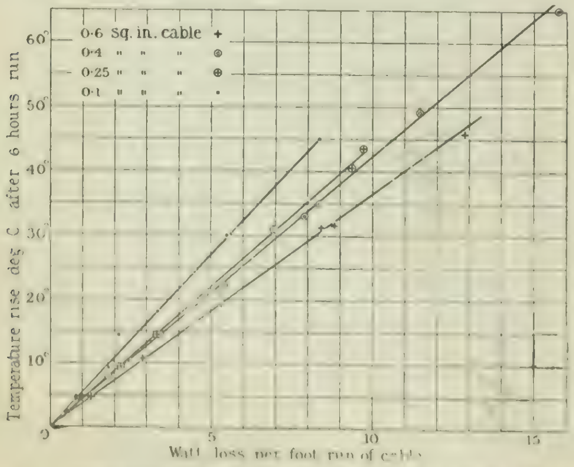


Fig. 6.—Curves showing Temperature Rise of Cables laid Solid in Bitumen in Stoneware Troughs.

Fig. 6 gives the results of the first series of tests, and in the original report diagrams are plotted for each of the four pairs of cables, showing temperature rise with time. The final rises in each case, at 750, 1,000 and 1,250 amperes per square inch, are substantially the same, *i.e.*, 10 deg., 20 deg. and 30 deg. C. The tests afford data enabling the effect of momentary overloads to be calculated. The correction due to "end-effect" is discussed and shown to be negligible. Curves are also presented showing the relation between rise in temperature after a 6-hours run and current. The rise in temperature is nearly proportional to the square of the current, but the rise is relatively small with cables of smaller section on given current-densities, which is a familiar fact. The most important factor in connection with cables laid direct in the ground is the moisture in the earth surrounding them. Extreme variations in moisture-content were from 9 to 13 per cent. during a comparatively dry spell.

Following the first series of tests the 0·6-sq. in. cable was run for 58 hours at 600 amperes. The results are shown in Fig. 7, whence it appears that the final temperature rise was about 20 per cent. higher than in the case of the 6-hours run. A similar run was made with the 0·4-sq. in. cable for 96 hours at 475 amperes, and a similar temperature increase was noted.

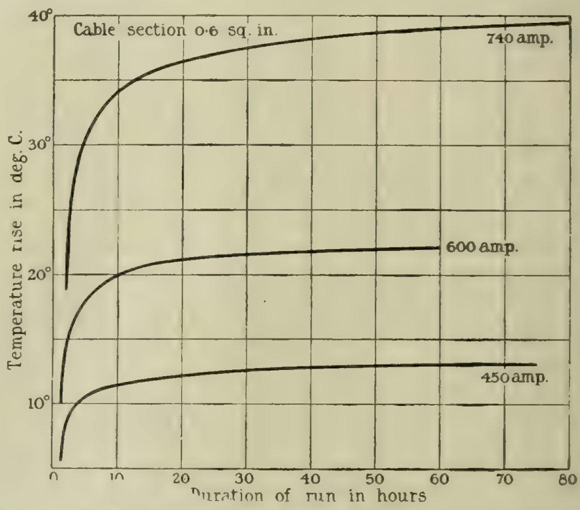


Fig. 7.—Curves showing Temperature-Rise of Cables laid Solid in Bitumen in Stoneware Troughs.

In the final section of this report the author discusses the theory and determination of thermal constants for insulating material. Values of thermal resistivity (*i.e.*, the difference of temperature in degrees Centigrade required to cause the flow of 1 joule per second between opposite faces of a centimetre cube) are given for cables of 0·6-sq. in. and 0·1-sq. in. section. For the former values of 487, 540 and 488 are recorded, for the latter values of 507, 530, 536 and 531. The corresponding thermal resistances (*i.e.*, difference of temperature in degrees Centigrade required to cause the flow of 1 joule of heat per second per centimetre length between core and outer surface of the cable) are respectively 43·3, 48·0, and 43·5; and 73·9, 77·1, 77·5, and 77·0. Finally the thermal resistance in the same units for the trough filling and ground (relating to half the trough, as two cables were laid in the same trough) is given as 87 for the 0·6-sq. in. cables and 92 for the 0·1-sq. in. cables. The cable covering did not show any serious sign of softening except in the case where the final temperature was 67°C. The working limit of temperature was estimated to be about 50°C., a result which is of the same order as the 43°C. usually employed in specifications for this type of cable.

The Home Secretary proposes to appoint two Additional Electrical Inspectors of Factories to undertake electrical inspection under the direction of the Senior Electrical Inspector of Factories, in factories and other places under the Factory Acts, in any part of the United Kingdom. They will be required to reside in such place as the Home Secretary may from time to time direct. The salary, exclusive of war bonus, will be £400 per annum, rising by annual increments of £20 to £650 per annum. The war bonus at present payable on the initial salary is £326 odd. The appointments will be for 5 years certain (subject to a year's probation) and will be capable of renewal at the expiration of that period. Responsible experience in large modern e.h.t. electricity supply undertakings will carry special weight. Applications by Jan. 22, 1921, to the Private Secretary, Home Office, Whitehall, S.W. 1.

The Institution of Electrical Engineers.

Discussion on "The Heating of Buried Cables."

The report of the Committee which was appointed by the British Electrical and Allied Manufacturers' Association some eight years ago to consider certain questions relating to the heating of buried cables has recently been received by the Institution of Electrical Engineers, and has been discussed at various meetings in London and the provinces during the past few days. We give an abstract of this report, which is largely either of an historical or an interim character, on another page of this issue. The report deals with a number of important practical considerations, and it is therefore unfortunate that so closely following the Papers of Messrs. W. B. Woodhouse and R. O. Kapp, those desiring to discuss it should have been affected with a not unnatural satiety. It might have been better either to have separated these communications by a wider interval or to have discussed them all together.

PROCEEDINGS IN LONDON.

The meeting in London was but scantily attended, though the unusual sight of a lady (Miss Cockburn) at the Council table should have proved an attraction. The President opened the proceedings by announcing that the Council had elected Prof. André Blondel, whose work will be well known to readers of The Electrician, to be an honorary member of the Institution. He also announced that Mr. E. M. Hughman, of Bombay, had indicated his willingness to give £250 to the Benevolent Fund if before March 31, 1921, nineteen donations of a similar amount were obtained. We hope that members will see to it that Mr. Hughman has to "fork out."

The Object of the Report.

No attempt was made to read the report before the meeting, though Mr. E. B. Wedmore, director of the Electrical Research Association, made a few preliminary remarks, in which he emphasised the importance of research on this subject, iu order that economies in the large sums which would have to be spent on cables in the course of the next few years could be effected. The object of presenting the first completed report was, he said, to disclose some valuable data which had already been prepared, and to obtain the criticism of members of the Institution with a view to further researches. The problems of the deterioration and of the safe working temperatures for various kinds of cables were of the utmost importance.

The Knell of the Solid System.

Mr. C. P. Sparks, though he starts slowly, is one of the best and clearest speakers that makes himself heard at an Institution meeting. He said, quite rightly, that the question of fixed charges in connection with huge power stations was of ever-increasing importance, and it was only by really knowing what factor of safety we were working with, and what was the limiting temperature the material would stand, that we could earn most interest on the colossal expenditure involved. The comparison of the three ways of laying cable—solid in bitumen, armoured, direct in ground and drawn into stoneware ducts—given in the report, he thought interesting, and a further stage in the investigations would probably show a still greater discrepancy against what might be termed the solid systems. Mr. Melsom had said that the thermal resistivity, although important, was not so important as might appear at first sight, but Fig. 12 in the report showed a difference as between solid and armoured cables of no less than 7°C., which did not appear to square with this. Mr. Fawssett's contribution on making the rating of cables dependent on depth at which they were buried was very valuable, but a certain definite distance from the surface must be kept to avoid mechanical interference (compromise again!). As Dr. Marchant pointed out, the watt loss per foot run of cable was the proper method by which to approach the question of temperature rise, especially in dealing with not one cable but a group where the cables were close together. The question of dielectric hysteresis, discussed in that room 20 or 21 years ago (this is a figure of speech), was now of prime and growing importance, whereas so short a time ago as 1913-14 it was of little importance. The report contained the statement that "the final permissible maximum temperature of a paper-insulated cable is at present stated in the I.E.E. Wiring Rules to be 150°F. That figure had been fixed when he was chairman of the committee, not for buried cables, or for the large cables in use to-day, but as a safe figure for the ordinary conductors used in houses.

Mr. C. Beaver was let down by the lantern, or, rather, by the lantern operator. He had hoped to be able to show some slides. However, without them he was able to say that to raise the figure of 150°F. given in the I.E.E. Rules would be dangerous, because though paper and other organic materials deteriorated quite slowly under the influence of heat, paper at least deteriorated fairly suddenly at some critical time. He also emphasised the importance of the heating due to dielectric loss.

The Report and Economies.

Mr. B. Welborn evidently thinks that this report is going to save money. One speaker at Manchester had said that a capital saving of 1 per cent. might be looked for as a result of the investigations, but he (Mr. Welborn) regarded that as an extremely low figure. Drawing cables into ducts was a moribund system if it was not already dead. It might be well to vary the section of conductor with the nature of the soil. (But would this really be worth while in practice?) Much useful data was given in the report, and Prof. Marchant's figures for the continuous working temperature of bitumen insulated cables were interesting. Bitumen cables were used in colliery installations where the conditions were unusually hot, and that showed that the permissible safe rise to be allowed must inevitably be cut down the current-carrying capacity of the cable. Mr. Welborn does not speak very loudly, and it was sometimes difficult for those remote from him to hear what he was saying.

Temperature Questions.

Mr. P. Rosling remarked that the temperature of a cable was generally taken as that of the lead sheath, but the temperature of the conductor was what mattered; that would be of importance in supertension cables. In the I.E.E. Rules it was not specified whether the temperature of the conductor or of the exterior of the cable was referred to. This should certainly be defined.

Mr. R. O. Kapp remarked that the theoretical law for temperature rise plotted against time was generally taken to be an exponential curve. Most of the heating curves given in the Report approximated very closely to an exponential curve, though others departed from it by about 10 per cent.

DISCUSSION AT LEEDS.

The "Heating of Buried Cables" report was discussed at Leeds, on December 14th.

Mr. E. B. Wedmore pointed out that the research in question had been first inaugurated primarily on behalf of the user in contradistinction to the manufacturer. The whole of the research work had, however, now been co-ordinated, and one body was carrying out research work both for user and manufacturer.

Mr. S. W. Melsom said that as this was only an interim report it was recognised that the date therein was not in such a form as to be readily applicable. One of the most important points yet remaining to be determined was the maximum temperature that the dielectric of a cable would stand indefinitely without deterioration.

The Indefiniteness of the Data.

Mr. A. S. Gibbon complained that he had difficulty in discussing a report of such an indefinite and preliminary nature, and that these points which were required to be known were still apparently under consideration. He said that he would like to have seen more reference to the particular instance of cables laid together, and thought the one important point which the report had brought out was that heavily-loaded cables should be of larger section where they leave the ground.

Mr. A. G. Cooper said that apparently most of the tests had been carried out on short lengths. On long lengths of cable what would be the effect of the joints. He was doubtful whether the results obtained were of direct practical application, since the heating appeared to have been effected with a lower voltage than that for which the cable was primarily intended.

Some Fundamental Criticisms.

Mr. W. M. Selvey said that in making any investigation in which a number of variables occurred, it was necessary first to investigate under conditions where all the variables could be controlled. These could be called the control experiments. Apparently the control experiments in the present report were those in which Mr. Melsom had taken observations with a cable in air laid on a floor. But the nature of the floor, of the contact of the cable with the floor, the temperature of the envelope surrounding the cable, the colour of the surface, the nature of the surface of the cable, had none of them been considered. Hence these control experiments could hardly be called perfect, and yet all the results in the report were referred to them as an origin. The final report should be passed under the pencil of an editor-in-chief. Complete data as to moisture content in the soil were available, but for this work knowledge of the capacity of the soil both to absorb and to retain moisture would have to be obtained. The control experiments should be carried out on a cable suspended in air. A cable laid in soil could dissipate heat more easily than one in air, and hence could be more heavily loaded. This loading could be co-related to the loading on a cable suspended in air by a constant made up of various components.

Mr. B. C. French wanted further information as to the conditions under which certain tests had been carried out. The results were very indefinite, and more reference should have been made to a definite heating under definite conditions. No thermal time constant of cables had been given, and the mixture of English and Metric Measurements was to be deprecated.

Mr. S. W. Melsom, in reply, was of opinion that it would not be possible to give hard and fast rules for loading cables, owing to the great diversity in conditions of working. He did not agree with Mr. Selvey's ideas about control experiments as he took it the criterion of a control experiment was whether the results could be reproduced at will with negligible differences. This had been done in the present instance. The data available from agricultural experts on moisture only referred to depth of 6 in., and was, therefore, not very valuable for the present investigations.

DISCUSSION AT NEWCASTLE.

A discussion on the Heating of Buried Cables' Report took place at Newcastle-on-Tyne on December 13th when Mr. C. Vernier, Chairman of the Buried Cables Sub-Committee, said the deplorable delays which had occurred since the commencement of the research were due to circumstances beyond the control of the Committee. The difficulty in obtaining material during the war was the primary cause, whilst the question of finance also contributed. The latter difficulty was now fortunately almost overcome.

After the contents of the Report had been briefly outlined by Mr. S. W. Melsom and Mr. E. Fawcett, Dr. W. M. Thornton pointed out that when using the Kelvin double-bridge method, where extreme accuracy was required, all the bridges should be carefully checked with one another in order that the results might be truly comparable. It was admitted that this had not been done, although the bridges used had all been compared with check bridges. It was stated that an aluminium-painted cable became 22 per cent. hotter than a cable surface. This difference in temperature was evidently due to the difference in radiation, which proved that the dissipation of the heat in a cable was not entirely due to radiation, but must be assisted by conduction and convection. Otherwise the effect of the aluminium painting would have been much more marked. the main point with regard to the heating of cables was deterioration. In the case of paper-insulated lead-covered cables it should be possible to make the life of the cable anything that was desired by varying the current density. So long as the Paper was properly enclosed in the lead there should be no deterioration provided there is no overheating.

No Difference Between A.C. and D.C.

Mr. C. Bertram commented on the fact that the results obtained by the A.C. and D.C. tests showed no appreciable difference. Hysteresis effect in the dielectric must be therefore negligible The rise in temperature on the last 10 ft. of cable was surprising, and he did not favour the scheme of using tail pieces of larger section. It was later pointed out that this increased heating was largely due to the end of the cable coming into the air, where the thermal conductivity was considerably lower than that of the ground, and further that the practice of installing larger tail sections had been in use for a considerable time on the North-East Coast, without encountering any great difficulties.

A Practical Suggestion.

Mr. P. C. Parker stated that operating engineers were extremely anxious to know at what temperature a cable might be safely run, particularly on overloads of one or two hours' duration. The temperature rise was the vital point with most apparatus, but in the majority of cases an indication of the temperature rise was obtainable. Such information was also required in the case of cables, and some instrument which would give the current in the core and the temperature of the sheath was urgently required. Such an instrument would not need to be exceptionally accurate. If it would read to within 5 per cent. it would be extremely beneficial, as it would give some guide as to the life in the cable. Under present conditions it was only possible to guess at the condition of the cable or to run until breakdown occurred.

Mr. P. F. Allan considered that the most important point was the effects of different soils and surroundings upon the heating of the cables, He suggested that the results obtained in this country for the earth temperatures at different seasons of the year should be passed on to, say, Australia and Canada, with the request that they should compile corresponding data. The conditions must be very different in other countries, and the behaviour of the cable would be affected accordingly. He also suggested that investigations should be made to ascertain the temperature of the dielectric between the cores in the case of three-core cables, as he understood that this was usually the hottest part of the cable, and the temperature here might easily be the limiting factor effecting the life of the cable. This was supported by other speakers.

The Factor of Ignorance in Cable Laying.

Mr. H. Bridges observed that in the past cables had been both manufactured and laid under a factor of ignorance. The present report went a long way towards remedying that condition although it was primarily concerned with single cables. Information was urgently needed as to the effect of grouping cables ; as the usual congestion of power station sites invariably resulted in extensive grouping, a fact to which little attention had been paid in the past. Information as to the effect of plain jute covering on the temperature rise of cables would also be welcomed. In the case of concentric cables the inner core was apparently at a higher temperature than the outer core; this could be partially remedied by crossing the cores at all joints. The difference in the temperature of the lead sheath and the cores tended to show that the temperature of the cores and sheath were uniform, and that the temperature gradient in the dielectric was also uniform. Regarding the use of increased sections of cable mention was made of a 40-mile loop of cable which was laid in varying sizes to meet the different conditions of the route in which it was laid, on which an earth fault developed, and was immediately located to within a few yards, thus showing that the varying sizes were not detrimental from a practical point of view, although the cost was, of course, increased.

Mr. S. W. Melsom (in reply) said that such an instrument as required by Mr. Parker had actually been constructed in an experimental form for use on direct-current cables, and the possibilities in the case of alternating-current cables were being investigated. The temperature of the dielectric in three-core cables was also being investigated, and the lines of heat flow were being checked. The important question of the deterioration of the dielectric was being carefully explored by various processes of heat treatment.

Distribution in 1940.

By "A FUTURIST."

After reading the two Papers on "Distribution of Electricity," one by Mr. Kapp and one by Mr. Woodhouse, and hearing some of the discussion thereon, I fell to musing and found myself opening my "Times" twenty years hence.

On looking at the contents page I saw that the list of interruptions yesterday to the National Power Supply was published on p. 17, Finance and Commerce Section. Not wishing to harrow myself with seeing who had suffered, I next turn to the Editorial page and found a leader in connection with the English Territorial Section of the Heat, Light and Power Department, or was it the National Power Combine ? It appeared that, "The parsimony of those in charge of the undertaking in meticulous interconnection of the network to save a few thousands in the yearly account, and their entire failure to realise that the provision of sufficient trunk feeders is the very life blood of the country, makes us sometimes wish for those good old days when local interruptions were so few and unimportant. We must, however, welcome the much-belated official announcements made in the House to-day. . . ."

Trouble in Parliament

Turning next to the Parliamentary Intelligence, the following paragraph caught my eye : "The Member for Edinburgh rose to ask whether any announcement could be made to the House as to the recent disturbances to the Power Supply in South Wales arising out of the regrettable occurrences at Pony Tandy. The ex-PRIME MINISTER asked, If in replying to the Honorary Member's question, current rumours could be dealt with that the many interruptions to supply in the Woollen Districts of Yorkshire were not uninfluenced by the contemporary complaints of the Ministry of Transport as to the delay of the local authorities of those districts in collecting and transmitting to the Exchequer the transport dues until they were considerably overdue, and was not this a recrudescence of that deadly policy of reprisals which had formerly obtained within the recollection of some of the members ? The

MEMBER FOR SLO-CUM-WILDERNESS was also understood to ask, amidst some little disturbance, when his constituency was to have a supply, and why the main trunk feeder passing their door could not be tapped for their benefit to-morrow.

THE PRIME MINISTER ON ELECTRICITY SUPPLY.

In reply the PRIME MINISTER announced that it had finally been decided to allot the sum of 10 million pounds for main-trunk feeders, the work to be spread over a number of years, but that 100 miles of main-trunk feeders would be this year changed over from the old overhead high-tension system to the new single-cable direct-current system, and that the first alteration would be in the Pony-Tandy district. In the meantime, he added, requisite measures were being taken to safeguard all main-line trunk-feeder routes, and all admission to electricity works, except by pass countersigned by two responsible officials, had been prohibited. Some allowance had to be made for the miners, who were faced with decreasing output due to electrical economies and, at the same time, were annoyed by the demands of electrical engineers for clean coal. He repudiated with indignation the suggestion as to reprisals. Since the Taxing Department of the Ministry of Transport and the Power, Light and Heat Department were in separate watertight compartments, no possible communication could have taken place between them. The disturbances in Yorkshire, he thought, might fairly be attributed to the extravagant demands made by the manufacturers for power resulting, he understood, from an abrupt change in ladies' fashions which demanded woollen garments instead of the light silks recently worn. He did not understand what exactly Slo-cum-Wilderness wanted. Surely it was not suggested that a local supply cable, from which the power of 100 horses was required for four hours a day, should be attached to a main 100,000-volt trunk feeder supplying Birmingham from the Severn Barrage, on the non-interruption of which depended the daily livelihood of the vast thousands of that manufacturing district ?

An interruption by the Member here occurred, but his remarks were not distinguishable on the electrical record of the proceedings.

In conclusion, the PRIME MINISTER said that they, the Government, were fully aware of the importance of the whole matter, but that they would not be influenced by the continual nagging they had to suffer. He suggested that the more profitable line for Members to take would be to educate the public in the proper usage of the supply in their own interests, and to impress upon the manufacturers of electrical apparatus that they must produce goods absolutely undamageable and fool-proof, in which case we should soon enjoy the rare and refreshing experience of a totally uninterruptable supply.

And then I finally fell asleep and dreamt of an "uninterruptable supply."

Electrical Peddlery.

An Untried Method of Selling.

By "ELECTROCYNIC."

It is evident that a considerable amount of business is done by people who hawk their wares from door to door. Usually the things they sell are not of great utility, and it may be presumed that a large proportion of the sales are due to the sheer (and sometimes profane) persistence of the seller, rather than to the purchaser's desire to buy. Ever since the day—about a year ago—when an exquisitely dressed and delightfully mannered young lady sold to me, on my own ungenerous doorstep, a furniture polishing outfit for ten shillings, I have been obsessed by the possibilities of this intimate form of trading. I did not want the furniture polish, but for all that my pocket was depleted to the considerable extent of half a sovereign by the specious and persuasive arguments of a pedlar.

ELEGANT SCRUPLES.

If things of little or no value can be sold in this way, and often by people of repulsive aspect, the method should surely succeed in the case of articles of practical and demonstrable utility, such as electric irons and small heating and cooking appliances, especially if peddled by men or women of reasonable education and refinement. It may be objected that to barter the distinguished products of engineering genius in this fashion would be indelicate and undignified. There is no room on the retail side of the electrical business for these elegant scruples, which are really only appropriate in the purveyor of such articles as pearl-handled lorgnettes to the higher ranks of the aristocracy. If, as seems evident, the peddling method of selling electrical goods provides a way out of the impasse to which the contracting section of the industry has so largely contributed, I think that it should be adopted with enthusiastic alacrity. The present volume of business in domestic electrical appliances is ludicrously small, in comparison with what it should and could be if contractors were properly alive to their opportunities.

A MOBILE SHOWROOM.

I am quite sure that any dealer who cared to experiment along these lines could sell hundreds of irons or boiling-rings where now he is hard put to it to sell one. Of course, such an enterprise as electrical peddling must be properly organised. First of all you want a salesman possessing technical knowledge, an attractive appearance and a refined and convincing manner. Then there must be a van or motor lorry capable of carrying a varied stock of small appliances and also serving as a showroom for the heavier stuff, such as cookers, washing machines, &c. The salesman would be armed with a pedlar's licence and a complete list of electric light users in his radius. If thought desirable, the visits of this electrical pedlar might be announced a few days before-hand by means of carefully-written letters.

AT THE SMITHS'.

Imagine this lorry—perhaps electrically driven—drawing up outside the villa residence of Mr. and Mrs. Smith. This worthy couple have for many years enjoyed the benefits of electric light but, so far, nobody has ever attempted to introduce them to the pleasures of electric ironing or the clean simplicity of electric cooking. The Smiths' are not rich, but they have enough money for all necessities and most reasonable luxuries. They have never needed to economise in the equipment and furnishing of their house.

About once a year Mr. Smith has to buy a few lamps, which he gets from a busy city ironmonger's shop, where there is little risk of being subjected to the propagandist oratory of the electrical enthusiast. A contractor near his home occasionally advertises electric cooking and heating apparatus in the local newspaper. Mr. Smith, however, has never seen this pallid and inept publicity, for the simple reason that, like most men of his class (the "middle-middle" class), he does not read the local paper. Needless to say, the Smiths' carefully whitened threshold has never been darkened by the form of a canvasser. The central station washed its hands of Mr. Smith as soon as the electricity meter had been connected.

A RARE PHENOMENON.

Consequently, when the hawker of electrical devices knocks gently but firmly at the front door of the Smiths' delectable villa, he comes bearing a message which is entirely new to husband and wife. Since he is well-dressed and well-spoken and in possession of a perfectly clean visiting card (a somewhat rare phenomenon in the electrical business), he has no difficulty in obtaining an interview with Mrs. Smith. He asks her permission to bring one or two electrical appliances into the house, so that he may show them in actual use. This is given at once.

Of course he has irons, boiling-plates, vacuum cleaners, &c., of the right voltage and wired up so that they can be immediately connected to lampholder or wall-plug. These things are demonstrated to the amazed Mrs. Smith, who had never imagined that electricity could be applied to so many domestic purposes. The salesman explains how to use the various devices, and tells her exactly how much current each consumes.

GOOD BUSINESS.

The pedlar stays in this house about 15 minutes, and when he leaves he leaves behind him an iron and a boiling-plate, for which he has been paid on the spot ; and a vacuum cleaner, which Mrs. Smith wishes to discuss with her husband before buying. The price of the vacuum cleaner is about £20, so she may be pardoned her slight uncertainty in respect of this last item. Anyway, the enterprising pedlar has pocketed about £4 and has an excellent chance of receiving a cheque for £20 in a day or two.

Does this little story sound unlikely ? I am quite convinced that it could be translated into actual fact half-a-dozen times a day by a clever salesman. If he only did business with, say, 10 or 15 per cent. of those he called upon, the profits would be almost incredibly large. And it should be remembered that the pedlar always has the tremendous advantage that he can seek his market anywhere within lorry radius of his supply base.

Virgin Soil.

In my own immediate neighbourhood there are several blocks of flats—about 200 flats in all. Practically all are electrically lighted; while, from observations and discreet inquiries I have made, I should estimate that not more than 5 per cent. use electricity for any other purpose. The rents of these flats range from £70 to £120 per annum—at least they did before the recent increase—so that it is reasonable to suppose that the inhabitants could quite easily afford to buy such things as electric irons, &c. And, of course, they *would* buy them, if anyone made a serious attempt to sell. Amongst my own six acquaintances in these flats, not one has ever received, during his tenancy, a single piece of electrical advertising matter—unless the Company's quarterly account may be so regarded. It is extraordinary that a field so richly promising should have been continuously neglected by every electrical interest. My pedlar could do wonders here, and I shall be pleased to divulge the location of these flats to any bona-fide electrician who can prove to my satisfaction that he possesses the following: (1) A pedlar's license; (2) a stock of suitable apparatus; (3) a lorry; (4) the ability to sell.

The Contractor's Three-fold Objection.

I don't for a moment suppose that this suggestion is being now put forward for the first time, although I have never seen any previous reference thereto. The great objection to it from the average suburban contractor's point of view is that it involves (1) capital expenditure; (2) personal effort; and (3) a modicum of risk. Contractors, as a class, seem to prefer a passive role. They love to sit in their shops, surrounded by a miscellaneous collection of electrical scrap—ceiling roses, broken shades, bits of fittings, and the like—and await the trustful solicitations of those enthusiastic souls who are content to order, and perchance to pay, on the dealer's promise to "send to the City for it in the morning if I can get away."

The electrical contractor is chronically devoid of capital and enterprise. Perhaps the first deficiency produces the second, or the second the first. Obviously, it is useless to expect this type of business man to engage in what must to him appear an adventure of the most desperate character.

Perhaps. . . . . .

However, I am sure that there are great possibilities in electric peddling. Electrical appliances lend themselves to this method of selling better than almost any other class of domestic apparatus. There is an element of fascination in any electrical device, which is irresistible to the average housewife. Curiosity alone would ensure a welcome in most cases. Then again, these devices can so easily be shown in operation, and their merits are so evident, that every housewife will want to buy even although, for various other reasons, she may not actually do so.

Perhaps one of these days, some of the younger bloods in the electrical business will put their heads and their money together and make the experiment. Although my flat is completely—not to say elaborately—equipped with electrical apparatus, I should most certainly buy something—a shaving water-heater or cigar lighter, say, to encourage them in their worthy enterprise.

The National Budget as a Business Proposition.

By ERNEST J. P. BENN.

The recent debate in the House of Commons on the question of economy has thrown the business world into a condition of despair, and has brought home as nothing else has yet brought home the entire hopelessness of the politician from the business point of view. In 1914 industry was providing the State with £200,000,000 a year, and that sum was thought by many to be highly excessive. During the war industry produced at one time nearly £3,000,000,000a year, and since the war the business men of the country have provided £1,500,000,000 at the bidding of the politicians. This murderous burden, for no less expressive term adequately describes it, has been accepted by industry on the plea that we were reconstructing and that time must be given to the politicians to clear up their war-like commitments. But it now transpires that all this talk of reconstruction is pure camouflage, and that the politician proposes to go on collecting indefinitely at the present impossible rate. Business men know very well that this cannot be done, they know that the limit has long ago been exceeded, and that the Chancellor will never again be able to squeeze out of their pockets such sums as have been recently extracted from them.

Stronger Backing Needed

Mr. Peter Rylands representing The Federation of British Industries, is doing yoeman service in pressing sound views on a Treasury which seems incapable of understanding them, but it is evident that if the country is to be saved from industrial ruin, Mr Rylands must be backed up by a very much stronger body of public opinion than is at present in evidence behind him. There seems to be a fatalistic impotence about amongst our ministers and our Members of Parliament, which, somehow, must be removed. The Chancellor himself estimated a year ago that our expenditure would drop to £808,000,000, now he comes forward as if he were the victim of uncontrollable circumstances, and proves that he cannot do with less than £1,100,000,000. He has issued a statement to the Press in which he sets out the minimum requirements for next year as follows:—

Interest on debt	34[illegible]	millions.
Redemption of war debts necessary to keep faith with the holders	110	,,
Pensions to disabled soldiers, widows and children and old-age pensions	149	,,
Ex-soldiers' land settlement and training schemes	35	,,
Payments in relief of your rates, viz.:—		
(*a*) Education of your children	56	,,
(*b*) Health and unemployment insurance	17	,,
(*c*) Grants to local authorities and police in relief of your rates	23	,,
(*d*) Grants to provide houses	11	,,
(*e*) Improvement of roads (in part work for unemployed	7	,,
Revenue Departments, including cost of Post Office	60	,,

Mr. Chamberlain adds a footnote to the effect that the Navy, Army and Air Forces will cost £270,000,000, and that expenditure "cannot be reduced unless the State repudiates its obligations to its pensioners or to its creditors, or risks the safety of the Nation."

Expenditure Can be Reduced.

If Mr. Chamberlain would take a week-end in Birmingham and consult a few practical business men, he would very soon be convinced that expenditure can be reduced very considerably. If he could divest himself of his official position, and all the Parliamentary politeness which vitiates deputations to the Treasury, and thus get at the real mind of the business world, he would discover some very big cuts which can and ought to be made.

To begin with, interest on debt is based upon a 6 per cent. return, due entirely to Government extravagance; if the Government could regain the confidence of those who understand money matters, the rate of interest could go back to 4 per cent. This would not affect so much of the debt as is funded for long periods, but it would at once reduce the cost of the enormous floating debt and all the short-dated securities. The interest item in Mr. Chamberlain's budget need not, therefore, stand at more than £300,000,000.

How Economies Might Be made.

To include redemption of war debt in an annual budget at a time when unemployment is rampant because industry has no working capital is a proceeding which it is surely impossible to justify; in so far as debts have to be redeemed they could be readily replaced at lower rates of interest, if national finance was on a sound basis. In this way £110,000,000 would come out of Mr. Chamberlain's budget.

Nobody will quarrel with pensions to disabled soldiers, widows, children and old-age pensioners, but Mr. Chamberlain lumps these together at £149,000,000 as if this money were paid to these people. At the most modest estimate £10,000,000 could be taken off this total if the swollen and grandiose Ministry of Pensions with its elaborate machinery in every village were reduced to proportions such as would enable it to perform its functions efficiently. Then settlements and training schemes at £35,000,000 is very largely a farce. We have yet to learn of any sort of business purpose which has been served by any training scheme, and this item must be looked upon as in the nature of doles to ex-service men. If the subsistence allowance paid under these schemes were handed over to these men by way of pension or grant, and all the paraphernalia of unwanted training, abolished, £15,000,000 could be deducted from this item.

The Rates Question.

The way in which Mr. Chamberlain introduces the succeeding items as if they were in the nature of Treasury Charities for the relief of YOUR rates, is to say the least offensive in view of the fact that most of the rates in question would never be levied at all if local authorities with their knowledge of local needs left no choice in the matter.

Space prevents an examination of these items on this occasion, but it is permissable to point out that (*d*) grants to provide houses should be described as expenditure to prevent houses being built, and certainly £11,000,000 could be saved in that direction. It is, further, a matter of astonishment to most business folk to think that the Post Office has now to be subsidised in view of the fact that the Socialists led by Mr. Sidney Webb have for a generation been pointing to the profits of the Post Office as a reason for the nationalisation of the rest of our industries. It would not be unreasonable to ask the Postmaster-General to make his business balance, and in that way reduce Mr. Chamberlain's estimate by a further £20,000,000.

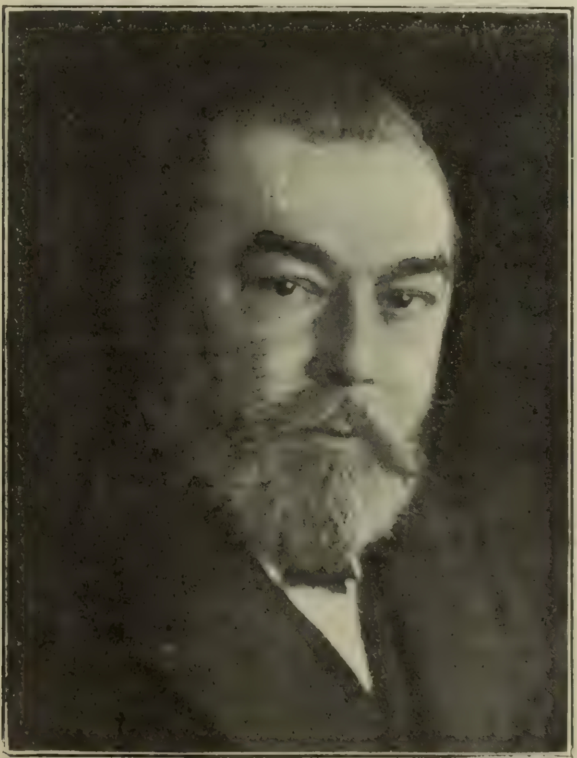
Finally, having won the war, and swept off the earth the enemy, on whose account we built up our expenditure on fighting forces to £400,000,000, the business world finds it a little difficult to understand why in this third year of peace, it is necessary to allocate £270,000,000 for this purpose. If we treated the fighting forces liberally, and gave them the whole of the national income before the war, we should reduce Mr. Chamberlain's budget by a further £70,000,000. These alterations, all of them modest, reasonable and practical, would bring the Chancellor's expenditure even below the figure which he mentioned last year as normal, and which Mr. Lambert endeavoured to establish by his resolution on economy.

This is not a political question; it is a direct business problem, upon which depends the very life of our Commerce and Industry.

Obituary.

DR. ALEXANDER MUIRHEAD, F.R.S.

As briefly recorded in our last issue the death of Dr. ALEXANDER MUIRHEAD, F.R.S., took place on Monday, December 13th. This removes one of the few remaining pioneers of telegraphic science.



Elliott & Fry.

THE LATE DR. ALEXANDER MUIRHEAD, F.R.S.

Alexander Muirhead, who was born on May 26, 1848, was the second son of John Muirhead, of E. Salton, East Lothian, N.B. On the removal of his father to London, he attended University College School, where, in spite of the handicap of deafness, he carried off many prizes and was Cook's prizewinner for his year. At his father's wish he gave up one of his half-day holidays weekly to drawing and the other to practical work at the Regency Street Works, where his father was in partnership with Latimer Clark.

From school he went on to University College, where he studied under Prof. De Morgan, and afterwards, instead of going to Cambridge, as he had wished, he was articled as a pupil to Dr. Matthiesen and worked in his laboratory at St. Bartholomew's Hospital. Before his time with Dr. Matthiesen expired he was called upon by Latimer Clark to work on the subject of Electrical Standards.

In 1869 he took his D.Sc. degree at London University, choosing electricity in preference to chemistry as his subject. Prof. Carey Foster was one of the examiners and he and Muirhead afterwards became close friends. In 1870 he was elected a Fellow of the Chemical Society. In 1874 he carried out, in conjunction with the late Mr. Herbert Taylor, experiments to solve the problem of duplexing long submarine cables. In 1875 he and Mr. Herbert Taylor took out a joint patent for the artificial line.

During the next few years he successfully established duplex working on many long cables, using the Marseilles-Bona line in 1875 and the Marseilles-Malta line via Bona in 1876 for trial purposes. It is interesting to note that the cable from Ballinskelligs Bay, Ireland, to Torbay, Nova Scotia, belonging to the Direct United States Cable Company, was the first ocean cable to which the system of duplex working was applied. This was established with complete success by Dr. A. Muirhead and Mr. Herbert Taylor in 1878. The working speed on this cable was found to be about 100 letters per minute each way, or nearly twice the speed of simplex working. The receiver used was the mirror galvanometer.

After the death of his father in 1885 Muirhead left Regency Street Works and took rooms at Elm Court for consulting work. He soon left here and established a laboratory in Cowley Street, Westminster, afterwards going on to Princes Street, Storey's Gate.

In 1893 he married Mary Elizabeth, daughter of Mr. William Blomfield, of Upper Norwood, and settled at The Lodge, Shortlands, Kent. In 1896 he gave valuable evidence before the Pacific Cable Committee appointed to consider the proposal of laying a telegraph cable between British North America and the Colonies of Australasia. About 1896 he became associated with Sir Oliver Lodge in his work in connection with Wireless Telegraphy, and was jointly responsible for the Lodge-Muirhead system of Wireless Telegraphy. In 1904 he was made a Fellow of the Royal Society for his work in connection with the development of telegraph science.

In later years Dr. Muirhead took an active part in solving the problems in connection with transmission, retransmission and reception on submarine cables, and a large number of patents stand in his name dealing with this subject.

Recent Developments in Illuminating Engineering.

At the meeting of the ILLUMINATING ENGINEERING SOCIETY on December 14th, Mr. LEON GASTER presented a summary of events during the vacation, and the meeting was given up to the reading of reports and the exhibition of novelties. Mr. Gaster's address was devoted largely to an account of the work of the various committees of the Society, to which two dealing respectively with the measurement of light and illumination and motor-car headlights have recently been added. The latter is a joint committee, receiving the co-operation of a number of leading bodies concerned with automobiles. Industrial lighting has figured largely in recent discussions and Papers, for example, at the congress of the Royal Institute of Public Health, held in Paris this year, and at the conference of the British Industrial "Safety First" Association, at Olympia in September. Attention was drawn to the formation of the Committee on the Causes of Blindness, appointed by the Ministry of Health, which will doubtless pay attention to the part played by inadequate lighting in causing defects of vision; for example, the disease known as "miners' nystagmus."

Reports on progress in lamps and lighting appliances were presented by the two committees concerned respectively with electrical and gas developments. The position in regard to electric lamps and fittings is stated to be better than at the corresponding time last year. Supplies of gasfilled lamps have improved, production having been increased five or six times during the last year. A notable step has been the introduction of 40 and 60 watt types of gasfilled lamps and of suitable shades and bowls for use therewith.

After the presentation of these reports there were a number of short accounts of exhibits and novelties. Major ADRIAN KLEIN exhibited the latest form of the Sheringham daylight, which has now been produced in a practical standardised form, and gave some account of the applications of this type of "artificial daylight." It was stated that a small form of portable apparatus is also in preparation, and this will doubtless find applications in many cases where the large units are unsuitable.

Mr. Staines, of the Edison Swan Electric Company, Ltd., showed small wattage gasfilled lamps equipped with opal glass bulbs, and Mr. J. S. Dow exhibited two small neon lamps, which had been loaned by this company for demonstration at the meeting. This form of lamp, which is becoming familiar abroad, but is at present little known in this country, utilises an electrical discharge through rarified neon gas. The lamp can be inserted into an ordinary socket on 220 volts, and resembles an ordinary small metal filament lamp in appearance. The interesting feature about these lamps is that no transformer or pressure-raising device is needed, and they can be switched on and off in exactly the same manner as a metal filament lamp. The bulb is filled with an orange glow, and, though the light yielded is at present small (apparently less than 1 c.p. for a 5 watt lamp), the very low consumption for which such lamps can be made should render them useful in cases where only a small light is needed A special application mentioned is in connection with luminous signs, as lamps can be made in the form of letters of the alphabet.

Among other items may be mentioned the exhibition of a small "foot-candle meter," lent by the British Thomson-Houston Company, Ltd., which has the quality of enabling a reading to be obtained by mere inspection of a scale, bearing a number of spots of graduated brightness, without its being necessary to manipulate the apparatus to obtain balance. Mr. A. Cunnington described a method of lighting railway time-tables by transmitted light from a lamp concealed from view inside the rack, as used at Waterloo station.

At the conclusion of the discussion it was announced that the next meeting in January would be devoted to a discussion on "The Use of Light in the Preparation of Films, with Special Reference to the Lighting of Cinema Studios," to be opened by Mr. J. C. Elvy.

Heating and Cooking Notes.

New "Falkirk" Apparatus.

We have previously made reference to the fact that it is not always wise practice to place an electric fire in the fireplace of a living room. With the exception of the bowl type of fire, however, the majority of radiant fires seem to have been designed for that purpose. No particular regard has been paid to making the back of the fire as presentable as the front, and usually the heat is reflected from the front only. The Falkirk Iron Company, Ltd., have, however, designed the "Falco-Orbit" fire with a view to overcoming these disadvantages. In plan this fire is of an eliptical shape, the back being finished in as pleasing and neat a manner as the front. The fire bars are mounted on an inclined plane, so that heat not only radiates frontwards, but also upwards, being diffused in the upward direction by means of a dome-shaped deflector hood. Under this hood is mounted a humidifier or air moistener, consisting of a water pan, access to which is obtained by lifting the dome-shaped hood. Switches for heat-control purposes are mounted in the base of the frame of the fire. The general style of the decoration of the frame is of the "Adams" period, and a number of finishes are offered.

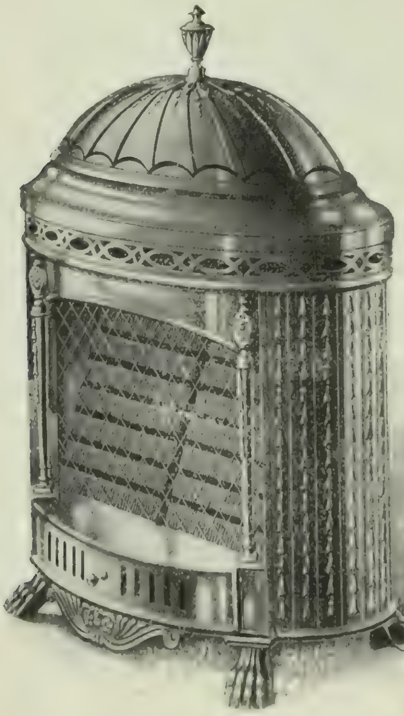


Fig. 1.—"Falco-Orbit" Fire in Adam's Style.

Another fire manufactured by the same firm for use in the middle of a room is the "Brazier" fire. This consists of a circular cast-iron base with a dome-shaped casting forming a protecting hood for the elements which, together with the control switches, are mounted in the base of the fire frame. Four sizes are offered, viz., 1 kw. to 2·5 kw. in 500-watt stages.

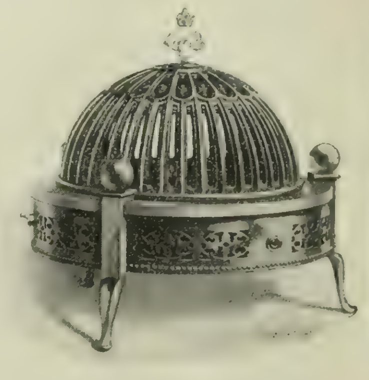


Fig. 2.—"Falco" Brazier Pattern Fire.

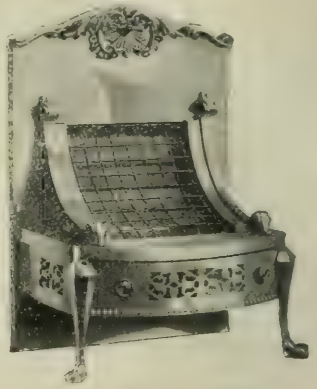


Fig. 4.—"Falco" Dog Grate Fire.

The "Mantel" pattern fire, which is also manufactured by the Falkirk Company, is a serviceable type for use in living rooms, where it is decided to install the fire in the fireplace. The frame is of cast-iron and can be obtained finished in standard ebony black, or in coloured enamel finish. A trivet, as illustrated, can be obtained if desired, but the use of this accessory rather interferes with easy access to the rotary switch which is mounted at the base of the fire. The sizes made range in 500-watt steps from 1 kw. to 2·5 kw.

The Dog Grate Pattern Fire, made by this firm, is a most pleasing pattern, especially when finished armour bright. In this fire the elements are brought somewhat forward on the lines of the new type of coal grate, a factor which certainly aids heat distribution. The same range of sizes are offered, and also a variety of finishes.

The "Falco" Auto-Heater consists of a convector element mounted in a perforated sheet-steel cylinder, and is intended for use in the hood of a motor-car to prevent the water in the radiator jacket from freezing. In addition to electric fires there is also the "Falco" standard domestic cooker, which was described in our recent Autumn Trades Promotion Issue*, and a range of electric kettles, from the plain type designed for kitchen use, to the more elaborate patterns intended to be employed in the drawing room, or on the tea table; and to complete the "Falco" series there is the inevitable electric iron. All of the apparatus is well made, in fact

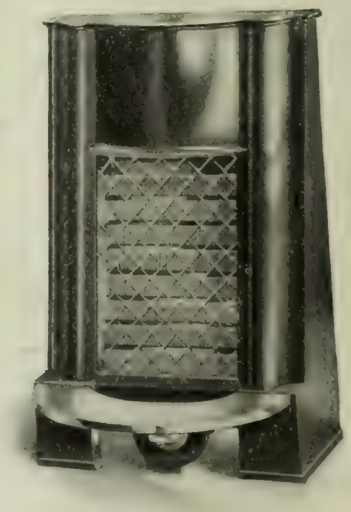


Fig. 3.—"Falco" Mantel Pattern Fire with Trivet.

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* September 24th, 1920.

what might be termed a thorough engineering job, and supply authorities and contractors are advised to visit the Falkirk Iron Company's showrooms to see these new lines, or to send for the descriptive lists of fires, cookers, and domestic appliances. Space does not permit us to describe all the apparatus detailed in these new lists.

A Convertible Electric Fire.

Messrs. **Baxendale & Company** have placed on the market a 750-watt convertable portable fire, which can be either used as an electric fire or hot-plate as desired. The normal position of the apparatus when in use as a fire is shown in Fig. 5. By operating a spring mounted in the back or third leg of the fire, the apparatus takes up the position shown in Fig. 6, where the element is in a horizontal position, and the fire suitable for use as a boiling plate.

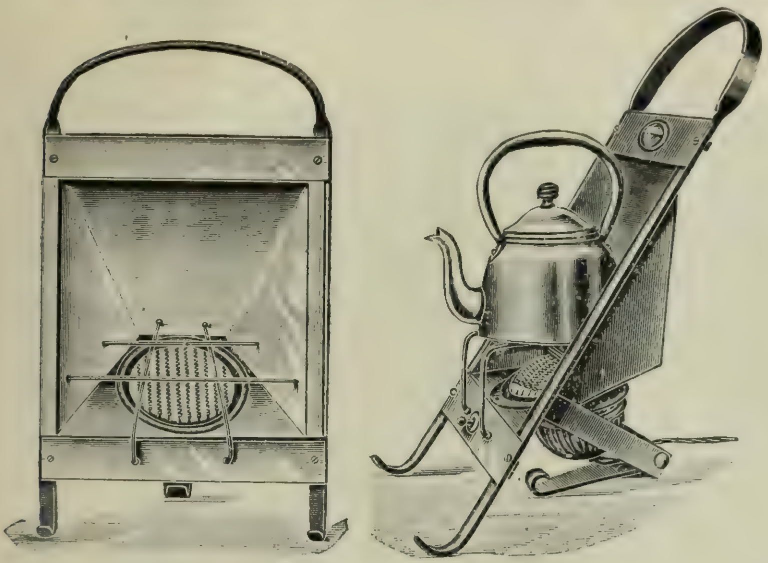
Fig. 5. Fig. 6.
Baxendale Convertible Fire.

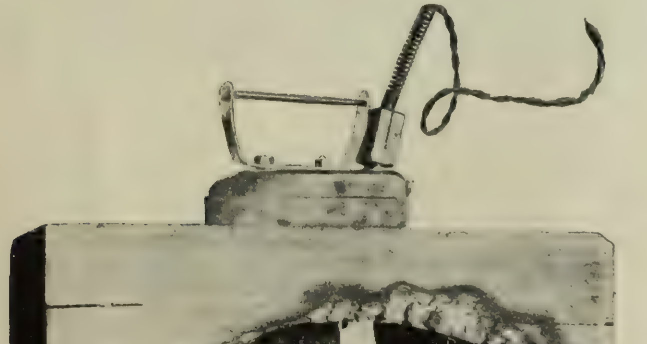
Fig. 7.

To convert the apparatus into a fire again it is only necessary to lift the appliance by means of the handle mounted on the top of the frame, when the spring in the back leg is released and this leg becomes rigid. The framework is constructed of sheet metal, and a polished copper reflector is fixed behind the element. A switch for control purposes is mounted on the front of the base of the fire.

An Interesting Iron Test.

Apropos of the efforts being made by British manufacturers to oust American, German and Continental irons from the British market, it is interesting to know the result of a test carried out with an "Elect" domestic iron made by **The Electric Heating Company**, as a result of the requirements of an Australian buyer on a visit to this country.

Fig. 7 and 8, graphically show the result of the test. A wood plank 14 in. wide, and $4\frac{1}{2}$ in. thick was selected, a 6 lb. iron put in position in the middle, and the current switched on. It can easily be imagined that by the time the iron had burnt its way 4 in. through the plank the heat was very great, and the hole was like a miniature furnace, the whole of the iron being at white heat. The wood handle of the iron was burnt away, and of course all the nickel plating was removed, the flexible being only slightly charred. From the start to the time the iron fell through the bottom of the plank was 13 hours. On the following day the iron was again tested by boiling a pint of water on it, and the doubtful Colonial was convinced of its efficiency. We don't much wonder!

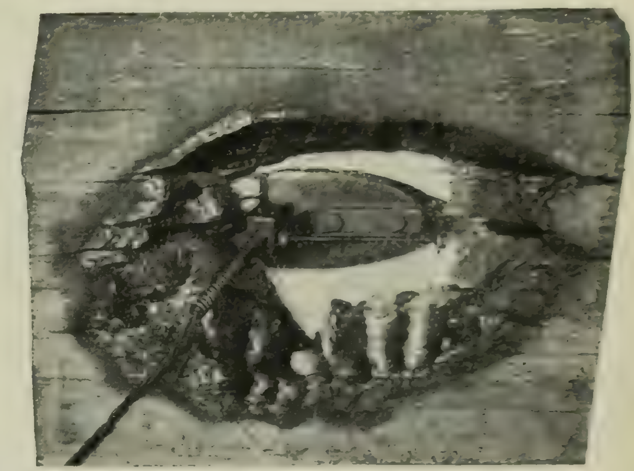
Fig. 8.

Correspondence.

THE CRAWLING OF INDUCTION MOTORS.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In your issue of October 15, 1920, Mr. L. H. A. Carr gave a theory of the phenomenon known as the crawling of induction motors, which has just come to my notice. I am surprised to find that it has not been challenged. The statement that continuous current is produced in the rotor winding arouses suspicion at once, and I think that a few elementary considerations will serve to show that this is impossible. For instance, will a given rotor conductor be always opposite to a shaded portion of an N-pole and never opposite the corresponding portions of a S-pole? What will happen in the case of a conductor opposite a shaded portion between two poles?

The mathematical treatment with which Mr. Carr supports this statement is not sound, for the non-uniformity of the permeance affects the transformer E.M.F. as well as the rotation E.M.F., and the expression for the flux linked by a rotor turn must include a term of the form, $\int \sin a \,.\, (1 + q \,.\, \sin na)\, da$, and will no longer be a simple sine function of the time. I think that if Mr. Carr incorporates this alteration he will find that the continuous component of the E.M.F. will disappear, and his theory will come into line with the rotating-field theory.

I am very glad to see that Mr. Carr's experience with squirrel-cage windings having one slot per pole-pair more than the stator has been successful. This agrees with my own deductions, for in my articles on the induction motor which appeared in The Electrician I showed that the inductance per bar of a squirrel-cage winding is infinite when the number of bars per pole is 0·5 (*i.e.*, one bar per pole-pair).* For this to be true of the $(n+1)$th field the number of bars per pair of poles of the fundamental field must be $(n+1)$.—I am, &c.,

Hendon, December 18. F. C. Chapman.

THE SEVERN BARRAGE SCHEME.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: We have read with interest in The Electrician of the 10th inst. your remarks on the Ministry of Transport's scheme, as well as Mr. S. E. Britton's letter on the subject.

While it is doubtless rather premature to discuss details at this stage, still there is a point in connection with the proposed gearing transmission on which your correspondent appears to be labouring under a misapprehension. In your "Notes" you mention, "A direct-current dynamo of special design, with vertical axes," subsequently drawing attention to Mr. Britton's comparison between the proposed installation and that at Chester. We would, however, like to mention that in the Chester scheme the axes of the generators are horizontal, while those of the turbines are vertical, and the transmission is by means of Citroen speed-increasing bevel gears, which is also the type of gearing to be supplied to the York hydro-electric scheme at Lynton Falls, the power in the latter case being 460 h.p. per unit.

Admittedly this power is much less than that contemplated under the Ministry of Transport's scheme, but Citroen bevel drive has been applied to powers as high as 2,000 h.p., an example of which is the installation at the Societé Hydro-Electrique, of Lyons (France), which was put into commission in 1916 and has been running continuously ever since.—We are, &c., The Citroen Gear Company, Ltd.,

London, December 20. G. P. W. Sims, A.M.I.Mech.E.

AN ENGINEERS' CLUB FOR LONDON.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: With regard to your paragraph in this week's The Electrician, I am very glad to see the question of a club being established in London again to the foreground. I well remember before the war broke out this question being discussed, amongst others, by Mr. Sidney Rentell, Mr. J. O. Pearston and Mr. H. Porter-Cox, the latter two being connected with "The Electrical Review," and a move was being made towards establishing such a club; but, unfortunately, the war suspended all ideas of progress.

I would suggest that a meeting should be arranged of electrical men who are interested, at which a committee should be elected to make all necessary preparations. I feel sure, also that Manchester Electrical Club would be pleased to give advice and suggestions to such a committee if they required it. There is no doubt about it that its success is a foregone conclusion, and I trust some practical steps will be taken in the very near future.—I am, &c.,

For the Walsall Electrical Company, Ltd.,
Walsall, Dec. 17. J. Delebeque,
Works Manager.

The British Electrical Development Association.

Following on the first annual general meeting of the British Electrical Development Association a luncheon, at which about 200 members and guests were present, was held at the Hotel Cecil on Friday last, Mr. Hugo Hirst occupying the Chair. Those present included: Sir John Snell, Sir Harry Haward, Sir Tom Callendar, Dr. R. Mullineux Walmsley, Dr. A. Russell, Mr. Ll. B. Atkinson, Mr. H. Booth, Mr. A. F. Berry, Mr. C. O. Bastian, Mr. R. A. Chattock, Mr. D. N. Dunlop, Mr. A. Gamage, Mr. W. W. Lackie, Mr. C. H. Merz, Mr. J. R. Orr (Director of Housing, L.C.C.), Mr. A. Page, Mr. G. Scott Ram, Mr. H. Gordon Selfridge, Mr. C. H. Wordingham and Mr. J. W. Beauchamp (Director and Secretary).

The Chairman, in proposing the toast of "Electricity, the Electricity Commissioners, and the Institution of Electrical Engineers," said that he addressed them with some diffidence owing to the high character of the assembly and the fact that his only qualification for being in the chair on such an occasion was the telegraphic address of the company with which he was connected. There was, however, a more serious reason why he was not quite happy on this occasion. He was usually an optimist, but he found it difficult nowadays to tune his optimism to its accustomed pitch. They were passing through an industrial crisis in which money was short and goods were short. This was a new situation which was likely to lead to widespread unemployment and other difficulties. Nevertheless, in spite of this the world would go on and he felt sure that electricity would play a great part in its reconstruction. The world did not, however, know how great this part would be, and it was the job of the British Electrical Development Association to instruct them in this matter. In the early days of the electrical industry it had not been the custom to worry about the public and it was left to the electrical contractor alone to get in touch with that great body and to sing them the song of electricity. Then manufacturers took a hand in propaganda work, mainly, it seemed to him, for the benefit of the supply authorities. Now it was realised that it was only right that the worth of their collective wares should be presented to the public by an Association working for every member of the industry. But they would not succeed in this propaganda unless it were carried out on a broad plane. It had recently been said that transport was civilisation. It was equally true that electricity was civilisation and it also had the very great property of fascinating the public. In such questions as coal conservation by means of electric power, the utilisation of water power by the same means, the economies possible in telephony by the use of thermionic valves, great improvements were to be expected. By inaugurating supplies to villages for driving agricultural machinery and generally by cheapening the cost of living electrical engineers could help civilisation and improve the health of the population. If the electrical industry wished to succeed they must appeal to the idealism of the public, not through engineers who were cramped by dimensions and figures, but by those who understood the question. They needed for this purpose not only a budding Kipling, but a Calisthenes as well. The Association might also take a hand in educating M.P.'s as to the requirements of the electrical industry by insuring that patent litigation did not always go against the patentee, a state of things which, though it might be good law, was bad in every other way. For it was obvious that all the work of research and the money that was being spent on carrying this research out must not be sacrificed to that sort of thing.

The Work of the Electricity Commissioners.

In reply to this toast Sir John Snell said that he was glad of this opportunity of saying something about what the Commissioners were doing and hoped to do in the future. The object of the Commissioners and of the Association was the same—the development of electricity, although they approached the problem in different ways. The Commissioners were hampered by statute and this must be remembered in criticising their policy and actions. They had, however, made it a point in their policy to get into touch with other electrical associations, such as the Research Association and the Institution of Electrical Engineers, whose assistance they greatly appreciated in amending the old Board of Trade regulations. It was soon hoped to set up Advisory Committees who would be able to give them help on many knotty points. During the past year loans amounting to £13,000,000 had been granted, of which 6½ millions were for large-power stations such as that at Barton, near Manchester. This expenditure would contribute to the development of the supply of electricity on a larger scale than was now possible, as would the expenditure of 4½ millions on transmission lines. On the other hand, the 2¾ millions that had been expended on the extension of small stations would be nearly all lost in future and would never have been allowed to be spent if it had been possible to constitute Joint Electricity Authorities from the very first. They were, however, faced with the alternatives of complete sterilisation or of extending on these lines.

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* *See* Electrician, Vol. LXXVII., p. 708 (1916), Table III.

This state of things would, however, soon cease to exist. He referred to the large number of approvals which had been given to small undertakings to increase their maximum charges and to the enthusiasm which the electric supply industry had put into the question of the delimitation of areas. So great had been this enthusiasm that the Commissioners felt justified in recommending the Minister of Transport to drop the Bill which had been before Parliament this session, conferring compulsory powers. He warned them, however, that if this combination turned out to be illusory it would be necessary to ask Parliament for these powers and the Commissioners would then be able to give that body a real reason for doing so. In place of this Bill they had introduced only this week a short non-contentious measure which would enable certain urgent points to be dealt with. All this activity would he felt sure help the industrial development of the electrical industry and make electricity supply a really living thing.

Electricity in Amsterdam.

Mr. **Llewelyn Atkinson**, who also replied to the toast, said he had often wondered in what occult fashion electricity appealed to the public. It was generally referred to by them as being in its infancy, but it would be much truer to say that gas was in its dotage. Then there were the older scientists who protested that we were quite ignorant of the nature of electricity. This was a fundamental error as we knew more about the real nature of electricity than we did of the physical dimensions of our boots. All this mystery was in fact due to our lack of electrical sense. The old proverb that good wine needed no bush hid more than it declared. It was not true of most commodities and was not even true of wine in its infancy. For 50 years the electrical industry had been half-heartedly preaching the advantages of electricity and it had succeeded in getting the electric light and the telephone partially employed. They were now trying to force home the fact that electricity must be in every home. It was interesting to know that at this stage of electrical progress there was only one city in the world that had electric light in every house and that was Amsterdam, but the British Electrical Development Association were determined that they would not rest until every city in this country was in the same position. When that occurred they would have got rid of half the dullness, half the work and half the dirt of the present-day world.

Mr. A. F. **Berry**, in proposing the toast of "The Guests," appealed to the lay press not to persuade the public that electricity was something to be afraid of.

Mr. **Gordon Selfridge**, in reply, rallied Mr. Hirst upon his unwonted appearance in the role of pessimist, a person who had been defined as a man who wore two pair of braces and a belt. It was the duty of the Association to remove the feeling of conservatism which existed in this country about electricity as a part of their daily life. He found it rather difficult to see how people could continue in that state of conservatism which was exhibited by the man who would not use the telephone because he never had done so. This could all be removed by the power of publicity, for money intelligently spent on this service would produce almost any results, and it might with truth be said that there was no better outlook for the imagination than in making people realise that electricity was a necessity to their life. Newspapers, he thought, were one of the cheapest things that could be bought, but electricity should be able to go far beyond a newspaper in getting at the great heart of man. He paid a tribute to the enterprise of the Marylebone Electricity Supply undertaking, which he had found was ably directed by both engineers and business men.

The Guests at the B. E. D. A. Lunch. Query: Whose is the Vacant Chair?

Birmingham Engineers' Club.

For some time past an influential committee has been working in Birmingham with the object of providing a club where engineers can meet both for business and socially. Such progress has been made that an option has been exercised on premises in the heart of the city. Names of prospective members and promises to subscribe to capital are being received, a fact which is very gratifying to the committee after the hard work which has been put in through the preliminary stages. The project is receiving the hearty support of many of the leading industrial as well as professional leaders of the Midlands, and the list of officers include: *President*, Sir Hallewell Rogers, J.P., M.P. (chairman of the B.S.A. Company, Ltd.); *vice-presidents*, Sir Gilbert Claughton (chairman of the L. & N.W. Railway), Mr. Hugo Hirst, Mr. R. A. Chattock, Mr. F. J. Dixon (chief engineer to the South Staffordshire Waterworks Company), Mr. J. H. Lloyd, J.P. (director, Messrs. Stewarts & Lloyd), and Mr. Claude Tryon. *Chairman of the General Committee*, Dr. C. C. Garrarde. *Chairman of the Finance and Buildings Committee*, Mr. J. W. Madeley, J.P. *Chairman of the Rules and Propaganda Committee*, Mr. R. A. Chattock. *Chairman of the Membership Committe*, Mr. W. F. Higgs. *Hon. Secretary*, Mr. J. Fearn, (B.S.A. Company, Ltd.) We wish the new venture the heartiest success.

Electrical Trades' Benevolent Institution.

The festival dinner of the Electrical Trades' Benevolent Institution was held at the Connaught Rooms on Wednesday, December 15, the President, Mr. E. Manville, M.P., being in the chair.

The attendance was very small, those present including Sir T. Brooke-Hitching, Sir James Devonshire, K.B.E., Mr. L. B. Atkinson President of the Institution of Electrical Engineers and Vice-President of the Benevolent Institution, Mr. W. O. Smith, Vice-President of the Institution, Mr. Hugo Hirst, Mr. Godfrey Isaacs, Mr. H. Booth, O.B.E., Mr. J. E. Edgecombe and Mr. F. B. O. Hawes (secretary).

In proposing the toast of "The Institution," the President said that he regretted he was not able to report greater progress. Without a doubt the affairs of the Institution were not advancing as they ought to be, and such a state of affairs did not reflect credit on the electrical industry. There was a time when firms engaged in electrical work could not afford to do anything in the way of benevolence. This excuse did not hold good now. The electrical industry was one of the leading industries of the land and it could even with truth be said that it was one of the key industries on which all the others depended. It was, therefore, not right that it should be materially behind-hand in providing for those of its workers who had given of their best in their youth and who, for one reason or another, had fallen on evil times. The provision for these men in their time of want should be the first duty of a great industry. It should be pointed out that the Institution was primarily concerned with those workers who had no other means of assistance except such as they could obtain from a fund of this kind. The staffs of a manufacturing concern had at least as great a claim on their employers as had the machines, but while a depreciation fund was always established for the latter, the same could not be said of the former. In his view there was an absolute obligation on everyone employing men of staff rank to see that everything was done to help those who on their side had done so much for the industry. Looked at from this point of view the electrical industry had done very little. This might be partly due to the fact that few claims had been made upon the fund, but this was only because the electrical industry was an industry employing relatively young men. That was not going to last for ever, and more and more funds would be necessary as time went on.

Continuing, Mr. Manville drew an interesting comparison between the position of the Electrical Trades' Benevolent Fund and a similar fund which had been established in the cycle and Motor Trades. In the former case £14,780 had been invested and this practically represented the total sum that had been subscribed, since the inauguration of the Institution in 1905. The amount invested in the motor trades' fund in 1914 was £19,000, as against £5,500 in the Electrical Institution. This sum had gradually risen to £22,000 in 1915, to £25,000 in 1916, to £30,000 in 1917, to £32,000 in 1918 and to £36,500 in 1919. In addition to this the Society of Motor Manufacturers & Traders had a fund of their own which had been named after the speaker. This was maintained at £5,000. They had further subscribed a sum of £25,000 to the fund about which he had just been speaking. so that altogether there was a sum of about £85,000 available for charitable purposes in that trade. Again, the Institution of Civil Engineers' Benevolent Fund now stood at about £100,000. These were figures which put the electrical industry to shame. Nevertheless, he hoped that there were now some signs of improvement. Local advisory committees were putting in good work and more could be done if collectors were appointed in the various undertakings. Concluding, he announced a gift of 100 preference shares in an electric light undertaking, which would bring in an income in the usual way, beside placing a capital sum at the disposal of the Institution.

Mr. Llewelyn Atkinson, in supporting the toast, said that while the President had dealt with facts he proposed to deal with some fancies. Before doing so, however, he reiterated the fact that the Benevolent Funds were an insurance against a rainy day. He gave a humorous account of a club to which he had belonged which had for its object the bailing out of members who got into trouble with the authorities. They found, however, that the whole of the fund soon went in expenses and there was every reason for their own Benevolent Fund not being run on those lines. There were certain typical members of the electrical industry who might do very much more for the fund than they were doing, including the contractor who got £5 a point, the cable maker whose dielectric losses were now becoming so great that he was in danger of sinking into the trench that he had dug for his own cable, and even the bankers who should look upon the liquidation of overdrafts for electrical engineers as a means of assisting a very deserving profession. On a recent occasion he had had all the powers of the "purse" against him, on this occasion he hoped that all the powers of the "purse" would be with him, for it should be our privilege to support those who were unfortunate enough to fall by the way.

Mr. W. O. Smith, Vice-President, who also supported the toast, confessed that he had been an hardened sinner in regard to subscribing to the fund. He, however, made ample penance by announcing that he had decided to become a life governor. The fund was one which he thought ought to appeal to the electrical industry, as in these days of rapid movement no one knew what to-morrow would bring forth. The war might, indeed, bring premature old age to many and cause great demands upon the funds. These must, therefore, be accumulated as quickly as possible so that as large a sum as possible might be available to meet the demands from income.

Mr. J. Y. Fletcher proposed the toast of the "Chairman." He said that in his view the fund was resting on too few props, and that the Committee were anxious to find out how the untold thousands in the electrical industry might be tapped in its support.

In replying to the toast of his health, the President said that the amount subscribed in connection with the festival was £1,030 1s. 6d., including an extra donation of £105 from Mr. Hirst, being £3 for each of the 35 years they had been acquainted.

Labour Movements.

By ARTIFEX.

A scheme has been approved for establishing central headquarters in London for the London Trades Union and Co-Operative movements.

The British Bankers' Association is to be requested by the Bank Officers' Guild to co-operate for the purpose of forming a Whitley Council.

Mr. Elias Williams, who was recently appointed by ballot, chairman of the Cardiff and District Union of Engineers, representing over 3,000 workmen, is only 26 years of age.

Dr. Macnamara, the Minister of Labour, states that there are 412,000 unemployed workers in the country at the present time. More than half of these are ex-Service men.

The claim made by the representatives of the Iron and Steel Trades' Confederation that the cutters-down employed by William Bain & Company, Lochrin Ironworks, Coatbridge, receive an increase in wages of 2d. per ton has been referred to arbitration.

It has been decided to adjourn further discussion of the claim for an advance of 6d. per hour to time workers, and an equivalent increase for piece workers employed in the shipyards and engineering establishments throughout the United Kingdom, for six months.

The recently formed National Union of Commercial Travellers has opened its registered office at St. Bride's Institute, Bride-lane, Fleet-street, E.C. It is proposed to take a census of all travellers and their respective trades, to decide upon a standard wage for each trade.

Speaking at Batley on Sunday, the Rt. Hon. J. R. Clynes, M.P., said that under five heads, definite proposals for absorbing the unemployed and turning them into some useful channel had been submitted to the Minister of Labour, and not one had been accepted.

A meeting of the International Labour Conference is announced to commence at Geneva on April 4th next. This Conference was set up by the terms of the Peace Treaty of Versailles. Each member of the League of Nations will be represented by two Government representatives, one representative of the employers, and another of Labour.

With Mr. Evan Williams, Chairman of the Mining Association, in the chair, and Mr. Robert Smillie in the vice-chair, a meeting of the National Coal Committee, appointed under the coal strike settlement, had a full day's sitting at the Coal Association offices in London recently, and discussed claims for a flat-rate advance.

Parliamentary Intelligence.

ALDERSHOT ELECTRICITY SUPPLY.

In the House of Commons last week, Capt. Bowyer asked the Secretary of State for War whether the military authority at Aldershot was negotiating to supply electricity in bulk through the Aldershot Command electricity generating station to Aldershot Urban Council within the statutory area of the Aldershot Gas, Water & District Lighting Company; whether the Order under which the Aldershot Council supplies electricity does not contain any clause authorising the purchase of electricity in bulk; whether he has considered the legality of the proposal; whether the generating station in question is intended to serve military purposes only; and whether, if effect be given to the proposal, a non-trading Government Department, through its electricity generating station, which is not liable to pay local rates, would be unfairly competing with the statutory gas undertaking.

In reply, Mr. Churchill said negotiations were in progress on the representation of the Ministry of Transport and Aldershot Council. He was advised that, although the Order of the Aldershot Council may not contain a clause specifically authorising the purchase of electricity in bulk, the Order is subject to the Provisions of the Electric Lighting Act, 1882, under sec. 11 of which the Council have full powers to contract for bulk supply. The Command generating station has hitherto been used to serve Government purposes only, but owing to a recent reduction of the Government demand it has been suggested that, in the interests of economy, use might be made of the surplus capacity of the station in the way mentioned, instead of extending the plant at the Council's generating station, which is undesirable. The proposed area of supply was outside the area within which the Aldershot Gas, Water & District Lighting Company had the right to supply, and the Council was the only body authorised to supply electricity in the area in question.

Legal Intelligence.

Electricity Agreements Cancelled.

Mr. Justice P. O. Lawrence has given his reserved judgment on the application of the North Metropolitan Electric Power Supply Company for an order under the Courts (Emergency Powers) Acts of 1917 and 1919, to annul three agreements entered into in the years 1904, 1906 and 1911 respectively, with the Stoke Newington Borough Council for the supply of electricity in bulk. The facts were briefly reported in our issue of the 10th inst.

In giving judgment, his Lordship said he must first be satisfied that there had been an alteration of trade conditions affecting the manufacture and supply of electrical energy occasioned by the war, and that owing to that alteration, the enforcement of the agreements would inflict serious hardship on the company. The latter had proved that the price of coal had risen from 17s. 6d. to 58s. 10¾d. per ton, and that wages of engine drivers had risen from 7½d. to 2s. an hour, and they contended that those rises made it impossible for them to manufacture the energy except at a heavy loss, and that they constituted an alteration of trade conditions within the meaning of sec. 1 (1) of the Courts Emergency Powers Act, 1919. In the result, his Lordship held that the increases in the cost of coal and wages had brought about an alteration in the trade conditions under which the company generated and supplied electrical energy.

LOSS CAUSED BY WAR.

On the next question, whether that alteration had been occasioned by the war, he was assisted by the evidence of Mr. Gilbert Stone, who said that had it not been for the legislation passed during the war the price of coal for electricity undertakings would have risen much higher than it had in fact risen. The wages of miners in 1914 averaged £79 per annum per person, and by September, 1918, they had risen to £159 per annum. Without going through the affidavit in detail, his Lordship contented himself by saying that it proved that the abnormal rise in the price of coal was caused by the war. The purchasing power of the pound had fallen owing to the war, and that was really the main cause for the demand for higher wages and for the high prices. It could not be doubted that the depreciation in the purchasing value of money and the alteration of trade conditions were caused by the war within the meaning of the section quoted. The next question was whether the agreements in question could be enforced without serious hardship on the company. Mr. Murray's affidavit said that the proportion of the works costs attributable to the current supplied to the Corporation exceeded by £744 the amount received by the company under the scale, and he explained that to that should be added £1,878 as the proportion of the capital charges. That made a total of £2,622, and the company said that that sum represented the annual loss to them under the agreements at present. The Corporation disputed that any loss had been occasioned by the war in furnishing the supply; they pointed out that Mr. Murray's figures were only estimates, and that, even if they were accepted, the amount of current supplied to the company bore only a small proportion to the current supplied to all the other customers. Therefore, the proportion of works charges attributable to the current supplied to them was negligible. The conclusion he had arrived at on those points was that, although there was great force in the Corporation's contention that Mr. Murray had placed the actual annual loss of the company at too high a figure, yet the only practical way in which the company could ascertain whether the manufacture and supply of a given quantity of current was being carried on at a profit or loss was by attributing to the current supplied to customers the proper proportion of the total cost. If the company was to be held bound by the agreements, they could only supply the energy at a heavy annual loss.

The Council had contended that the scale of charges agreed to by the company was the result of a cutting of the price owing to competition, and that the price was deliberately fixed by the company at such a low figure. As a result the company were inevitably bound to suffer a loss, and that any hardship in that respect was not caused by an alteration of trade conditions, but by the company having agreed to too low charges. The evidence, however, did not bear out that contention. The company were prepared to bear some loss in the early part of the agreements, and until the demand of the corporation's customers had reached a substantial level. Mr. Murray's affidavit showed that there had been a progressive diminution in the net loss, until in 1914 it amounted to not more than £289. In 1914, therefore, the company were justified in anticipating a profit in the near future, and they would by now be making a substantial profit if conditions had not altered. The Corporation's demand for energy in 1919 was 836,966 units, compared with 469,261 in 1914. The further point had been taken that the company had been taking supplies from Hackney Council at a price considerably less than the cost of production at the company's power station, and the Corporation said that Mr. Murray's figures ought not to be accepted. Mr. Murray, in his second affidavit, pointed out that the supply under the agreement with Hackney was a reciprocal one, and that the agreement was made in the interests of both contracting parties, in order to reduce their total production costs and to safeguard the supply. Mr. Murray was right in ignoring the cost of the Hackney supply in calculating the cost. In his lordship's opinion the heavy pecuniary loss of the company in carrying out the terms of the agreement amounted to a serious hardship within the meaning of the section.

JURISDICTION TO ANNUL AGREEMENTS.

The Court therefore had jurisdiction to annul the agreements, but he could not help feeling much embarrassed in having to exercise such a power. It was left to the Court to decide whether it was fair between man and man that a particular contract should be allowed to continue or be suspended. It would be highly inexpedient to lay down any general principles upon which the Court should act in all cases, and he did not intend to do any such thing. The parties not having agreed to the agreements being amended, the question was whether the Court should annul the whole of them. Having come to the conclusion that the enforcement of them would inflict serious hardship on the company, he conceived it to be in accordance with the spirit of the section that the Court should annul the agreements, unless the circumstances of the case or the position of the parties should afford some good reason to the contrary, or unless the company were proved to be unreasonable in not accepting the offer by the Corporation to vary the agreements. On the annulment of the agreements the Corporation would be entitled to demand from the company, and the company would be bound to supply, a sufficient supply at a price to be fixed, and there was, therefore, no question of the Corporation being left without a supply. The supply of electrical energy was a matter of public and local importance, and it was essential that the company should be able to earn sufficient profits to induce investors to take up capital in the concern as and when required. It appeared to him that during the last two years the profits of the company had reached a dangerously low level, and any contract which was to decrease those profits must necessarily jeopardise their position. The financial results of 1919 were a sufficient answer to the suggestion that the company could still afford the loss. The company offered to vary the agreements by inserting a "coal clause" in February, 1919; that offer had never been withdrawn, but the Corporation had not accepted it, and at the hearing it was definitely declined by Mr. Jenkins. The principle of the "coal clause" appeared to him to be fair, and he gathered that the only reason for rejecting the offer was that the Corporation thought they were entitled to adhere to the terms of their agreements. During the hearing there was a counter offer, but he did not think that the company was unreasonable in refusing that—viz., a payment of £372 per annum, being half of the deficit of £744. It would, in his opinion, be inadequate, and would not place the company in nearly as favourable a position as they would have occupied under the agreements if trade conditions had not altered. In the result he had come to the conclusion that there should be an order for annulment as from the date of the order, the company paying the costs of the application. He stayed the operation of the order until the first day of the Easter sittings, the Corporation undertaking to pay on the footing of the "coal clause" in the meantime.

Extension of Patents.

Last week Mr. Justice Sargeant granted an extension of four years for two patents (Nos. 20,314 and 24,413 of 1904) granted to Mr. Walter Dixon and Mr. Geo. H. Baxter for an electrical capstan for use in docks and railways. The royalties amounted to £2,518 for 183 capstans down to 1915, when the war suspended their manufacture. In 1916 only one capstan was manufactured, and seven in 1917, and to March, 1918, while capstans were now in course of manufacture to fulfil orders which were suspended during the war.

Installation Contract Dispute.

Before Mr. Justice Acton on the 14th inst., the Electrical Contracts and Maintenance Company sued Mr. O. P. Davis for the recovery of £141 12s. 4d., balance of account due for work done at the Hotel Quebec.

Mr. Croom Johnson (for the plaintiffs) said the point to be decided was what was the true construction of a contract between the parties and whether a certain charge which had been made for establishment charges and profit was either within the terms of the contract, or, otherwise, fair and reasonable.

Mr. J. J. Leyland Newlands, director of plaintiffs' company, said the work related to the installation of electric light and bells and the charges made were in accordance with plaintiffs' usual scale.

Mr. Leonard G. Tate, secretary of the National Electrical Contractors' Trading Association, said the considered the addition of 15 per cent. for establishment charges and 25 per cent. for profit fair and reasonable.

Mr. F. C. Gibbons said he had audited the accounts of the plaintiffs, and the establishment charges for the year 1918 amounted to 43 per cent.

Mr. Hawke, K.C. (for defendant) submitted that a profit of 10 per cent., plus 10 per cent., was a generous one in substantial undertakings.

Mr. John D. Scott, architect, who supervised the work on behalf of defendants, said that at the time of the contract an ample percentage would have been 5 and 10 respectfully.

His lordship characterised the case as a lamentable one—lamentable because the amount involved was entirely out of proportion to the labour, ingenuity and expense that had been lavished upon it. He came to the conclusion that 15 per cent. was a reasonable charge for establishment charges and that 25 per cent. was a reasonable profit on work of that kind. He accordingly entered judgment for plaintiffs for £44 5s., judgment having already been entered for £92.

The INTERNATIONAL ELECTRO-TECHNICAL COMMISSION are publishing biographies of the great men after whom the electrical units are named, and amongst these is James Watt, whose name is commemorated by the unit of power. A short biography of James Watt is being prepared by Prof. Burstall, and it is hoped to include some new information which has come to light through a search made in the papers of the Boulton and Watt collection, which are preserved in the Birmingham Reference Library.

Commercial Topics.

Brazilian Traction Contracts.

The Department of Overseas Trade reports that the Congress have authorised the expenditure of 60,000 contos (at present about £2,900,000) for the conversion to electric traction of the Central of Brazil Railway, which is owned by the Brazilian Government. This will probably mean that some important contracts for electric railway plant will be given out very shortly, and British firms requiring further particulars are recommended to get into touch with the Inspectoria Federal das Estradas, Ministerio da Viacào e Obras Publicas, Rio de Janeiro, or with H.M. Commercial Secretary.

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German Trade with Portugal.

It appears that Germany is gradually getting back to her pre-war position in her trade relations with Portugal. The unfavourable rate of Exchange is a great barrier to the development of British trade, and consequently many orders are being placed in Germany for railway plant and rolling stock, industrial machinery, electrical plant, motors and appliances, tools, hardware, fancy goods, toys, &c.; and, on the other hand, exporters are looking to the countries of Central Europe to form one of their most promising future markets. In pre-war days Germany held second rank as a furnisher of imported goods to Portugal, and she was also Portugal's second best customer both for home and Colonial produce

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Patent Legislation in Uruguay.

The National Council of Administration has reported to the General Assembly of Uruguay that the Commission, which was appointed in May last to prepare new legislation regarding patents of invention, has prepared a draft Bill embodying the proposals. A "patente de invencion" is defined as "the certificate issued by the Office of Marks and Patents of Invention for confirming the exclusive right of temporary exploitation of an invention or discovery of an industrial character which the Nation grants in favour of the patentee, without guaranteeing its originality, priority, convenience, or utility." Patents will be granted in respect of (*a*) new industrial products; (*b*) new methods, or new application of known methods, of obtaining an industrial result or product. A patent will remain in force for 15 years, and this period will not be extended. Patents granted abroad and presented for ratification in Uruguay will remain in force for the period allowed to them, but in no case shall the period exceed 15 years. If the foreign inventor does not exploit his patent in the Republic, imports covered by the patent are protected only for five years, or less if the rights in the country of origin do not extend to that period.

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The World's Industrial Development.

Reports from the Overseas Dominions and foreign countries indicate the determination of those countries to develop their own manufacturing industries and to treat their own natural resources, at any rate to an extent that will provide for their local needs. Though the establishment of these local industries and the imposition of tariffs for their protection in early days may increase competition with British exporters, it should be borne in mind that the tendency to self-development is opening up a considerable new market for British manufacturing engineers. The propaganda work carried on by the British Engineers' Association brings many inquiries for machinery and plant from all parts of the world to its offices, and to a certain extent these may be regarded as an index to the world's industrial development. Many of these inquiries are from people abroad who are anxious to develop local industries or to start new ones, but do not quite know who to get to help them. A list of the inquiries has been recently distributed by the Association to its members, and these include communications for various kinds of machinery from Japan, Algeria, Italy, Canada, New Zealand, Spain, South America, &c.

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Electrical Development in Tasmania,

A report upon the progress made with the Great Lake hydro-electric power scheme was recently issued by the Minister of Works, the Hon. J. B. Hayes. The high cost of machinery, the shortage of cement, &c., had militated against the plans for development. Parliament will be asked to vote £649,000 this year for extensions of the scheme. On the commercial side the scheme is satisfactory, a profit of £5,000 having been made during the year. Lake Rolleston and King River will be harnessed as the establishment of industries require fresh sources of power. A sum of £120,000 has been voted for the erection of a transmission line to Launceston, a distance of about 60 miles. The line will transmit 3,000 H.P. for which Launceston Corporation will pay £5 7s. per H.P. The local station is unable to meet the demand for power for the large woollen mills to be erected there.

Much of the machinery required was ordered from America, and in a statement by the Treasurer, Sir Elliott Lewis, a serious difficulty arose out of the adverse rate of exchange between Australia and the United States. The Hydro-Electric Department had placed orders in America for h.t. plant, &c., and it was not obtainable elsewhere. In order to overcome the exchange difficulty the manufacturers agreed to accept the State's bonds for the price, carrying interest at 7½ per cent., free of exchange, and with a currency of five years, but redeemable at any earlier date, at the option of the Tasmanian Government. Great Britain can supply all the possible requirements of the Department, and it is to be hoped that steps will be taken to secure a large share of the plant and equipment required for the completion of the scheme.

Electricity Supply.

Plymouth Corporation has applied for sanction to borrow money for a rotary converter and switchgear.

Faversham Town Council is recommended to obtain authority to borrow £17,000 for additional plant at the electricity works.

Sanction to a loan of £5,700 has been applied for by Beckenham Urban Council for cable extensions, and for wiring the new houses to be erected at Elmers End.

The small oil-driven electricity station at Monasterevan (co. Kildare) has been compelled to close down owing to lack of fuel and oil lamps are again used for street lighting.

Messrs. Buchan & Partners, electrical engineers, have submitted a scheme for a central supply of electricity for the Border district to Galashiels Council, who will hold a conference on the subject next month.

A scheme of extensions, estimated to cost £200,000, has been prepared by the borough electrical engineer and manager, Col. W. A. Vignoles, and the Grimsby Electricity Committee has referred the matter to a sub-committee for a detailed report.

Kirkcaldy Corporation has decided to cease negotiations with the Fife Power Company for a bulk supply, and ways and means to develop the municipal system are being considered, so as to be able to meet requests for current.

Portsmouth Corporation has applied for authority to borrow £91,000 for extensions of the electricity work and the tenders of Messrs. Babcock and Wilcox and the Metropolitan Vickers Electrical Company for the supply of plant have been accepted.

The threatened strike of electrical engineers at the generating stations of the Hackney, Hornsey, Finchley and Ilford Councils, owing to the refusal to recognise the new scale of pay, has been postponed till after Christmas, when probably an agreement will be arrived at.

Owing to a breakdown at Todmorden electricity works two mills dependent on electric power have had to close down. As there is not sufficient current for normal requirements arrangements have been made with large power consumers to work alternate parts of the week.

Guildford Corporation are applying to the Electricity Commissioners for a special order authorising the purchase of the undertaking of the Guildford Electricity Supply Company, Ltd., the production and supply of electricity by the Corporation in the borough of Guildford and the rural districts of Guildford and Hambledon, the purchase, sale, letting on hire, &c., of meters, fittings, stoves, lamps, dynamos, &c., and the exclusion of same from liability to distress, &c.

The Salford Corporation have approved a scheme for extensions of their electricity undertaking at an estimated cost of one-and-a-quarter million pounds, and a Bill is being promoted to obtain the necessary powers. Land has been purchased on the banks of the Irwell for the erection of a super-power station. The scheme, which has been prepared by the Borough Electrical engineer, Mr. J. A. Robertson, has received the general approval of the Electricity Commissioners.

A conference of local authorities owning electricity undertakings was held at Sheffield on the 16th inst. for the purpose of considering the formation of a joint electricity authority. Among those represented were Sheffield, Rotherham, Chesterfield, Doncaster and Buxton, and Ald. Styring, of Sheffield, presided. Recommendations were adopted that the various authorities represented at the conference should pass resolutions agreeing to the formation of a joint authority for the proposed area and generally accepting, subject to modifications, in detail, the area provisionally determined by the Electricity Commissioners.

The staff and chief engineers of the Lancashire Electric Power Company were entertained to dinner at the Queen's Hotel, Manchester, last week, by the directors, in celebration of the twentieth anniversary of the undertaking. The assembly was a happy one, about 50 guests being present. Dr. Parshall, chairman of the Company, presided and gave a review of its progress since its inception. From a position of cold isolation in the county, where it was at first treated as an interloper and opposed by the municipal authorities, he said, the Company had grown to be of such important service to the communities and the districts which it supplied that the spirit of hostility and opposition had entirely disappeared, and at present the Company and the local authorities were co-operating to the fullest extent to make the best use of the electrical plant at their disposal.

Owing to a breakdown of plant at the Ocker Hill (Staffs.) station of the Midland Electric Corporation for Power Distribution, the supply of electricity has been curtailed between 7.30 a.m. and 5.30 p.m. by 50 per cent. On the 10th inst. a 3,000-kw. turbine broke down, necessitating the spindle being returned to the makers, and on the following Monday a 5,000-kw. alternator also broke down. It will probably take four weeks to get the 3,000-kw. machine repaired, and about three weeks to get the 5,000-kw. alternator in order. During the latter part of the war, the company had a very large demand on their generating station, and unfortunately the Ministry of Munitions could not see their way to grant us permission to instal additional plant. New plant was ordered as soon as possible after the armistice, and towards the end of 1919 arrangements were made to obtain a supply of 4,000 kw. from a neighbouring generating station. Owing to continuous delays, the new generating plant and the additional supply are not yet available, and during the last few months, the company have had to carry a load of nearly 18,000 kw. with only 20,000 kw. generating plant.

Electric Traction.

In order to cope with the rush traffic on the Bakerloo Tube Railway eight additional cars were put into service on Monday.

It is proposed to re-open the Portmadoc-Beddgelert light railway as an electric line. The North Wales Power Company is prepared to electrify the railway, and thus help in the movement to re-start the local quarries and mines.

The action of the Ministry of Labour in constituting a court to hold an inquiry, under Part 2 of the Industrial Courts Act, into the Application of the Tramway Workers for an Advance of Wages by 12s. a week, will probably avert a strike, as both sides are likely to accept the findings of the court. The municipal tramways undertakings, by a comparatitively small majority, refused to go to arbitration ; but it is understood that most of the undertakings would have acquiesced in arbitration if the majority had so determined. The financial position of all tramway systems is so bad that it is difficult to see how the men's demand can be conceded, for even a further increase in fares would not, probably, lead to increased revenue. However, it is an advantage to have an impartial investigation by the Court, even though its finding has no binding force on the parties to the dispute. The court has not yet been constituted and it will not sit until after Christmas.

The report of Major G. L. Hall, Inspector to the Ministry of Transport, into the circumstances of a District Railway train running into buffer stops at Wimbledon Station on October 14 last, has been issued. His conclusion is that the accident in which eight bystanders were injured including one killed, was the result of an error of judgment on the part of the motorman, and that he underestimated the speed of his train when he first applied the brake. There was no reason to conclude that the accident was due to any failure or defect in the brake equipment. He adds that buffer stop collisions have been somewhat frequent during the past year, but the provision of an automatic safeguard presents some difficulty. Automatic speed control of trains approaching a terminus might reduce the risk, and the practicability of such a device will, no doubt, be considered by the recently-appointed Committee on Automatic Train Control

A public inquiry was held at Halifax on the 7th inst. into the tramcar accident on the 23rd ult., when a woman lost her life. To the inspector (Major Hall) the driver of the car (William Baines) said he had been in the Halifax tramway service only six or seven weeks this time, but he was in the service in 1906-7, and between 1907 and the war he was doing similar work at Bury and Burnley. He said the rails were very greasy, and though he had put sand in the hoppers a short time before, his brakes took no effect when he felt speed increase on passing Archer-street. The trolley pole had come off the wire, and that prevented the electric brakes from working. He ascribed the trouble to the hand brake not releasing.

The inspector said, for the information of the Corporation, that new tramcars were being fitted with side guards, in addition to the front-line guards. It was impossible to account for all the life-guard failures. The inquiry into the blowing over of two tramcars at Stocks Gates on the 3rd inst. was then taken in private.

Imperial and Foreign Notes.

The sum of £600,000 has been allocated by the Government of the Union of South Africa for improvements of the telegraph and telephone system.

In a recent issue we referred to the formation of a new association, entitled the South African Association of British Manufacturers and their Agents. To avoid confusion, we are now asked to state that the objects of this association are somewhat similar to those of the British Manufacturers' Representatives' Association of Cape Town, which has been in existence for some years.

According to recent statistics, about 5,000,000 h.p. can be developed from waterfalls in Italy and concessions have already been granted for 2,500,000 h.p.

M. Deschamps, Under Secretary for French Posts and Telegraphs, opened on Saturday the Lafayette Wireless Station at Croix d'Hins, 18 miles from Bordeaux. The station, which consists of eight pylons 850 ft. high, is designed to reach in normal circumstances any point in the world, including New Zealand, while North and South America will be within its effective radius, however bad the atmospheric conditions.

The Department of Overseas Trade has received particulars of an inquiry by a firm of marine and mining engineers in Montevideo, who desire to be placed in touch with manufacturers of submarine apparatus for going down to great depths (more than 150 metres), under water telephonic and electric light apparatus, air pumps, submersible centrifugal electric pumps, &c. U.K. manufacturers interested may obtain the address of the firm, who desire catalogues, &c., from the Department.

A new Company, entitled the Compañia Nacional de Electricidad, with a total capital of £12,000,000, has been formed in Chili to take over the Cia Nacional de Fuerza Electrica (Valparaiso) and the Chilean Electric Tramway and Light Company, Ltd., which is now controlled by Messrs. S. Pearson & Son. The new Company's capital will be divided into £6,000,000 ordinary and £2,250,000 non-cumulative perpetual preference shares, with £3,750,000 debentures. Both the debentures and the preference shares will bear interest at 8 per cent. per annum. The Chilean Tramway and Light Company are to take up immediately £850,000 in shares of the Compañia Nacional, whose paid-up capital will be increased to £1,500,000 and will be enabled to develop 90,000 h.p. on the River Maipo and its affluent, the River Colorado.

Institution Notes.

Among the various lectures announced to be delivered before the Royal Institution are three lectures on "Spectroscopy" by Mr. A. Fowler, F.R.S., commencing on Saturday, Feb. 12, and on "Electricity and Matter" by Sir Ernest Rutherford, F.R.S., commencing on Saturday, March 5.

Mr. J. Herbert Parsons, C.B.E., F.R.C.S., M.B., D.Sc., has been elected President of the Illuminating Engineering Society in succession to Mr. A. P. Trotter. Mr. Parsons was the first Chairman of Council of the Society and has taken a leading part in its work on the influence of light on vision. He is also a member of various Departmental and other Committees concerned with lighting and its effect on eyesight.

Mr. E. M. Hughman, of Bombay, has made an offer of a donation of £250 to the Benevolent Fund of the Institution of Electrical Engineers, on condition that 19 similar donations are received before the 31st March, 1921. This will result in the fund being benefited to the extent of £5,000, and it is hoped that the 19 donations will be forthcoming. All communications should be addressed to the Secretary of the Institution at 1, Albemarle-street, London, W.1.

The annual exhibition of the Physical Society and Optical Society will be held on Wednesday and Thursday, Jan. 5th and 6th, 1921, at the Imperial College of Science, South Kensington, and will be open from 3 to 6 p.m. in the afternoon, and from 7 to 10 p.m. in the evening. Arrangements have been made for Sir W. H. Bragg, K.B.E., F.R.S., to give a discourse on "Sounds in Nature," at 4 p.m., on Jan. 5th ; Prof. Archibald Barr to discourse on "The Optophone," at 8 p.m., on Jan. 5th, and at 4 p.m. on Jan. 6th. A demonstration will be given afterwards by a totally blind person. At 8 p.m. on Jan. 6th, Prof. C. R. Darling will give a discourse on "Some Unnsual Surface Tension Phenomena." Invitations have been issued to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London, and the Rontgen Society. As admission is by ticket only members of the above Societies should apply to the Secretary of the Society to which they belong. Others interested should apply to Mr. F. E. Smith, F.R.S., National Physical Laboratory, Teddington, S.W.

Business Items, &c.

The works of Messrs. A. Reyrolle & Company, Ltd., will be closed from Dec. 24 until Jan. 3.

Messrs. E. G. Acheson, Ltd., have removed their London office to 40, Wood-street, Westminster, S.W. 1

Mr. A. N. Douglas, 4, Pembroke-terrace, Queen-street, Cardiff, has been appointed agent in the South Wales district for the Swedish General Electric, Ltd.

The Enterprise Mfg. Company, Ltd., have appointed the Isis Electrical Company, 57, Albert-road, Aston, Birmingham, to look after their interests in Birmingham and district.

From Jan. 1, Messrs. Stothert & Pitt, Ltd., will be represented on the north-east coast by Mr. Wilson S. Carr, M.I.Mech.E., M.I.E.E., Victoria-buildings, Grainger-street West, Newcastle-on-Tyne.

The partnership between Hubert Jones, Archibald Caig, Frederick Samuel Green and John David Caig, trading as Caig Brothers & Jones, electrical engineers, 61, Renshaw-street, Liverpool, has been dissolved. Debts by Messrs. A. Caig, F. S. Green and J. D. Caig, who continue the business under the same style.

Chas. T. Stanton and Cecil M. Cocking, trading as the S. & C. Electric, electrical engineers, 25, Beckenham-road, Penge, have dissolved partnership. Debts by Mr. Stanton, who continues to trade at the same address under the name of the Southern Electric and Engineering Company. Mr. Cocking will carry on the business as an electrical engineer at 46, Oakfield-road, Penge.

Capt. W. H. Upton Marshall, R.E. (T.), M.I.E.E., M.I.Mech.E., after having been on war service for five years, has reopened his office at 2, King's-terrace, Portsmouth, as consulting electrical and mechanical engineer, the inspection and testing of electrical and steam plant, &c. He will be glad to receive catalogues and price lists of electrical plant and apparatus, steam plant, oil engines, &c.

The sales department of the English Electric & Siemens Supplies, Ltd. (also of Messrs. Siemens Brothers & Company, Ltd.), formerly trading at Central House, New-street, Birmingham, have removed to new premises, and in future their address will be : English Electric & Siemens Supplies, Ltd., White House, 111, New-street, Birmingham. Telephone, Midland 964 ; telegrams, Siemens, Birmingham.

Bankruptcies and Liquidations.

The Cannon Motor & Electrical Works, Ltd., is being wound up voluntarily, and Mr. P. G. Clegg, 10, Cannon-lane, Brighton, has been appointed liquidator.

A meeting will be held at 32, King-street, Covent Garden, London, W.C.2, on Jan. 14 to receive an account of the winding up of the Alliance Electrical Company, Ltd.

A meeting to receive an account of the winding up of the Masham and District Electric Supply Company, Ltd. (in voluntary liquidation) will be held at the Town Hall, Masham, Yorks, on Jan. 19.

A first and final dividend of 4s. 6d. will be payable on January 10 at 9, Fountain-street, Halifax, to creditors of Johnson Jagger, trading as J. Jagger & Company, electrical engineers and contractors, 28, Northgate, Halifax.

Miscellaneous.

A large number of the officials and employees of Messrs. A. Reyrolle & Company, Ltd., Hebburn-on-Tyne, spent a very enjoyable evening on the occasion of the annual dinner of the Company's fire brigade on the 11th inst., at the Station Hotel, Hebburn, Mr. N. Merz presiding.

On the 13th inst. the Inquest was Concluded on the boy Maurice Pettet, who was killed on the 29th ult. by a flying piece of metal from a turbo-generator at the Woolwich Electric generating station. The coroner agreed with the representatives of the manufacturers of the machinery involved that the necessary technical evidence which must be given in any attempt to discover the cause of the accident should be given before a competent tribunal to be appointed, his only duty being to find the cause of death. The jury returned a verdict of "Accidental death."

The United States of America Senate Inter-state Commerce Committee has recently been taking evidence as to the position of America's System of Submarine Cable communications. Among the witnesses examined last week were Mr. Elihu Root, jun. of the All American Cable Company, and Mr. Newcomb Carlton president of the Western Union Telegraph Company. Mr. Root alleged that commercial messages were tapped by British Government Departments, and Mr. Carlton is reported to have stated, "that all cable messages leaving Great Britain for America are held for examination by the British Naval Intelligence authorities." Mr. Carlton was not sure whether the cable messages from the United States were also held for examination, but his company had received an assurance from the British authorities that messages would not be interfered with or censured.

In reply to the above statement, Sir John Denison-Pender, G.B.E., K.C.M.G., Chairman of the Eastern Telegraph Company, in a communication to *The Times*, asserts that the statement made by Mr. Root, that no cable message which might be of value either to the British Foreign Office or the British Board of Trade is assured of secrecy if at any point of its journey it passses over a British line is "absolutely false as far as our associated cable companies are concerned."

On the 3rd inst. a social evening, organised by the Elliott Social Association, was held at the Parish Hall, Ladywell, when about 300 employees of Elliott Brothers (London), Ltd., with their friends, were present. The entertainment opened with a concert arranged by Mr. R. O. Smith, conductor of the "Century Works Orchestra," which gave admirable and much-appreciated selections during the evening. Songs and humorous interludes followed. After the concert medals and prizes were distributed to members of the Elliott Cricket and Swinming Clubs by Mr. W. O. Smith, chairman of the company. Great enthusiasm greeted the members of the Cricket Club, who, to crown a most successful season, had won the S. London League Cup. To show their appreciation, members of the staff had subscribed for gold medals for the highest averages of the season, which were presented to: W. Nicolle, best batting, and P. R. Harriss, best bowling average; and to C. Helmer, best all-round man. Prizes to successful members of the Swimming Club were also awarded.

The Annual Dinner of the Elliott Cricket Club was held on the 10th inst. The president of the club (Mr. L. W. Smith) occupied the chair, and he was supported by Sir Keith Elphinstone, K.B.E. (vice-president), and Mr. E. J. Griffin (chairman of committee). In proposing the toast of "Messrs. Elliott Brothers," said that when one realised the world-wide reputation of Messrs. Elliott Brothers one was proud to be associated with it, and little functions such as theirs cemented the good relations between employer and employee, and had helped in building up the business which he had the honour to toast.

Sir Keith Elphinstone, K.B.E., in reply, said he was glad to be with them that evening. On behalf of his fellow-directors he thanked the Club for their toast and felt sure that all present would be proud of the firm's reputation in the electrical and mechanical world. In his journeys abroad he had found that the quality and efficiency of Messrs. Elliott's products were much valued. He reminded them of the good relations which had always existed between the firm and its employees, even in times of general difficulties. The directors were keen on the games element, and would develop that side as much as possible. In the near future it was hoped to obtain a recreation ground.

Mr. L. W. Smith proposed the toast of "The Club," and congratulated it on its brilliant season, and the secretary, Mr. E. A. Wisdom, replied.

A dinner was given on Saturday last by the employees of Messrs. Girdlestone & Company, Electrical Engineers, to the members of the firm as an expression of their appreciation of the cordial relations existing between them. The dinner is worthy of more than passing notice at the present time when the need for a better understanding and closer and more sympathetic relations between employers and employed are so vital to the welfare of the country. Seeing that the whole of the employees are members of the E.T.U., which not so very long ago was by no means on amicable terms with the Employers' Association, it would seem that an end of the strife has at last been reached, and that the electrical industry has entered upon what everyone will hope may prove to be a long term of industrial peace and goodwill for the benefit of all concerned. The utmost cordiality prevailed throughout, and one could not but be impressed by the evident sincerity of the speeches and the genuine enthusiasm that characterised the whole affair, the keynote of which was that as fellow workers each necessary to the other, the identity of interests between employers and employed was complete and fully recognised upon both sides. To quote the words used by one of the employees in an admirable speech: "Under whatever system we live, there must be a man at the helm, and a man at the furnace, each serving with honour and loyalty to each other."

Personal and Appointments.

Mr. Richard Haggard, of Wigan, has been appointed tramway traffic manager at Lincoln at £350 a year, rising by £25 a year to £4000.

Mr. A. W. Lamont, of Motherwell, has been appointed manager of the electricity works at St. Andrews.

Capt. J. C. Denison-Pender, M.P., director of the Eastern and Eastern Extension Telegraph Companies, has decided, owing to business reasons, to retire from Parliament at the next general election.

Lt.-Col. A. F. H. S. Simpson, C.M.G., R.E. (retired), late director of Wireless, Indian Government, has been appointed to a seat on the Board of Marconi's Wireless Telegraph and the Marconi International Marine Communication Companies. He has been appointed a Joint General Manager of both companies in addition to the present Joint General Managers—Mr. H. W. Allen, F.C.I.S., and Mr. W. W. Bradfield.

The General Manager of the Sun Electrical Company, Ltd., Mr. A. G. Beaver, has been invited to join the Board of the company as Managing Director. Mr. Beaver's association with the company covers the entire period since its formation, and he has been for many years General Manager. Under his guidance the company has progressed in a manner so entirely satisfactory to the directors and shareholders that in recognition of his untiring vigilance his responsibilities have now been extended.

At Preston, last week, a presentation of a silver tea and coffee service, hot water bottle and stand, and silver tray, was made to Mr. James Connor, consulting mechanical engineer to Messrs. Dick, Kerr & Company, in recognition of his services for 19 years as works manager. Mr. J. Taylor presided, and he was supported by Mr. W. Rutherford, managing director (who made the presentation), Mr. R. Livingstone, manager of Preston Works, Mr. H. B. Player, commercial superintendent, &c. Mr. Connor is transferring his services to the English Electric Co.

Prof. F. Bacon was presented with a handsome solid silver rose bowl by the students of the engineering department of the University College, Cardiff, as a token of affection and esteem on the occasion of his departure for Swansea, on the 14th inst. Speeches containing appreciative reference to the useful work accomplished by Prof. Bacon during the seven years he has occupied the chair of engineering at Cardiff were made by Mr. J. Dyer Lewis, President of the South Wales Institute of Engineers; Mr. David E. Roberts, President of the Cardiff Students' Association, and Mr. Arthur Ellis, last year's Chairman of the Western Centre of the I.E.E.

Calendars, &c.

We have received from Mawdsley's, Ltd., Zone Works, Dursley, Glos., a dainty picture printed on silk, to the mount of which is attached a monthly tear-off slip calendar.

The Key Engineering Company are issuing a convenient calendar for 1921 which is printed on celluloid and along the longer edges of which is printed on one side an inch scale and on the other a metric scale. We have no doubt that this will be much referred to during the coming year.

Messrs. Pirelli, Ltd., 144, Queen Victoria-street, London, E.C. 4, send us a useful daily tear-off slip date remembrancer, affixed to an enamelled metal tablet bearing a striking advertisement of the rubber tyres, which, in addition to electric cables and wires, are manufactured by the Company.

The Hart Accumulator Company, Ltd., are celebrating Christmas and the coming of 1921 by issuing to their friends a handsome blotter, which is not only eminently suitable for writing upon, but has the useful feature of a small calendar printed on each sheet of the blotting paper. Those, therefore, who get on the right side of the Company will have no excuse for not knowing what day of the week or month it is.

Catalogues, Price Lists, &c.

A seasonable folder (No. 2421) on "The Problem of the Christmas Gift; some electrical suggestions," has been issued by the General Electric Company, Ltd. Those who are looking for appropriate gifts will find their task much simplified for they will find in the folder a variety of artistic and useful gifts, incuding table standards, electric fires, heating, cooking and other domestic appliances, &c.

A pamphlet (No. 2278) on "Geecko" electric head lamps, side and tail lamps for motor cars and motor cycles has also been issued by the General Electric Company. Illustrated particulars and prices are given on pages 1 to 4, while on pages 5 to 7 Osram automobile type lamps (both gas-filled and vacuum) are listed in detail for British, French, &c., and American cars as well as for motor cycles, while on page 8 interior lighting patterns are listed.

The County of London Electric Supply Company, Ltd., have issued a handsome showcard on which can be noted the name and number of those persons with whom it is desired to keep in close telephonic communication. The upper portion of the card contains a representation of a domestic scene in high life and reminds us of one of those problem pictures with which Mr. John Collier is so fond of startling art circles in the spring time of the year.

Recent trade literature of the Edison Swan Electric Company, Ltd., include a leaflet (No. B.B. 197) giving illustrated particulars of the "Ediswan-Acme" portable lamp, which is specially suitable for watchmen, inspectors, &c., and a leaflet dealing with the company's "Lazilite" telephone arm. Briefly, this fitting is designed to bridle the trailing flex of the telephone, to keep it and the instrument clear of desk and papers, to bring it into speaking position, and to replace it with a minimum of effort.

Tenders Invited and Accepted.

Yeovil Corporation require tenders by Dec. 31 for a 4-kw. dynamo, switchboard, &c., Specification from the Borough Surveyor.

Walsall Guardians require tenders by Dec. 30 for lighting the infirmary and the men's day room at the workhouse electrically.

Napier (N.Z.) Council require tenders by Jan. 17 for a 500 kw. gas-electric generating set.

Battersea (London) Council want tenders by Jan. 5 for a 5,000-kw. turbo-alternator. Specifications, &c., from the Electrical Engineer.

Antwerp municipality require tenders by Jan. 25 for 20 5-ton electric cranes. Specifications can be seen at the Department of Overseas Trade, 35, Old Queen-street, London, S.W.1.

The **Commissioners of H.M. Works** require tenders by Jan. 6 for the supply of electric wire and cable for six months. Forms of tender, &c., from the Controller of Supplies, King Charles-street.

Paisley Corporation want tenders by Dec. 27 for electric light wiring in connection with the Whitehaugh housing scheme. Plans may be seen at the office of the Master of Works, 13, Gilmour-street, Paisley.

Portrush Urban Council require tenders by Jan. 1 for a gas plant, engines, dynamos, booster and balancer, switchboard, accumulators and underground and overhead mains. Specifications from the Clerk.

Leyton Urban Council require tenders by Jan. 11 for electric wiring in 142 houses on the Barclay estate. Specifications from Mr. J. H. Jacques, 2, Fen-court, Fenchurch-street, London, E.C.3.

Manchester Electricity Committee invite tenders for supply of six motor-driven circulating water and three boiler-feed pumps, and one pump for weigh tank sump. Specifications from Mr. F. E. Hughes, secretary of the Electricity Department.

The **Victorian Railway Commissioners** want tenders by Feb. 2 for various requirements, including axle generator train-lighting material and accumulator cells (contract 33,750) and miniature electric staff instruments (contract 33,694.)

Tenders are invited by Jan. 26, 1921, for the supply and delivery to the Postmaster-General's Department, State of **Queensland**, of telephone apparatus and parts (schedule 509). Tender forms at office of High Commissioner for Australia, 406, Australia House, Strand, W.C.2.

Tenders have been invited for the conversion of the first zone of the **Chilean State Railways** (from Valparaiso to Santiago) to electric traction. The offers, which are of two classes, will be opened on March 31, 1921. The first class is from those proposing to furnish the electric power, and the second the rolling-stock and equipment.

Blackpool Corporation want tenders by Dec. 31 for electric wiring and fitting of 410 houses on two of the sites of the Municipal Housing Scheme. Specifications for Layton Estate from Messrs. F. T. & H. G. Waddington, 52, Abingdon-street, Blackpool; and for St. John's Estate from Messrs. Lumb & Walton, 19, Clifton-street, Blackpool.

Durban (Natal) Corporation require tenders by Jan. 26 for telephone cable (air-space and paper insulated type), paper sleeves, pipes and other electrical accessories. The Corporation also want tenders by Feb. 16 for a 1,000 kw. rotary converter, with transformers and switchgear. Specifications can be seen at the Dept. of Overseas Trade, 35, Old Queen-street, S.W.1.

The **Rand Water Board** (Johannesburg) invite tenders by Jan. 13 for the supply and erection of a steam boiler, superheater, stoker, economisers, &c. (contract No. 191), at the Swartkopjes pumping station; also steam turbo-driven centrifugal pump, condenser, piping, &c. (contract No. 192). Specifications may be consulted at the Department of Overseas Trade, 35, Old Queen-street, S.W.1.

The **Electricity Commissioners of Victoria** (Australia) invite tenders for the supply of plant and material required for the Morwell Power Scheme, including 25,000–12,500 kw. turbo-alternators, 600 kw. turbo-alternators, transformers, switchgear, cables, transmission steel towers, steel telephone poles, &c. Tender forms and specifications can be obtained from the Agent-General for Victoria, Victoria House, Melbourne-place, Strand, London, W.C.2, and drawings can be seen at the offices of Messrs. John Coates, & Company, Ltd., consulting engineers, at the same address. Tenders by noon, Feb. 24, to Mr. R. Liddelow, secretary, Electricity Commissioners, 673, Bourke-street West, Melbourne.

The **Great Northern Railway Company of Ireland** has placed a contract for six months for schedule No. 15, items 11, 12, 13 (lead covered wire), 23 to 26 inclusive (overhead line and tinned copper combined wire) with the Edison Swan Electric Company of Ponders End.

Bradford Tramways Committee recommend the acceptance of the tender of a Belgian firm for the supply of 100 s steel tram tyres. It is stated by Mr. R. H. Wilkinson, the Tramway Manager, that nine British firms and one Belgian concern sent in tenders. The Belgian firm fulfilled all the requirements of the specification, but all the British firms altered the same clause in the specification—that relating to one of the tests. The Belgian price also, represented a saving of between 40 and 50 per cent. on the tenders of the British firms, whose prices were all alike. Mr. Wilkinson's suggestion is that there was some sort of conjoint action on the part of the tendering British firms. So far as quality is concerned, the Belgian tyres are said to be "all right," and no trouble about delivery is anticipated. The order is not a large one, but the Committee consider that they are justified in giving the order to Belgium in the interests of economy.

Patent Record.

SPECIFICATIONS PUBLISHED

The following abstracts from some of the specifications [illegible] Messrs. [illegible] 70 and 72, Chancery-lane, London, W.C.

[illegible] lodged at the Patent Office the former is given in brackets after the title.

1916 [illegible]

152,365 **British Thomson-Houston Co.** [illegible] for producing [illegible]

1919 [illegible]

133,706 **Soc. Anon. des Ateliers de Secheron.** [illegible] furnaces for high temperatures. [illegible]
134,225 **Siemens & Co. Ges.** Electric [illegible]
137,276 **Soc. Anon. des Ateliers de Secheron.** [illegible] ing-furnaces. (28 12 18. Addition to [illegible])
138,858 **Soc. Anon. des Ateliers de Secheron.** Electric furnaces. (12 2 19. Addition to 133,706.)
138,859 **Soc. Anon. des Ateliers de Secheron.** Electric resistance heaters and furnaces for high temperatures. (12 2 19. Addition [illegible])
141,005 **Relay Automatic Telephone Co.** [illegible] operating sets of electrical contacts. (2,4,19.)
141,006 **Relay Automatic Telephone Co.** [illegible] operating sets of electrical contacts. (2 4/19.)
142,779 **Smits.** Electric heating apparatus. (5/5 19.)
152,377 **Harrison.** Manufacture of [illegible]
152,378 **Harrison.** Electric incandescence lamps. (10 5 19.)
152,379 **Harrison.** Manufacture of incandescence electric lamps. (13,5 19.)
152,386 **Frankis.** Receivers of wireless signals. (13 6, 19.)

Two parallel earth connections for the antenna [illegible] variable condenser and a switch, while the other has in it two inductance coils, to one of which is coupled a receiving circuit which is preferably of the oscillating type, and to the other is coupled an oscillatory circuit having in it a switch.

152,402 **Ashcroft.** Process for electrolytic decomposition of anhydrous magnesium chloride, and the production of magnesium and [illegible]
152,409 **British Thomson-Houston Co. & Clinker.** Static electrical condensers. (11/7/19. Cognate Application 24,106 19.)

The movable element of the condenser is divided into two parts [illegible] by a lost motion device or the equivalent so that one of the parts may be [illegible] through a certain angle without moving the other part. Means may be provided [illegible] clamping the two or more parts together, so that they may be moved separately or as one piece at will. One part may connect to the operating head or handle, and may form the fine adjustment part while the other main part may be carried upon a spindle co-axial with the operating handle.

152,411 **Jackson.** (Sperry Gyroscope Co.) Flaming arc lamps. (11 7 19.)
152,418 **Rohman.** Brush rocking-gear and terminal mechanism for dynamo-electric machines. (12,7/19.)
152,422 **British Thomson-Houston Co.** (General Electric Co.) Radiating-antenna systems. (14/7/19.)
152,429 **English Electric Co. & Weaving.** Electric radiators and the like. (15 7 19.
152,438 **Norton.** Electrical low-tension oil switches. (17 7 19.)
152,451 **Tonks & Sparks.** Electrical switches. (31 7 19.)
152,469 **Zweigbergk.** Electric locomotives. (16 8 19.)
152,480 **Halpin.** Connectors for wires and electrical conductors. (28 8 19.)
152,483 **Jordan.** Electric light fittings. (3,9,19.)
152,490 **Zweigbergk.** Electric motor control systems. (11 9 19.)
152,514 **Western Electric Co.** (Western Electric Co.) Printing telegraph systems. (10/10/19.)
152,535 **Jackson, Mellersh.** (Waterhouse & Prince.) Apparatus for electrically controlling air-brakes. (11 11, 19.)
152,541 **Rotax Motor Accessories Co. & Hill.** Electric lamps for illuminating dash-boards of motor-vehicles or for like purposes. (3 12 19.)

APPLICATIONS FOR PATENTS.

Note.—*Names within parentheses are those of [illegible]*

July 7, 1920.

19.348 **Ges. fur Drahtlose Telegraphie.** Means for signalling to railway trains in motion. (4/2/19. Germany.)
19.349 **Ges. fur Drahtlose Telegraphie.** Wireless receivers. [illegible] Germany.)
19.350 **Ges. fur Drahtlose Telegraphie.** [illegible] frequency currents. (28 5/19. Germany.)
19.353 **Bleriot.** Electric soldering bits. (7/3, 18. France.)
19.361 **Allgemeine Elektricitats Ges.** Clamp for electric wires. (11,5 18. Germany.)
19.362 **Allgemeine Elektricitats Ges.** [illegible] Germany.)
19.375 **Latour.** Electro-magnetic wave-signalling aerials. (11 11, 15. France.)
19.376 **Latour.** Thermionic tube amplifying-devices.
19.377 **Ges. fur Drahtlose Telegraphie.** Gas relays for coupling electric circuits. (9/2/15, Germany.)
19.378 **Ges. fur Drahtlose Telegraphie.** Telegraphic [illegible] systems. (28/5/19, Germany.)
19.379 **Soc. Francaise Radio Electrique.** Electro-magnetic wave [illegible] (9/7/19. France.)
19.380 **Soc. Francaise Radio Electrique.** Electro-magnetic wave receiving systems. (7,5/19, France.)
19.387 **Morris-Airey, Mullard & Mackorie.** Supports for [illegible] values, &c

July 8, 1920.

19.408 **Schuil.** Means of breaking h.t. currents.
19.443 **Zeiss.** Current interrupters. (28 5 18. Germany.)
19.446 **Underwood.** Transmission and reception of pictures [illegible] telephones.
19.451 **Robertson.** Reversing switch for electric [illegible]
19.480 **Soc. Anon Constructions Electriques de Belgique.** Controllers for motors. (18/3/19. Belgium.)
19.495 **Siemens-Schuckertwerke.** Electric indication of [illegible] (19 12 18. Germany.)
19.496 **Siemens-Schuckertwerke.** Receiving arrangements for [illegible] detection of fairways of ships.
19.504 **Siemens-Schuckertwerke.** Stranded conductors. (14 12 17. Germany.)
19.512 **Telephon Ges.** Strengthening telephone currents. &c. (20,4, 17. Germany.)
19.527 **Krupp (F) A.G.** Electro-magnetic chuck. (23 6 19. Germany.)
19.530 **Krupp (F) A.G.** Weight-lifting magnet. (28 5 19. Germany.)
19.533 **Krupp (F.) A.G.** Electric long distance control of valve gear of hydraulic gun-mounting mechanism. (10 11 17 Germany.)
19.539 **Korting & Mathiesen A.G.** Electricity meters. (2, 4, 17. Germany.
19.560 **Western Electric Co.** Telephone systems. (20 2/19. U.S.)
19.565 **Telephon Ges.** Strengthening telephone currents &c. (14 5 17. Germany.)
19.573 **B.T.H. Co.** Electron discharge apparatus. (16,10/13, U.S.)
19.574 **B.T.H. Co.** Electron discharge apparatus. (20/3/14, U.S.)
19.636 **Kohler Co.** Electric generating systems. (20 6 17. U.S.
19.637 **Kohler Co.** Electric generating systems. (2/3/16, U.S.)
19.682 **Boin.** Collectors for c.c. machines. (13/10/17. France.)
19.685 **Gesellschaft fur Drahtlose Telegraphie.** Conducting coils. (24/10/17, Germany.)

Companies' Reports, &c.

A quarterly dividend of 12 per cent., less tax, has been declared on the common stock of the Mackay Companies.

The Manila Electric Railroad & Lighting Corporation, Ltd., has declared a quarterly dividend of 1½ per cent. on the common stock.

Messrs. Crompton & Company, Ltd., have declared an interim dividend at rate of 7 per cent. per annum on the preference shares for the six months ended Sept. 30.

Owing to reason of health Mr. J. M. Falkner has resigned his position as Chairman of the board of Sir W. G. Armstrong Whitworth & Company, Ltd., and Sir Glynn West succeeds him as chairman.

The directors of the Marconi International Marine Communication Company, Ltd., have declared an interim dividend of 5 per cent. (1s. per share) less tax, and payable on the 17th prox.

Marconi's Wireless Telegraph Company, Ltd., announce the following dividends: Seven per cent. upon the 250,000 7 per cent. cumulative participating preference shares, and an interim dividend of 5 per cent. upon the 2,016,906 ordinary shares. (both less tax)

The directors of Waygood-Otis, Ltd., announce that the results of the trading during half-year ended Sept. 30 are quite satisfactory, but owing to general financial stringency they deem it undesirable to distribute an interim dividend on the ordinary shares.

The directors of the Eastern Extension Australasia and China Telegraph Company, Ltd., have declared an interim dividend for the three months ended Sept. 30, 1920, of 5s. per share, payable tax free, on the 16th prox.

The Eastern Telegraph Company, Ltd., announce the payment on Jan. 15 next of dividend at the rate of 3½ per cent. per annum (less tax) on the preference stock for the quarter ending 31st inst.; and the third quarterly interim dividend of 2½ per cent. on the ordinary stock, tax free, in respect of profits for the year ending 31st inst.. The transfer books of the ordinary stock will be closed from Jan. 7 to 14 inclusive.

The net profit of the Castner-Kellner Alkali Company, Ltd., for the year ended September 30, after allowing for upkeep of plant, and making provision for excess Profit Duty, &c., was £283,853, and with £51,876 brought forward the total is £335,730, less debenture interest (£7,598), interim dividend (£100,000), leaving £228,131. The directors recommend placing £50,000 to depreciation reserve, £10,000 as provision for grant to Universities, a final dividend of 12 per cent. (making 22 per cent.), carrying forward £48,131.

At the meeting of the Consolidated Signal Company, Ltd., last week the chairman, Mr. H. G. Brown, said the future of power signalling was very bright indeed. The company traded not only in Great Britain and her dependencies, but also with other countries, and on account of the highly technical nature of the work it was evident that the most efficient method of developing each country was to be closely allied with a well-established firm having works of its own in those countries and which manufactured apparatus of a similar character for the same clients. Arrangements had been made for their signalling systems to be handled by the Westinghouse Brake Companies in a number of the European countries. As the same type of manufacturing equipment was required for both brakes and signalling apparatus, and as the sales organisation were in touch with the same clients, it would be obvious that increased efficiency could be obtained by a union such as they had made. The boards of both companies agreed to accept a valuation placed on the respective businesses by Sir Albert Wyon, K.B.E., for determining an equitable division of the holdings in the combination. The result was to apportion to the Consolidated Signal Company approximately a 40 per cent. interest in the combination.

Forty Years Ago.

(The Electrician, December 25 1880.)

The New French Cable.—The new French cable, which was fractured several weeks ago off Cape Cod, has been repaired, and communication with New York has been resumed *via* that line.

The Lontin Electric Light. The Eastern of France railway station has been lit up by the electric light on the Lontin system, which, after trial in the goods station, has also been adopted in the passenger station of the Lyons and Mediterranean Company.

The Brush Electric Light. The clock face of the clock tower of the Houses of Parliament facing towards Charing Cross, has been lately lighted by the Brush electric light, and the contrast with the face looking towards Gt. George-street, which is still lit by gas, is very striking. The electric-lit face has a bright silvery white appearance, whilst the gas-lit face has a dark, dingy red tinge. The first night of the electric lighting the contrast was still more striking, and we strongly suspect that more gas has been turned on or the gas-burners altered since the electric light was first employed.

The Post Office and Telephony.—With reference to the decision pronounced in the Exchequer Division in the Telephone case, it will be seen from public advertisements that, in order to meet the convenience of the public, the Post Office is now prepared to establish in any town a system of intercommunication by means of the telephone instrument, as it has done hitherto, for some years, by means of the A B C instrument. At the same time the Post Office holds itself ready to make arrangements for the establishment or continuance of systems of intercommunication between any number of private individuals or firms.

Arrangements for the Week.

Royal Institution.

At Albemarle-street, Piccadilly, London, W. Christmas Lectures for Juveniles on "The Haunts of Life," by Prof. J. A. Thomson, M.A.

THURSDAY, December 30th.
3 p.m. The School of the Shore.

SATURDAY, January 1st.
3 p.m. The Open Sea.

Junior Institution of Engineers.

8 p.m. At Caxton Hall, Westminster, London, S.W. Lecturette on "Drying Plant," by Mr. A. E. Alliott.

Benn Brothers Journals.

Some Features of the Current Issues.

"Aeronautics": "Help Next Year?"; "Vickers' Instructional Machine"; and "The Instalment of an Aeroplane Engine," by A. J. Rowledge.

"The Cabinet Maker": "The Furniture Trade in 1920"; "Report of the Committee on Business Rents"; and "The Decoration of Furniture."

"The Chemical Age": "Passage of the Dyestuffs Bill"; "Manufacture of Napthol Yellow S," by J. E. Winfield Rhodes; and "Micro-Organisms," by A. Chaston Chapman.

"Farm and Home": "The Farmer's Christmas"; "The Tractor and Large Scale Farming"; and "York Fat Stock Show."

"The Fruit Grower": "The Mistletoe and Its Associations' "Food Value of the Tomato"; and "Fruit and Vegetable Imports."

"The Gas World: "A Study of Gas Cookers," by W. Heathcote; "The Modern Tendency in Gas Supply," by Stephen Lacey; and "Review of the Coal and By-Products Markets for 1920."

"Gardening Illustrated": "The Mistletoe"; "Preparing Chrysanthemum Plants for Cuttings"; and "Flowers for Christmas."

"Hardware Trade Journal": 'Special Christmas Issue. "Hardware in the Making: The Manufacture of Spoons and Forks"; and "The Financial Status of Oversea Traders (III.)."

"The Transport World": First Issue, January 5, 1921.

Prices of Metals, Chemicals, &c.

Tuesday, Dec. 21.

		Price	Inc	Dec.
Copper—				
Best selected.........	per ton	£84 0 0	—	£2 0 0
Electro Wirebars...	,,	£87 0 0	—	£2 0 0
H.C. wire basis......	per lb.	1s. 1d.	—	¼d.
Sheet	,,	1s. 2⅝d.	—	⅜d.
Phosphor-bronze Wire (Telephone)—				
Phosphor-bronze wire, basis	,,	1s 6⅝d.	1⅜d.	—
Brass 60/40—				
Rod, basis	,,	0s. 9½d.	—	¼d.
Sheet, basis	,,	1s. 2½d.	—	¼d.
Wire, basis	,,	1s. 2d.	—	¼d.
Pig Iron—				
Cleveland Warrants	per ton	£11 17 6	—	—
Galvanised steel wire, basis 8 SWG	,,	£37 0 0	—	—
Lead Pig—				
English	,,	£25 10 0	—	£1 0 0
Foreign or Colonial	,,	£23 5 0	—	£1 2 6
Tin—Ingot	,,	£208 0 0		£7 10 0
Wire, basis	per lb.	0 2 9½	—	1d.

Salammoniac.—Per cwt. 110s.-105s.
Sulphur (Flowers).—Ton £16 15s.
,, (Roll Brimstone).—Per ton £16 15s.
Sulphuric Acid (Pyrites, 168°).—Per ton, £9 17s 6d.

Copper Sulphate.—Per ton £40.
Boric Acid (Crystals).—Per ton £74.
Sodium Bichromate.—Per lb. 10½d.
Sodium Chlorate.—Per lb. 5¼d.

Rubber.—Para fine, 1s. 1d.; plantation 1st latex, 1s. 11d. lb.

The metal prices are supplied by British Insulated & Helsby Cables, Ltd., and the rubber prices by W. T. Henley's Telegraph Works Company, Ltd.

The Editorial, Advertisement and Publishing Offices of "The Electrician" *are at* 8, *Bouverie Street, London, E.C.4. Telegrams: Benbrotric, Fleet, London. Telephone: City* 9853 (*4 lines*).

The subscription to "The Electrician" *is* £2. 12. 0. *per annum in the United Kingdom, and* £2. 14. 0. *per annum Abroad. Advertisement Rates can be obtained on application to the Manager. Advertisement copy and blocks should be received on the Friday preceding date of publication.*

An Invitation to Write

MOST readers of this journal are practical men, engaged daily in meeting and solving problems of industrial organisation, of management, boiler house practice, steam raising, coal handling and so forth. Hardly one but has some special information which would be useful and interesting to hundreds of others, and we invite you to contribute to our Magazine, "Cheap Steam." The chief purpose of this Magazine is to provide a forum for the free and frank discussion of boiler house problems and the promotion of efficiency and economy in this sphere and in industry generally.

Original articles on subjects coming within the scope of the Magazine are cordially invited, and, if accepted, will be paid for at the usual rate. Among the subjects dealt with in recent issues are: The strength of furnace tubes, measuring gas temperatures, boiler corrosion, sulphur in coal, fuel economisers, control and measurement of temperatures, spontaneous heating, atmospheric pollution, smoke abatement, coal conservation, boiler recording instruments, effect of soot, safety valves, conditions of evaporation, calorific value of coals, grooving in steam boilers, determination of total carbon, abuses of dye house steam, belt driving, &c. A specimen copy of "Cheap Steam" will be sent post free to any intending contributor.

Previous experience in writing is unnecessary and although we cannot definitely undertake to accept manuscript until we see it we shall be glad to discuss with authors regarding the probable usefulness of proposed articles. Every manuscript is immediately acknowledged, examined in turn and either paid for or returned at our expense.

Manuscript should be written on one side of the paper only, and *should have sufficient space between the lines* to permit changes should they be necessary.

Typewritten manuscript should be double spaced. We *prefer* all manuscript to be typewritten, but this is not essential.

Manuscript and sketches should be upon different sheets.

Arrangements can be made if desired for the omission of the author's name.

Photographs should preferably not be smaller than 3 by 5 ins. Glossy prints reproduce better than dull prints.

Photographs are returned when requested.

Drawings, freehand sketches, tracings or blueprints are acceptable. Original tracings are preferred, as *Blueprints cannot be reproduced without being retraced.*

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PAGES FROM OUR DESIGNER'S NOTEBOOK

WESTON ELECTRICAL INSTRUMENT CO LTD AUDREY HOUSE · ELY PLACE · LONDON · E.C.1

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A CONTRAST.

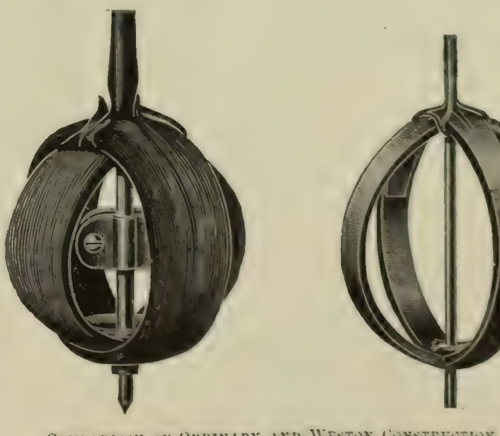
IN the design and construction of all WESTON Instruments the utmost attention is devoted to the production of a moving element of minimum weight and maximum strength; one, in short, which combines delicacy and a high degree of sensitiveness with mechanical qualities that will enable it to withstand all but the severest abuse.

This necessarily entails a very high standard of manufacture never found in low-priced instruments of the ordinary type, and the difference between WESTON workmanship and that put into many electrical instruments of this class is well exemplified in the accompanying illustrations, which are in no way exaggerated.

On the left is a reproduction which shows the common way of constructing the movable coils of a Power Factor Meter. The two coils are wound separately, and one is slipped inside the other, the whole being roughly mounted on a heavy spindle.

Such construction is inherently wrong; it is impossible to get even approximate magnetic equality with two such coils, and, in addition to being too heavy, this type of construction makes no provision for the establishment or maintenance of a definite relative position of the coils.

On the right is shown the WESTON method of construction, which is totally different and quite unique. The coils are wound by special machinery and interlaced layer for layer at diametrical crossing points. They are then treated with a special cement which gives them great rigidity and assures permanent angular relation of the coils.



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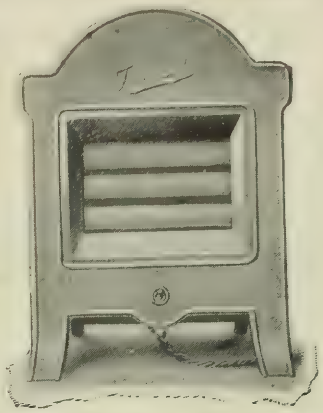

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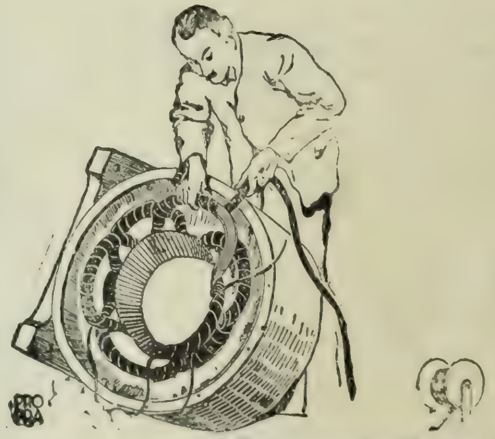

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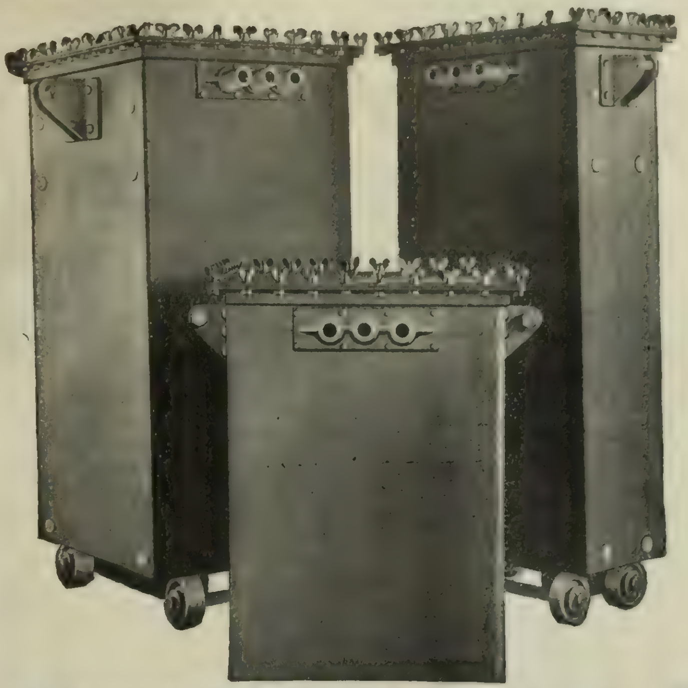

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